Factors Influencing the Intention of Using Solar Energy Household Appliances with an Extended TPB Model Approach: Evidence from Vietnam

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Abstract This study examines factors influencing the intent of purchasing solar energy appliances in Vietnam. In this research, the proposed model is constructed on the TPB paradigm with the addition of context factors (perceived benefit, perceived cost, word of mouth) to analyze factors affecting the intent. A survey of 375 customers was conducted in Hanoi, Bac Ninh, Hai Duong, and Nam Dinh in Vietnam to test the research model and hypotheses. The relation among constructs was evaluated through structural equation modeling. Only attitude and subjective norms were found to be positive contributors to the intention. Besides, the positive relationship between attitude and perceived benefit was also highlighted, but the relationship between attitude and perceived cost was not confirmed. The positive impact of interpersonal influence and e-word of mouth on subjective norms was supported, too. Finally, the study stimulates further research and serves as a reference for managers and scholars interested in solar energy.

Keywords TPB · Purchase intention · Solar energy · Appliances

1 Introduction

Together with economic development, the demand for electricity usage in Vietnam like other developing countries has been escalating in recent years. According to the estimation of Vietnam Electricity Corporation (EVN), the demand for annual electricity usage in Vietnam over the period of 2021–2025 will rise by 8.9%, equivalent to 23.6–30.5 billion kW/year. Meanwhile, the new supplementary output of electricity only reaches 6.1–17.6 billion kW/year. In addition, the energy power source

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mainly comes from coal-fired and hydroelectric power. Coal-fired power represents 50% of the electricity production in 2020 (123 billion kW). Next to it is hydroelectric power with 29.5% (73 billion kW) and gas-fired power with 14% (35 billion kW). Whereas, solar energy power and other renewable energy powers only account for 4% and 1.4% respectively (Manh Duc, 2021; Ali et al., 2020a, 2020b). The utilization of traditional energy sources has seriously impacted the environment and the eco-system (Duong et al., 2017; Nguyen et al., 2017). Being aware of that problem, many people in Vietnam have turned to the use of solar energy power for household appliances.

In recent years, solar energy power has received much attention from practitioners and scholars alike. Thus, there have been various researches on solar energy power from such various aspects as economic feasibility, policy barriers, and the role of propaganda and media (Khalid et al., 2013; Wang et al., 2017). From consumers' perspective, technology (Bandara & Amarasena, 2019), cost (Bandara & Amarasena, 2019; Ayoub et al., 2019; Akroush et al., 2019), ease of use (Stragier et al., 2010; Ali et al., 2020a, b; Bandara & Amarasena, 2019; Ayoub et al., 2019; Hua & Wang, 2019), usefulness or benefits (Stragier et al., 2010; Ali et al., 2020a, 2020b; Ayoub et al., 2019; Hua & Wang, 2019; Akroush et al., 2019; Wang et at., 2017), risk (Pham & Duong, 2020), environmental concern (Bhutto et al., 2022; Tan et al., 2017; Wang et al., 2017), and moral norm (Bhutto et al., 2021; Bhutto et al., 2022) were confirmed to have effects on consumers' behavioral intention in the prior studies.

In spite of the prior researches' theoretical and practical implications for solar energy power and energy-efficient products in general, few studies have centered on solar energy appliances in particular. Moreover, many other factors have not been thoroughly examined, but they potentially impact people's intent of using such appliances. Thus, to fill these gaps, this research is to explore how the factors of perceived benefit, perceived cost, and word of mouth (both traditional and electronic) affect people's intent of using solar energy appliances through behavioral attitude and subjective norms. In addition, this research is also to investigate how such factors influence people's purchase action through their purchase intention.

2 Literature Revision and Hypothesis

2.1 Literature Background

This study employed the Theory of Planned Behavior (TPB) as the underpinning one with the additional factors (perceived benefit, perceived cost, inter-person influence, and word of mouth) to predict and analyze the factors influencing the intent of purchasing solar energy appliances through behavioral attitude and subjective norm on the basis of a massive literature review.

TPB as the underpinning model with three antecedents (attitude, subjective norm, and perceived behavioral control) is employed to foretell and examine the behavior of

consumers in various domains (Ajzen, 2010). It has been considered as the backbone for the theoretical framework of various researches when it comes to electricity saving (Wang et al., 2011, 2014), green products (Chen & Tung, 2014; Sun & Wang, 2019), energy-efficient appliances (Akroush et al., 2019; Bhutto et al., 2021; Wang et al., 2017; Hua & Wang, 2019; Tan et al., 2017; Ali et al., 2020a, b; Bhutto et al., 2022), solar energy (Ali et al., 2020a, b; Tsuar et al., 2018), and smart household appliances (Stragier et al., 2010). Despite its widespread acceptance in predicting behavioral intent, the model has been criticized. The major complaint stems from the need for more variables to improve its predictive and explanatory power (Bhutto et al., 2021; Wang et al., 2014). Some researchers claimed that the TPB model failed to handle a sufficient variety of intentions (Ajzen, 2002; Rhode et al., 2003). As a consequence, additional factors can be included in the TPB paradigm if they provide a significant insight into the behavior (Ajzen, 1991, 2020). Therefore, researchers have attempted to improve its explanatory power with additional constructs such as environmental benefit (Bhutto et al., 2021; Bhutto et al., 2022) or environmental concern (Chen & Tung, 2014; Li et al., 2019; Bhutto et al., 2021), warm glow benefits (Bhutto et al., 2021), moral obligation (Bhutto et al., 2022; Chan & Bishop, 2013; Chen & Tung, 2014; Kaiser, 2006; López-Mosquera et al., 2014), knowledge of energy (Wang et al., 2014), publicity of information (Wang et al., 2014), daily habit (Wang et al., 2014), and residue effect (Wang et al., 2017). However, in the modern context with internet development, TPB may be inadequate to predict behavior due to benefit—cost awareness as well as internet impacts. To fill these gaps, some improvements were made in the TPB paradigm with the additional factors of perceived benefit and perceived cost to comprehend consumers' attitude toward the intent of utilizing solar energy appliances in this research. Moreover, word of mouth (both traditional and electronic) was added to the model in order to comprehend how these variables affect consumers' subjective norm.

2.2 Theoretical Model

Perceived Benefit

There has been a debate that people are more apt to perform a certain behavior when perceiving more benefits than costs. The positive effect of renewable energy utilization on consumers' attitude was confirmed, but its impact on the intent of adopting renewable energy was not supported (O'Driscoll et al., 2013). This significant finding suggested further examining the relation between perceived benefit and intent of buying energy-effective products in various domains. Leelakulthanit (2014) posited that perceived benefit was the only determinative factor of adopting LED lighting, yet the nature of the benefit sought was characterized in various terms. Quality was also found to be the most prevalent benefit that affected the behavioral intent among low-income families while the energy-saving benefit was found to be the most influential among higher-income ones. Akroush et al. (2019) confirmed

that perceived benefit positively affected both consumer attitude and intent of using energy-efficient products. Hence, this study hypothesizes that:

H1a: Perceived benefit positively affects behavioral attitude toward solar energy appliances.

Perceived Cost

The cost for solar energy appliances is inclusive of the initial amount of money to buy appliances and periodic maintenance. The costlier the appliances are, the lower values consumers receive and the lower appliances' utility rate gets (Premkumar et al., 1997). Cost is considered as one of the determinants affecting consumers' intent of adopting solar energy (Bandara & Amarasena, 2019; Ayoub et al., 2019; Akroush et al., 2019; Alam & Rashid, 2012). If people are to employ new technologies, these new technologies must be properly priced in relation with alternatives. If not, consumers' adopting new technologies may not be feasible.

Previous researchers agreed that there was a direct and significant correlation between cost and intent of using products (Bandara & Amarasena, 2019; Ayoub et al., 2019; Alam & Rashid, 2012). Meanwhile, Akroush et al. (2019) assumed that perceived cost was mediated through its effect on attitude toward behavioral intent and price was not confirmed in the research by Wang et al. (2017), who empirically analyzed the factors impacting Chinese urban residents' intent of purchasing energy-efficient appliances on the structural equation model, as well as in the research by Bketi et al. (2022), who examined factors influencing people's intention of using rooftop solar photovoltaic in Indonesia. In this current research, we are to verify the effect of perceived cost on purchase intention through the mediation of attitude toward behavioral intent. Therefore, we develop the hypothesis:

H1b: Perceived cost has a negative correlation with behavioral attitude toward solar energy appliances.

Interpersonal Influence

Word of mouth is known as a non-commercial communication among users about a certain product, service or business (Litvin et al., 2008). Such interpersonal exchanges offer references to the product or service consumption over and above the advertising released by companies. The interpersonal influence is seen as one of the aspects significantly affecting subjective norm (Bhattacherjee, 2000). It is attributed to the behavioral alteration in individuals due to others' perception and comments, which might impact others' adoption. Additionally, the strong influence of friends and family members (e.g., Hsu et al., 2006; Wang et al., 2017) was posited and stressed. However, the relationship between interpersonal influence and subjective norm was rarely investigated in previous studies on appliances. Hence, the hypothesis is suggested:

H2a: Interpersonal influence is positively related with subjective norm regarding solar energy appliances.

Electronic Word of Mouth (EWOM)

In the modern life, a novel form of EWOM can be consumers' positive or negative remarks on a certain product or service online (Hennig-Thurau & Walsh, 2003). EWOM is also regarded as a significant platform that permits customers to convey their thinkings to others (Godes & Mayzlin, 2004). Also, EWOM is argued to be more productive than traditional one on account of its ease of use and its range width (Fong & Burton, 2008). Furthermore, EWOM is also suggested to have effect on subjective norm (Doma et al., 2015; Jalilvand & Samiei, 2012). During the digital age, Vietnamese youngsters spend most of their spare time online (Nielsen, 2018). Thus, the study recommends the hypothesis:

H2b: EWOM has a positive correlation with subjective norm when it comes to solar energy appliances.

Behavioral Attitude

In the prior researches based on the TPB paradigm, one of the determinants shaping the intent is behavioral attitude (Ajzen, 1991), which is inclusive of agreeable or disagreeable evaluation, emotional sensations, and behavioral proneness. Many researches were implemented to scrutinize and confirm the positive attitudinal influence on behavioral intent in various domains (Ajzen, 2010; Chew & Abdul Adis, 2018; Jalilvand & Samiei, 2012; Juniwati, 2014). As for appliances, attitude is also one of the main determinants positively impacting the purchasing intent (Bhutto et al., 2021; Tan et al., 2017; Hua & Wang, 2019; Tsuar & Lin, 2018; Alam & Rashid, 2012; Akroush et al., 2019). The hypothesis is proposed:

H3: Behavioral attitude has a positive correlation with the intent of buying solar energy appliances.

Subjective Norm

In the TPB paradigm, subjective norm is defined as the second determinant of behavioral intent by Ajzen (1991). It is the awareness of pressures from the people around, who are important to an individual in some ways. It captures an individual's perception of social pressure regarding a certain behavior. The influence of subjective norm on behavioral intent has been proved in various domains of food (Shin & Hancer, 2016), health (Caso et al., 2019), advertising (Sanne & Wiese, 2018), green hospitality (Chen & Tung, 2014), shopping online (Hasbullah et al., 2016), and energy-efficient appliances (Bhutto et al., 2021; Bhutto et al., 2022). Hence, the following hypothesis is developed:

H4: Subjective norm positively correlates with the intent of purchasing solar energy appliances.

Perceived Behavioral Control

Perceived behavioral control was introduced into TPB by Ajzen (1991) as a determinative factor of behavioral intent. Perceived behavioral control is referred to an individual's awareness of the ease or difficulty in undertaking a certain behavior (Wang et al., 2011). Concerning solar energy appliances, some external factors such as time,

financial cost, and effort may be out of an individual's control (Lindenberg & Steg, 2007). When individuals believe that they have more opportunities and resources as well as expect fewer obstacles, their perceived behavioral control will be stronger and their intent of purchasing solar energy appliances will be greater. In line with prior studies, consumers are more likely to engage in the intent of purchasing solar energy appliances when they perceive that they can control the factors (Hua & Wang, 2019; Tan et al., 2017; Wang et al., 2017). This research is also to verify the effect of perceived behavioral control on the intent. Thus, the hypothesis is developed:

H5: Perceived behavioral control positively correlates with the intent of buying solar energy appliances.

Purchase Intention

Purchase intent is reflective of consumers' social trend. Accordingly, individuals often take specific actions in compliance with such tendency. It can be measured by individuals' willingness to have an attempt to take actions. On the basis of the TPB paradigm, behavioral intent is pointed out to be the best way to foretell actual actions. In another word, the stronger intent of taking certain actions individuals have, the higher likelihood of taking the action will be. Therefore, it can be inferred that consumers' intent of using solar energy appliances can determine the purchase behavior of solar energy appliances. This study proposes the hypothesis (Fig. 1):

H6: Purchase intention has significant and positive correlation with purchase action.

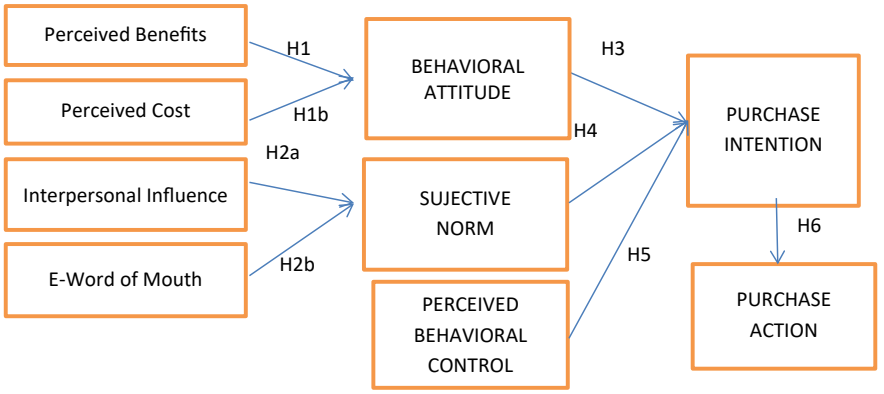

Fig. 1 Proposed paradigm and hypotheses. *Source* Authors

3 Research Method

3.1 Development of Measure and Questionnaire

With the convenient sampling, this research targeted those who have bought solar energy appliances such as lights, watches, heating water systems, fans, pumps, and air conditioners in Hanoi, Bac Ninh, Hai Duong, and Nam Dinh in Vietnam. The questionnaire has two sections: (1) demographics and (2) measurement items on Likert scale. Nine constructs were measured with 33 items. Each scale is composed of 3–5 items determined and adapted from related literature (Table 1). Perceived Benefit, Perceived Cost, and Purchase Intention were measured with the item scales of Akroush et al. (2019). The scales measuring Interpersonal Influence and E-Worth of Mouth were adapted from Kawakami et al. (2013). Subjective norm was measured with the item scale of Hua and Wang (2019) while the item scale of Tan et al. (2017) was taken to measure Perceived Behavioral Control. The item scale for Purchase Action was adapted from Bhutto et al. (2022). All scale items were translated into Vietnamese from English. The 5-point Likert scale from strong disagreement (1) to strong agreement (5) was employed to measure all the items.

3.2 Sample and Data Collection

Forty respondents were used in the pre-test to check the apprehension of survey questions and the time to complete the questions as well as the face validity of measurement scales, which was considered sufficient as recommended by Hair et al. (2010). There were tiny changes in the question-wording. Afterward, the survey questions were delivered to the people who have bought solar energy appliances in Hanoi, Bac Ninh, Hai Duong, and Nam Dinh in Vietnam from April 2021 to March 2022, through the mailing system and in person. The total of collected responses was 402, of which 120 were from the mailing system and 282 from customers directly in person. After eliminating inadequate replies, we found that 375 responses were valid for the analysis in the next steps. This is in alignment with a reasonable sample size to employ SEM (Kline, 2011). SPSS20 and AMOS24 software were employed to process the data in order to check hypotheses. Respondents' demographic information is composed of age, sex, household income, and education background (Table 2).

Table 1 Definition of variables and scale references

Research variables	Conceptual definition	Reference scholars
Purchase action	Action of purchasing solar energy appliances	Bhutto et al. (2022)
Purchase intention	Intention of using solar energy appliances	Akroush et al. (2019)
Behavioral attitude	Positive and negative comments on solar energy appliances	Akroush et al. (2019)
Subjective norm	Social pressure caused by using solar energy appliances	Hua and Wang (2019)
Perceived behavioral control	Assessment of the ability to use solar energy appliances after evaluating personal resources	Tan et al. (2017)
Perceived benefit	Individuals' perception of benefits on using solar energy appliances	Akroush et al. (2019)
Perceived cost	Individuals' perception of the costs related to initial investment in buying/installing solar energy appliances and periodic maintenance	Akroush et al. (2019)
Interpersonal influence	Effects of the opinions of friends, family, co-workers on using solar energy appliances	Kawakami et al. (2013)
E-word of mouth	Effects of comments (positive or negative) made by customers regarding solar energy appliances on the Internet	Kawakami et al. (2013)

Source Authors

4 Results

The scales' reliability and validity were assessed with Cronbach's Alpha and confirmatory factor analysis (CFA). It is because the proposed paradigm in this research was adopted from the related literature. Then, the relation among constructs was evaluated with structural equation modeling (SEM).

4.1 Reliability and Validity of Scales

The scales' internal consistence reliability was evaluated with Cronbach's Alpha. The Cronbach's Alpha for each scale was greater than 0.70 and within the range from 0.773 to 0.871, indicating a good level of reliability (Hair et al., 2010). Furthermore, to form the data's convergent validity, we checked the estimated loadings, the assessed average variance (AVE), and the extracted composite reliability (CR) for each indicator (Fornell & Larcker, 1981), too. With the value from 0.689 to 0.910 which was

Table 2 Demographic information

Sample	Category	Frequency	Percentage
Age	21–30	50	13.3
	31–40	66	17.6
	41–50	78	20.8
	51–60	122	32.5
	Above 60	59	15.7
Gender	Male	296	78.9
	Female	79	21.1
Monthly household income	Under 5 million VND	41	10.9
	5–under 10 million VND	112	29.8
	10–under 15 million VND	58	15.4
	15–under 20 million VND	51	13.6
	20–under 25 million VND	46	12.3
	25–30 million VND	37	9.8
	Above 30 million VND	30	8.2
Educational level	High school or less	69	18.4
	2-year or less vocational training	80	21.3
	3-year college degree	84	22.5
	Bachelor degree	85	22.6
	Graduate degree	57	15.2

Source Authors

greater than the cut-off value of 0.60, all the factor loadings for the construct items were of statistical significance ($p < 0.01$) (Table 3). Additionally, all the AVEs were higher than 0.5, and all the CRs were greater than 0.7, indicating that nine constructs achieved the high-level validity of convergence and internal consistence (Hair et al., 2010). Measurement model fit, convergent validity, and discriminant validity of the data were evaluated with Confirmatory factor analysis (CFA) (Hair et al., 2010). The findings of CFA proved the acceptable level of fit: X^2 (Chi-square) = 800.1; CMIN/df = 1.759, $p < 0.001$; GFI (goodness of fit index) = 0.889; CFI (comparative fit index) = 0.934; TLI (Tucker Lewis index) = 0.923; and RMSEA (root mean square error of approximation = 0.045. All the t-tests of observed variables were statically significant at the level of 0.001. All model fit indicators are confirmed to be proper, and the conformity between the paradigm and collected data is proved to be significant.

Table 3 Model fit level

Variables	Items	Factor loading	AVE (> 0.50)	CR (> 0.70)
Purchase action (PA)	PA1	0.880	0.665	0.855
	PA2	0.805		
	PA3	0.910		
Purchase intention (PI)	PI1	0.840	0.642	0.877
	PI2	0.882		
	PI3	0.870		
	PI4	0.831		
Behavioral attitude (BA)	BA1	0.689	0.538	0.777
	BA2	0.803		
	BA3	0.824		
Subjective norm (SN)	SN1	0.727	0.510	0.837
	SN2	0.779		
	SN3	0.845		
	SN4	0.738		
	SN5	0.776		
Perceived behavioral control (PBC)	PBC1	0.730	0.510	0.838
	PBC2	0.784		
	PBC3	0.803		
	PBC4	0.848		
	PBC5	0.693		
Perceived benefit (PB)	PB1	0.834	0.549	0.828
	PB2	0.848		
	PB3	0.813		
	PB4	0.738		
Perceived cost (PC)	PC1	0.855	0.569	0.798
	PC2	0.785		
	PC3	0.793		
Interpersonal influence (II)	II1	0.781	0.543	0.780
	II2	0.850		
	II3	0.847		
E-word of mouth (EWOM)	EWOM1	0.878	0.582	0.804
	EWOM2	0.819		
	EWOM3	0.801		

Source Authors' synthesis from SPSS20 software

4.2 Paradigm and Hypothesis Testing

*Interrelation among constructs

Prior to hypothesis testing, the correlations among the constructs are checked. Table 4 indicates that no serious problem of multi-collinearity was found. Also, the square root of AVE was higher than its highest relation with any other constructs and AVE was greater than MSV, too. Thus, all the variables' validity of discriminant in this paradigm was confirmed. To summarize, appropriate reliability, convergent validity, and discriminant validity were demonstrated by the constructs in this research.

*Analysis of Structural Paths

The paradigm of this research was tested with structural equation modeling (SEM) to make an examination of the overall paradigm fit and the related power of the individual casual paths (Hair et al., 2010). The indicators (GFI = 0.913, CFI = 0.969, RMSEA = 0.045, TLI = 0.965, PCLOSE = 1.000, and Chi-square/df = 1.948) show that the paradigm reached a good level of fit. Therefore, the paradigm is proved to have given significant comprehension of direct and indirect predictors of the intent of purchasing solar energy appliances. On the basis of the standardized beta coefficients, significant at the level of 0.05, the findings prove that the hypotheses (H1a, H2a, H2b, H3, H4, and H6) are supported, except for H1b and H5 (Table 5). The positive and significant correlation between Perceived Benefit and Behavioral Attitude ($\beta = 0.17$, $t = 2.71$) is confirmed, supporting H1a, but the positive relationship between Perceived Cost and Behavioral Attitude doesn't support H1b. The positive and significant relation between Interpersonal Influence and Subjective Norm ($\beta = 0.19$, $t = 3.76$) as well as between E-word of Mouth and Subjective Norm ($\beta = 0.30$, $t = 3.57$) is confirmed, giving support to H2a and H2b.

Regarding the TPB paradigm, the positive correlation is confirmed between Behavioral Attitude and Purchase Intent ($\beta = 0.07$, $t = 5.16$) as well as Subjective Norm and Purchase Intention ($\beta = 0.14$, $t = 7.95$), providing support for H3 and H4. However, the relationship between Perceived Behavioral Control and Purchase Intention is not supported. Furthermore, the positive and significant relationship between Purchase Intention and Purchase Action ($\beta = 0.30$, $t = 4.35$) is confirmed, supporting H6. Also, Subjective Norm is also indicated to have exerted the strongest effect ($\beta = 0.14$, $t = 7.95$) on the Purchase Intention of solar energy appliances.

Finally, R^2 result of 0.52 indicates that 52 percent of variation in purchase action of solar energy appliances was caused by the paths of Behavioral Attitude-Purchase Intention and Subjective Norm-Purchase Intention.

Table 4 Discriminant validity for the measure paradigm

	AVE	MSV	SN	PBC	PI	PB	PA	PC	EWOM	II	BA
SN	0.510	0.201	**0.714**								
PBC	0.516	0.044	−0.170**	**0.718**							
PI	0.643	0.201	0.448***	−0.004	**0.802**						
PB	0.549	0.093	0.056	−0.150*	−0.030	**0.741**					
PA	0.665	0.057	−0.063	0.013	0.021**	0.156**	**0.815**				
PC	0.569	0.214	0.133	−0.011	0.017	0.305***	−0.052	**0.754**			
EWOM	0.582	0.166	0.221**	0.179**	0.105	−0.011	−0.037	0.164*	**0.763**		
II	0.543	0.167	0.069**	0.133*	0.022	0.016	0.024	0.007	0.408	**0.737**	
BA	0.538	0.214	0.196	0.209	0.163**	0.205**	0.239	0.463	0.244**	0.110**	**0.733**

Note *, *p*-value < 0.1; **, *p*-value < 0.05; ***, *p*-value < 0.001. Significant at the 0.05 level
Source Authors' synthesis from SPSS20 software

Table 5 Estimate of structural equation coefficients

Hypothesis	Structural path	Standardized estimate	*P*-value	Decision
H1a	PB → BA	0.170	0.023	Accepted
H1b	PC → BA	0.202	0.000	**Unaccepted**
H2a	II → SN	0.191	0.008	Accepted
H2b	EWOM → SN	0.302	0.000	Accepted
H3	BA → PI	0.072	0.047	Accepted
H4	SN → PI	0.144	0.008	Accepted
H5	PBC → PI	0.019	0.776	**Unaccepted**
H6	PI → PA	0.315	0.000	Accepted

Source Authors' synthesis from AMOS24 software

5 Discussions and Implications

5.1 Discussions

This research is to provide a thorough insight into antecedents on the intent of purchasing solar energy appliances among Vietnamese people. The TPB paradigm was employed to give a better understanding of consumers' purchasing intent. Six out of the eight tested hypotheses received the confirmation from the data.

In line with TPB, two out of three predictors in our proposed paradigm (behavioral attitude and subjective norm) were positive contributors to the purchase intention and purchase action of solar energy appliances. Of the two direct antecedents, the latter (SN) positively had the strongest influence on customers' purchase intention (PI). This finding is similar to the empirical researches by Bhutto et al. (2021) and Bhutto et al. (2022). The former (BA) also had a positive impact on consumers' purchasing intent, which supports the research results of Bhutto et al. (2021), Tan et al. (2017), Hua and Wang (2019), Tsuar and Lin (2018), Alam and Rashid (2012), Ayoub et al. (2019), and Akroush et al. (2019).

In addition, only perceived benefit (PB) positively and significantly influenced the behavioral attitude toward customers' purchase intent. This is similar to the research findings of Akroush et al. (2019). Meanwhile, perceived cost was not confirmed to affect consumers' behavioral attitude toward the purchase intention of solar energy appliances. This result is different from the findings of Akroush et al. (2019), but supports the research results of Wang et al. (2017) and Bketi et al. (2022). It may be due to the fact that with the average income in the developing country like Vietnam, customers feel that the price of such appliances is quite high and not as their expectation.

Another finding is that subjective norm (SN) was significantly affected by interpersonal influence (II) and e-word of mouth (EWOM). This finding may be partly attributed to the following things. First, as the internet access is convenient and the e-commerce in Vietnam is booming rapidly, people are filled up with a huge amount

of information on the internet. Therefore, customers are often easily led by other internet users' remarks or judgements. Second, customers with certain education background often consult others before coming to a decision on purchasing solar energy appliances.

5.2 Implications

The outcomes of this research give useful insights for policymakers and producers to make up appropriate strategies to boost solar energy products for households.

Attitude is proved to have positively influenced consumers' purchase intent and purchase action. For that reason, attempts must be done to entice consumers for a favorable attitude toward such appliances through influential campaigns so that consumers will be well aware of the benefits of such appliances in relation with costs and alternatives of the same types.

Moreover, the significant impacts of subjective norm (interpersonal influence and e-word of mouth) on the purchasing intent signify the requirement for various online advertising and sharing channels to touch customers' purchasing intent in the digital era.

More importantly, costs and behavior control (costs and availability of appliances) seem not to be perceived to impact customers' purchasing intent. Maybe, the price of such appliances seems rather expensive while 40.7% of households have the monthly income of less than 10 million VND. Hence, it can be implied that a structured policy of incentives and replacement (including flexible and attractive schemes for consumers and manufacturers) will boost the use and production of such appliances. Cost incentives for the initial purchase and the exchange of conventional appliances for solar energy ones may enhance consumers' intent of buying such appliances for experience. Also, promotion schemes for retailers, such as tax exemption for selling solar energy appliances, can be productive.

Finally, the proliferation of the appliance manufacturing factories in localities will give rise to the availability of such products. Hence, a policy can be made up in order to boost local manufacturing and startups with the help of technical issues, fiscal incentives, and tax exemptions on importing solar energy technologies as well as related equipment. In this sense, fair transfer of benefits to all related stakeholders is key to ensure the feasibility and success of the policy.

6 Conclusions and Limitations

On the basis of evaluating the relationships among the constructs through structural equation modeling, only behavioral attitude and subjective norm were found to be positive contributors to the purchase action through purchase intention. In addition, the positive relationship between behavioral attitude and perceived benefit was also

highlighted, but the relationship between behavioral attitude and perceived cost was not supported. Furthermore, the positive impact of interpersonal influence and e-word of mouth on subjective norm was supported, too.

Despite some contributions to apprehending the likely driver of consumers' purchasing solar energy appliances, a number of limitations still exist in this research. First, our research placed an emphasis on the antecedents of consumers' intent and action of buying solar energy appliances only. There may still be some variations between respondents' stated preference and revealed preference. For that reason, using the combined methods (survey and interview) may give much more robust findings. Second, the data were gathered in a short time span. Thus, further researches should use longitudinal data to provide a deeper insight into the targeted customers' behavior. Finally, with time and budget restrictions, only customers in Hanoi, Bac Ninh, Hai Duong, and Nam Dinh in Vietnam were targeted for the data in this research. Hence, further researches should consider a wider geographic scope in both rural and urban areas, which will help us know how individuals in the rural and urban areas perceive the consumption of such appliances. With more constructs, larger sample, and qualitative analysis, further researches will provide more thorough comprehension of customers' purchase behavior of solar energy appliances in developing economies like Vietnam.

7 Appendix

Construct	Items		References
Perceived benefits	PB1	Solar energy appliances give me extra value such as economic, environmental and social value	Akroush et al. (2019)
	PB2	Solar energy appliances have high utility	
	PB3	Solar energy appliances can meet my requirements	
	PB4	Solar energy appliances give me more benefits than costs	
Perceived cost	PC1	The price of solar energy appliances is not expensive	Akroush et al. (2019)
	PC2	The price of solar energy appliances is not higher than that of ordinary ones	
	PC3	The price of solar energy appliances is not higher than my expectation	

(continued)

(continued)

Construct	Items		References
Behavioral attitude	BA1	It is important to me when making purchases of solar energy appliances	Akroush et al. (2019)
	BA2	If I can choose between solar energy and traditional appliances, I prefer solar energy ones	
	BA3	I have favorable attitude toward purchasing solar energy appliances	
Interpersonal influence	II1	I always refer to the people around me, including my friends, family and colleagues when purchasing solar energy appliances	Kawakami et al. (2013)
	II2	I look at others' suggestions on purchasing solar energy appliances	
	II3	I consider people around me who have recommended solar energy appliances before	
E-word of mouth	EWOM1	I always learn about positive aspects of solar energy appliances from user blogs and user websites	Kawakami et al. (2013)
	EWOM2	I always consult the websites of people who use solar energy appliances	
	EWOM3	I visit community web sites and review online postings when purchasing solar energy appliances	
Subjective norm	SB1	It is pleasing to have solar energy appliances	Hua and Wang (2019)
	SB2	If respectable or important people use solar energy appliances, I would like to use them more	
	SB3	If my family and friends use solar energy appliances, I would like to use them more	
	SB4	If the people around me use solar energy appliances, I would like to use them more	

(continued)

(continued)

Construct	Items		References
	SB5	Using solar energy appliances is a social trend	
Perceived behavioral control	PBC1	I am confident that I would use solar energy appliances even if it is slightly more expensive	Tan et al. (2017)
	PBC2	I am confident that I would use solar energy appliances even if another person advises me to use the conventional one	
	PBC3	I am sure that I would be able to make a difference by using solar energy appliances	
	PBC4	Using solar energy appliances is entirely within my control	
	PBC5	I have resources, knowledge and ability to use solar energy appliances	
Purchase intention	PI1	I like to purchase solar energy appliances	Akroush et al. (2019)
	PI2	I will pay more money on solar energy appliances	
	PI3	I will take solar energy appliances as a first consideration	
	PI4	I will recommend others to purchase solar energy appliances	
Purchase action	PA1	I have switched to solar energy appliances for economic, environmental and social reasons	Bhutto et al. (2022)
	PA2	I switch to the solar energy appliances for the social trend	
	PA3	When I have a choice between the traditional appliances and solar energy ones, I purchase the latter	

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