

## Article

# Exploring Consumers' Purchase Intention on Energy-Efficient Home Appliances: Integrating the Theory of Planned Behavior, Perceived Value Theory, and Environmental Awareness

Chien-Chi Lin <sup>1,\*</sup>  and Chih-Ming Dong <sup>2</sup>

<sup>1</sup> Department of Tourism, Food & Beverage Management, Chang Jung Christian University, Tainan City 71101, Taiwan

<sup>2</sup> Department of Environmental Engineering and Science, Chia Nan University of Pharmacy and Science, Tainan City 71710, Taiwan

\* Correspondence: christy@mail.cjcu.edu.tw; Tel.: +886-6-2785123 (ext. 2509)

**Abstract:** Extensive energy consumption has incurred global environmental problems such as climate change. Home appliances are highly used products and consume large amounts of energy. When widely applied, energy-efficient home appliances promote energy efficiency and reduce carbon emissions. Therefore, people's intention to purchase these home appliances merits research attention. In this study, a comprehensive model was developed using the theories of planned behavior, perceived value, and environmental awareness. Data were collected through a questionnaire survey, to which 448 valid responses were returned, and analyzed using partial least squares. The results indicated that consumers' intention to purchase energy-efficient home appliances was positively affected by their attitude toward purchasing the appliances. Such attitude was significantly and positively affected by functional value, price value, environmental value, and environmental awareness. However, consumers' attitudes toward purchasing these appliances were not significantly affected by emotional value or social value. Suggestions were proposed on promoting consumer intention to purchase these home appliances according to the research results.



**Citation:** Lin, C.-C.; Dong, C.-M. Exploring Consumers' Purchase Intention on Energy-Efficient Home Appliances: Integrating the Theory of Planned Behavior, Perceived Value Theory, and Environmental Awareness. *Energies* **2023**, *16*, 2669. <https://doi.org/10.3390/en16062669>

Academic Editor: Cristinel Petrisor Constantin

Received: 18 January 2023

Revised: 1 March 2023

Accepted: 11 March 2023

Published: 13 March 2023



**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** energy-efficient home appliances; TPB; perceived value theory

## 1. Introduction

Countries worldwide are paying increasing attention to climate change and the gradual depletion of energy [1–3]. According to climate scientists, one of the main causes of climate change is the substantial increase in greenhouse gas concentration in the atmosphere [4,5]. The carbon concentration in the atmosphere is increased directly or indirectly by carbon emissions from the use of energy and fuels by humans [6]. Therefore, various countries have implemented measures and policies to reduce carbon emissions and energy consumption [7–9]. Taiwan has been actively promoting energy conservation and carbon emission reduction in various areas to mitigate the pressure of energy shortages and achieve the goal of carbon neutrality [10–12]. Home appliances are a main source of energy consumption and carbon emissions among the public [13,14]. Therefore, the prevalent use of energy-efficient home appliances is an effective means of reducing energy consumption and carbon emissions [14,15]. Consumers' intention to purchase energy-efficient home appliances affects their purchase behavior, which in turn influences the amount of energy consumption and carbon emissions [13,16]. Accordingly, this intention to purchase is a topic meriting further research.

Studies have, from the perspective of consumers' own values and their perception of energy-efficient home appliances, investigated consumers' intention and behavior to purchase such appliances. For example, Gaspar and Antunes [17] found that the number one factor influencing European consumers' decisions to purchase mainstream home

appliances was prices, followed by quality and energy consumption. The study further indicated that consumers with higher environmental awareness were more willing to purchase energy-efficient home appliances. Xu et al. [18] and Gulzari et al. [19] also indicated that consumers' environmental awareness affects their attitudes toward purchasing or using green products. Zhang et al. [13] discovered that consumers' attitudes toward energy-efficient home appliances positively affected their willingness to pay the price premiums of these appliances and that consumers' perceived value affected their purchase attitude. However, contrary to the study results of Gaspar and Antunes [17], Zhang et al. [13] found that consumers' environmental awareness did not significantly affect their attitude to purchase energy-efficient home appliances.

To date, the theory of planned behavior (TPB), perceived value theory, and environmental awareness theory have been widely used in studying consumers' intentions or attitudes toward purchasing specific products [13,18,20,21]. However, existing studies either only integrated TPB and norm activation model (NAM) to study consumers' intention to purchase green products or only explored the impact of perceived value theory on consumers' attitudes toward purchasing energy-efficient appliances [13,20,21]. No existing study has integrated TPB, perceived value theory, and environmental awareness theory to establish a comprehensive research model on the consumers' intention to purchase energy-efficient home appliances. To address this shortcoming, this study employed a comprehensive model integrating TPB, perceived value theory, and environmental awareness in exploring consumers' intentions to purchase energy-efficient home appliances.

## 2. Literature Review

### 2.1. TPB

TPB is an extension of the theory of reasoned action (TRA) [22]. TPB is used to understand consumers' behavioral intentions under various situations [23,24]. In recent decades, TPB has been applied in research of numerous fields such as the purchase of electronic vehicle products [25,26] and green consumption intention [27]. TPB includes three variables: attitude, subjective norm, and perceived behavioral control [28]. Attitude explains an individual's positive or negative assessment of relevant behavior. Subjective norm represents the organizational or social pressure perceived by the individual that intends to perform the behavior. Perceived behavioral control reflects an individual's perception of the difficulty of engaging in the behavior [28–30].

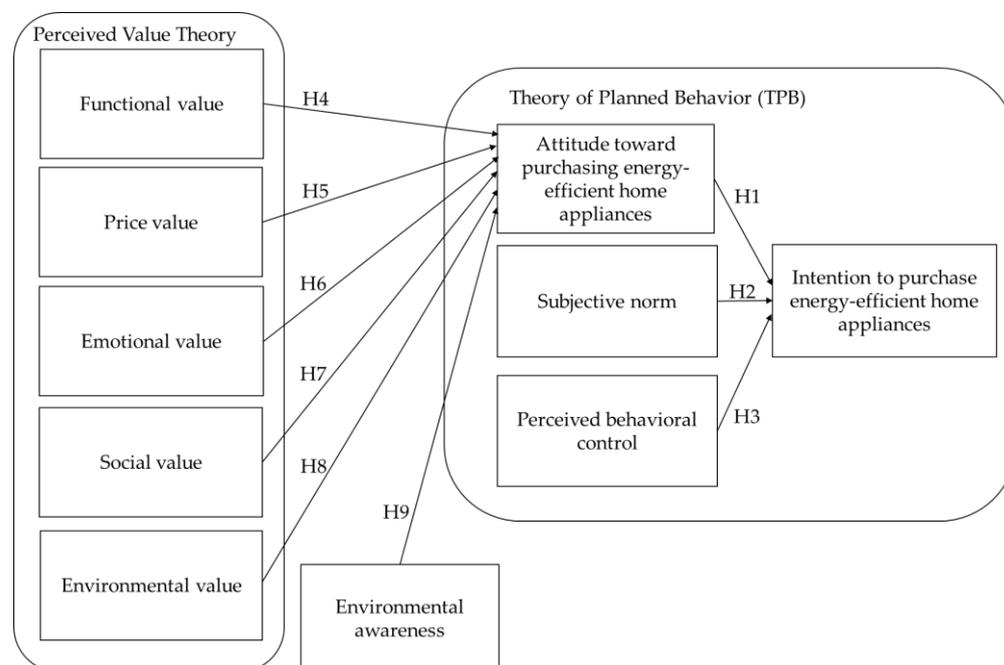
### 2.2. Perceived Value Theory

Studies have indicated that perceived value is a key factor affecting consumers' purchase attitudes [20]. Perceived value refers to consumers' overall assessment of the utility of a product and is based on the perceptions of what is received and what is given [31]. According to Sweeney and Soutar [32], perceived value includes quality, emotional, price, and social values. Sheth et al. [33] contended that perceived value includes functional, social, emotional, and conditional values. Investigating consumers' intentions to purchase electric cars, Kim et al. [20] indicated that perceived value, in addition to functional, price, and emotional values, includes environmental value, which refers to consumers' perception of values related to environmental friendliness in products. Compared to regular products, energy-efficient home appliances are more friendly to the environment. Therefore, this study included environmental value in the values perceived by consumers regarding these appliances. According to the findings in previous studies, this study divided perceived value into five dimensions: functional, price, emotional, social, and environmental values.

### 2.3. Theoretical Research Model

According to the TPB model, behavioral intention is composed of three variables (i.e., attitude, subjective norm, and perceived behavioral control) [18,34]. This study also considers the influences of perceived value and environmental awareness. These variables were incorporated with the TPB to form an integrative research model for exploring

consumers' intention to purchase energy-efficient home appliances. The theoretical research model is presented in Figure 1.



**Figure 1.** Theoretical research model.

#### 2.4. Variables of TPB

In this study, attitude was the positive or negative evaluation of the intention to purchase energy-efficient home appliances; numerous studies have shown that attitude has a positive effect on behavioral intention [15,35,36]. Subjective norm refers to the social pressure from individuals or groups that consumers consider important. This study defined subjective norm as situations where consumers are more willing to purchase energy-efficient appliances when the individuals or groups they deem important have a favorable opinion of energy-efficient home appliances. The fact that subjective norm can positively affect behavioral intention has been confirmed in the literature [25,26]. Perceived behavioral control refers to the potential difficulties in performing a particular behavior [18,37]. Wang et al. [38] have shown that perceived behavioral control is positively correlated with behavioral intention. In this study, perceived behavioral control implied that consumers have the time, money, and ability to purchase energy-efficient home appliances. In consideration of the literature's findings, this study proposed the following hypotheses.

**H1.** Attitude has a positive effect on the intention to purchase energy-efficient home appliances.

**H2.** Subjective norm has a positive effect on the intention to purchase energy-efficient home appliances.

**H3.** Perceived behavioral control has a positive effect on the intention to purchase energy-efficient home appliances.

#### 2.5. Perceived Value

##### 2.5.1. Functional Value

Functional value refers to consumers' perceived utility of a product's functional or physical performance [33]. The functional value of appliances is subject to their physical properties, which are determined by factors pertaining to product durability or technological advancement [13]. Examples of such factors include the energy efficiency, stability of quality, and superior production of appliances [13,39,40]. Ling et al. [39] studied the effect of functional value on consumers' attitudes toward purchasing smart speakers and found that

functional value positively affected such attitudes of consumers. If consumers perceived an energy-efficient appliance to have high functional value, they tended to have a good impression of the product, which improved their attitudes to purchase the energy-efficient home appliance. Accordingly, the following hypothesis was proposed.

**H4.** *Functional value positively affects consumers' attitudes toward purchasing energy-efficient home appliances.*

#### 2.5.2. Price Value

Price value refers to the utility perceived by consumers in a product according to its short-term and long-term costs [32,33]. Energy-efficient home appliances are more energy-efficient than other appliances. In the long term, energy-efficient home appliances incur lower electricity costs than other appliances [13]. In addition, purchasing energy-efficient home appliances also grants consumers the eligibility to apply for a tax rebate or subsidy from the government [41–43]. To consumers, lower electricity costs lead to higher price values. These price values influence consumers' intentions to purchase energy-efficient home appliances. Accordingly, the following hypothesis was proposed.

**H5.** *Price value positively affects consumers' attitudes toward purchasing energy-efficient home appliances.*

#### 2.5.3. Emotional Value

Emotional value refers to the utility perceived by consumers in a product according to their feelings for it [33]. Kim et al. [44] argued that consumers earn a sense of pleasure or comfort from purchasing electric cars. This is because they sense low noise and low vibration when driving or riding electric vehicles. Purchasing energy-efficient home appliances, which reduce energy consumption and carbon emission, brings a sense of altruism to consumers. The emotional value perceived by consumers in these appliances positively affects their purchase attitude [36]. However, some studies have reported that no significant relationship exists between the emotional value of consumers and their attitudes toward purchasing green products [13,43,45]. Accordingly, the following hypothesis was proposed.

**H6.** *Emotional value positively affects consumers' attitudes toward purchasing energy-efficient home appliances.*

#### 2.5.4. Social Value

Social value refers to the utility perceived by consumers in a product for raising their status in a social group [32,33]. Mahadin [46] noted that social value significantly and positively influences consumers' choice of green vehicles. The higher the social value consumers perceive in energy-efficient home appliances, the stronger consumers' attitudes may be regarding purchasing said products. However, some studies have argued that no significant relationship exists between the social value of consumers and their attitudes toward purchasing green products [47,48]. Accordingly, the following hypothesis was proposed.

**H7.** *Social value positively affects consumers' attitudes toward purchasing energy-efficient home appliances.*

#### 2.5.5. Environmental Value

Environmental value denotes the utility perceived by consumers in relation to a product's environmental friendliness [13,49,50]. Studies have reported that green products reduce the consumption of Earth's resources and mitigate environmental pollution, and purchasing these products generates special environmental values [13,49,50]. Compared with other appliances, energy-efficient home appliances are more energy-efficient and more effective in reducing carbon emissions, contributing positively to environmental protection. The environmental values in energy-efficient home appliances may play a key role in consumers' purchase attitudes. Accordingly, the following hypothesis was proposed.

**H8.** *Environmental value positively affects consumers' attitudes toward purchasing energy-efficient home appliances.*

### 2.6. Environmental Awareness

Environmental awareness refers to the formation of environmental protection concepts among consumers in the face of various environmental problems such as water pollution, air pollution, and energy depletion [51–54]. Environmental awareness represents consumers' views on specific environmental protection behaviors, reflecting the initiatives that consumers are willing to take for environmental protection [52,54,55]. According to a questionnaire on the intention to use environmentally friendly park-and-ride facilities in Groningen, the Netherlands, by De Groot and Steng [56], the respondents' environmental awareness positively influenced their attitudes toward using said facilities. Xu et al. [18] developed an extended model of TPB with environmental awareness as the anterior variable, revealing that environmental awareness positively affects consumers' attitudes toward purchasing green furniture. Accordingly, the following hypothesis was proposed.

**H9.** *Environmental awareness positively affects consumers' attitudes toward purchasing energy-efficient home appliances.*

## 3. Research Design

### 3.1. Questionnaire Design

As shown in Appendix A, the questionnaire items were based on the findings of existing studies. Some of these items had their wording revised to suit the goal of this study. All the items were measured using a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). The constructs and measurement items were reviewed and revised by three experts. A questionnaire pretest was administered to 30 participants. After verifying that the questionnaire had satisfactory reliability and validity, the formal questionnaire survey was conducted.

### 3.2. Data Collection

In this study, a formal questionnaire was conducted in PTT (<https://www.ptt.cc/bbs/index.html>, (accessed on 1 June 2021)) and Mobile01 forums related to home appliances (<https://www.mobile01.com/>, (accessed on 1 June 2021).), as well as large home appliance stores. These forums are the most common electronic platforms where Taiwanese people discuss home appliances, many of whom are consumers or potential consumers of energy-efficient home appliances. Many consumers of this nature can also be found in actual home appliance stores. To increase the questionnaire response rates, we provided gift cards in a draw to attract respondents. From 1 July 2021 to 30 April 2022, 485 copies of the questionnaire were distributed, and 448 valid responses were returned. Boomsma [57] recommended a sample size of more than 100, preferably more than 200, for an SEM. According to Nunnally [58], an SEM sample size should be 10 times or more than the number of items used. The current study employed 32 items for its SEM and collected a total of 485 responses, 448 of which were valid. Therefore, the study's sample size, 448 responses, was larger than the thresholds recommended by Boomsma [57] (i.e., 200 responses) and Nunnally [58] (i.e., 10 times the number of items, namely 320 responses) and thus fulfilled the sample size requirement.

The Harmon single-factor test was employed to test for common method variance. A common method variance problem exists if the eigenvalues produced by the exploratory factor analysis of all study variables suggest that the first factor accounts for more than 50% of the variance among variables [59]. Table 1 shows the nine factors with eigenvalues greater than 1. The total variance extracted by the first factor is 25.487%, which is lower than the recommended threshold of 50%. Therefore, no common method variance problem existed in the data.

**Table 1.** Total variance explained using Harman’s single-factor test.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.372	25.487	25.487	8.372	25.487	25.487	3.675	11.194	11.194
2	4.521	13.824	39.311	4.521	13.824	39.311	3.414	10.353	21.547
3	2.701	8.227	47.538	2.701	8.227	47.538	3.412	10.351	31.898
4	2.372	7.334	54.872	2.372	7.334	54.872	3.289	9.971	41.869
5	2.271	6.983	61.855	2.271	6.983	61.855	2.271	9.906	51.775
6	2.091	6.443	68.298	2.091	6.443	68.298	2.841	8.636	60.411
7	2.011	6.103	74.401	2.011	6.103	74.401	2.648	8.049	68.46
8	1.732	5.227	79.628	1.732	5.227	79.628	2.587	7.851	76.311
9	1.493	4.485	84.113	1.493	4.485	84.113	2.564	7.801	84.112

As shown in Table 2, 220 (49.1%) and 228 (50.9%) of the participants are female and male, respectively. Of these participants, 82.6% were aged 31–50 years; 60% had university education levels; 67.9% had an annual income of TWD 15,001–TWD 45,000. We used the chi-square ( $\chi^2$ ) test and *t*-test to compare the characteristics of early and late respondents and determined that no significant differences existed between early and late respondents ( $p > 0.05$ ). We also used the square ( $\chi^2$ ) test and *t*-test to compare the characteristics of respondents from online forums and from actual home appliance stores and determined that there were no significant differences ( $p > 0.05$ ) between them. According to the 2021 Taiwan Home Appliance Consumer Report by the Industrial Technology Research Institute [60], people aged 30–50 years were the primary consumers of home appliances, accounting for 80.2% of all consumers. Among these consumers, 52.8% and 47.2% were female and male, respectively; 51.5% had an education level of university or above; 60% had an average annual income of TWD 35,000. Therefore, the sample characteristics in this study align with the demographic characteristics of home appliance consumers in Taiwan.

**Table 2.** Demographic information of the respondents (N = 448).

Variable	Number	Percentage
Gender		
1. Male	220	49.10
2. Female	228	50.89
Age		
1. Under 20	1	0.2
2. 20–30	39	8.7
3. 31–40	180	40.2
4. 41–50	190	42.4
5. 51–60	26	5.8
6. Over 60	12	2.7
Education level		
1. Elementary	0	0
2. Junior high	7	1.6
3. Senior high	85	19.0
4. University	269	60.0
5. Graduate	87	19.4
Monthly income		
1. Less than TWD 15,000	5	1.1
2. TWD 15,001–TWD 30,000	151	33.7
3. TWD 30,001–TWD 45,000	153	34.2
4. TWD 45,001–TWD 60,000	70	15.6
5. TWD 60,001–TWD 75,000	29	6.5

**Table 2.** *Cont.*

Variable	Number	Percentage
6. TWD 75,001–TWD 91,000	17	3.8
7. TWD 91,001–TWD 120,000	12	2.7
8. More than TWD 120,000	11	2.5

#### 4. Data Analysis and Main Results

SmartPLS 3 is a common software tool capable of performing partial least square-structural equation model (PLS-SEM) analysis and is used to establish models and assess measurement and structural models [61]. PLS-SEM, which does not require the use of normality for covariance-based multivariate analysis, is unaffected by sample size [62,63]. SmartPLS 3 was employed in this study for analyses.

##### 4.1. Assessment of the Measurement Model

Composite reliability (CR) is a key indicator for measuring internal consistency reliability [64,65]. Table 3 shows that all CR values of all constructs were between 0.920 and 0.942, higher than the acceptable threshold of 0.7 [65]. Hair et al. [66] suggested that the factor loadings of all items must be  $>0.7$  to achieve convergent validity. In Table 3, each item in the constructs has a standard factor loading between 0.848 and 0.907, considerably greater than the threshold of 0.7. Fornell and Larcker [67] and Bagozzi and Yi [68] both suggested that the average variance extracted (AVE) must be  $>0.5$  to achieve convergent validity. In Table 3, all constructs have an AVE between 0.741 and 0.809, greater than the threshold of 0.5. Therefore, all constructs in the measurement model achieved convergent validity.

**Table 3.** Evaluation of validity and reliability of the measurement model.

Constructs	Items	Standard Factor Loadings	Cronbach's $\alpha$	CR	AVE
Attitude toward purchasing energy-efficient home appliances (AT)	AT1	0.863	0.884	0.920	0.741
	AT2	0.869			
	AT3	0.849			
Subjective norm (SN)	SN1	0.876	0.915	0.939	0.801
	SN2	0.900			
	SN3	0.907			
Perceived behavioral control (PBC)	PBC1	0.868	0.885	0.923	0.744
	PBC2	0.851			
	PBC3	0.868			
Intention to purchase energy-efficient home appliances (INT)	INT1	0.875	0.903	0.935	0.761
	INT2	0.868			
	INT3	0.874			
Functional value (FV)	FV1	0.872	0.888	0.927	0.750
	FV2	0.886			
	FV3	0.857			
	FV4	0.848			
Price value (PV)	PV1	0.886	0.917	0.942	0.809
	PV2	0.907			
	PV3	0.905			
Emotional value (EMV)	EMV1	0.854	0.901	0.932	0.757
	EMV2	0.86			
	EMV3	0.895			
Social value (SV)	SV1	0.863	0.904	0.936	0.763
	SV2	0.861			
	SV3	0.896			

Table 3. Cont.

Constructs	Items	Standard Factor Loadings	Cronbach's $\alpha$	CR	AVE
Environmental value (EV)	EV1	0.859	0.905	0.937	0.765
	EV2	0.866			
	EV3	0.898			
Environmental awareness (EA)	EA1	0.883	0.887	0.926	0.748
	EA2	0.854			
	EA3	0.868			
	EA4	0.853			

Discriminant validity refers to the situation where the correlation between two constructs, which is determined through a correlation analysis, is low [69]. The Fornell–Larcker criterion [67]—one of the critical methods used to determine whether discriminant validity exists between constructs—requires the square root of the AVE of each construct to be greater than the correlation coefficient between two other constructs. In Table 4, all constructs have an AVE with its square root falling between 0.765 and 0.801, greater than the correlation coefficient between the two other constructs. Therefore, discriminant validity exists between all constructs.

Table 4. Square roots of the AVE and constructor correlation coefficient.

	AT	SN	PBC	INT	FV	PV	EMV	SV	EV	EA
AT	<b>0.861</b>									
SN	0.530	<b>0.895</b>								
PBC	0.412	0.539	<b>0.863</b>							
INT	0.542	0.533	0.565	<b>0.873</b>						
FV	0.325	0.546	0.565	0.569	<b>0.867</b>					
PV	0.445	0.538	0.449	0.569	0.501	<b>0.900</b>				
EMV	0.317	0.382	0.516	0.419	0.411	0.475	<b>0.871</b>			
SV	0.426	0.473	0.386	0.399	0.391	0.378	0.473	<b>0.874</b>		
EV	0.506	0.416	0.632	0.234	0.423	0.433	0.482	0.435	<b>0.875</b>	
EA	0.505	0.445	0.606	0.475	0.412	0.443	0.493	0.378	0.369	<b>0.865</b>

Note: Values in the diagonal row are the square roots of the AVE and the others are the correlation between constructs.

#### 4.2. Assessment of the Structural Model

A structural model was developed to test the hypotheses of the conceptual model. The structural model was examined by investigating the relationships between the constructs and the predictive power of the model. The coefficient of determination ( $R^2$ ) and the Stone–Geisser criterion ( $Q^2$ ) were used to determine the explanatory predictive accuracy of the proposed research model [60]. The coefficient of determination ( $R^2$ ) reflects an exogenous construct's explanatory power for an endogenous construct in the PLS-SEM. The value of  $R^2$  ranges between 0 and 1, and a large  $R^2$  value indicates a strong explanatory power. According to Hair [65], an  $R^2$  value of 0.25, 0.5, or 0.75 suggests a weak, moderate, or strong explanatory power, respectively. Table 5 reveals an  $R^2$  value of 0.75 for the “attitude toward purchasing energy-efficient home appliances” construct, indicating that the “functional value”, “price value”, “emotional value”, “social value”, “environmental value”, and “environmental awareness” constructs had a strong explanatory power for said attitude. The  $R^2$  value for the “intention to purchase energy-efficient home appliances” construct was 0.71, suggesting that the “attitude toward purchasing energy-efficient home appliances” construct had a moderate-to-strong explanatory power for purchase intention. The recommended value for  $Q^2$  is  $>0$ , an estimate based on the blindfolding procedure with the default value of 7 for the omission distance [70]. Table 6 demonstrates the  $Q^2$  values of AT and INT are  $>0$ , supporting the predictive relevance of the model.

**Table 5.** Results of R<sup>2</sup> and Q<sup>2</sup>.

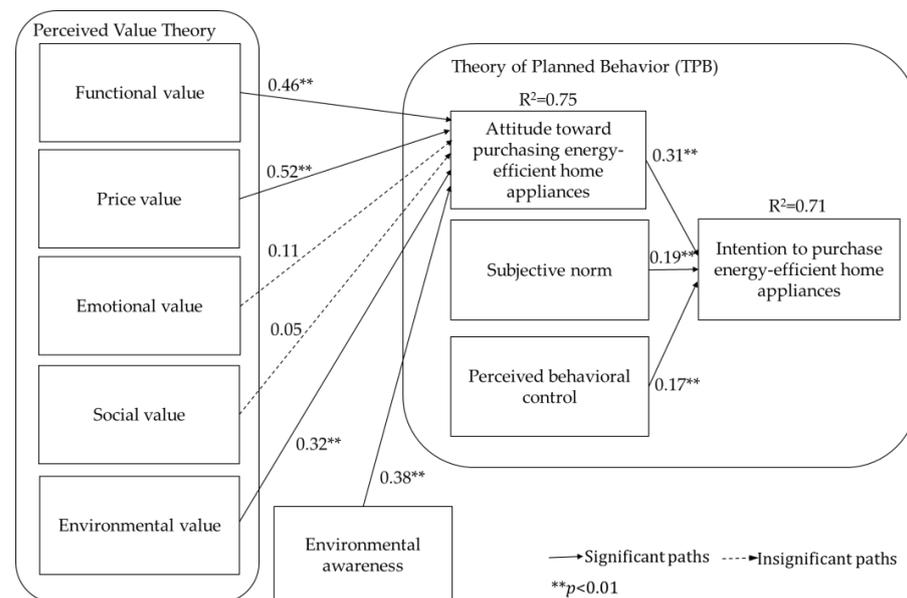
	R <sup>2</sup>	Adjusted R <sup>2</sup>	Q <sup>2</sup>	Interpretation
Attitude toward purchasing energy-efficient home appliances (AT)	0.712	0.709	0.289	Substantial
Intention to purchase energy-efficient home appliances (INT)	0.754	0.751	0.363	Substantial

**Table 6.** Structural model results.

Path	Path Coefficient (β)	t Value	p Value	Support
H1: AT→INT	0.31	4.753	<0.01	Yes
H2: SN→INT	0.19	4.864	<0.01	Yes
H3: PBC→INT	0.17	4.922	<0.01	Yes
H4: FV→AT	0.46	3.971	<0.01	Yes
H5: PV→AT	0.52	3.991	<0.01	Yes
H6: EMV→AT	0.11	1.075	>0.05	No
H7: SV→AT	0.05	0.816	>0.05	No
H8: EV→AT	0.32	5.154	<0.01	Yes
H9: EA→AT	0.38	4.751	<0.01	Yes

4.3. Hypothesis Testing

A bootstrapping procedure was adopted in this study to test the hypotheses of the proposed constructs and to analyze the path coefficients and their significance level. As shown in Figure 2 and Table 6, the path coefficient of “AT→INT” was 0.31 ( $p < 0.01$ ). Accordingly, AT had a positively significant effect on INT, supporting H1. The path coefficient of “SN→INT” was 0.19 ( $p < 0.01$ ). SN had a positively significant effect on INT, supporting H2. The path coefficient of “PBC→INT” was 0.17 ( $p < 0.01$ ). PBC had a positively significant effect on INT, supporting H3. The path coefficient of “FV→AT” was 0.46 ( $p < 0.01$ ). FV had a positively significant effect on AT, supporting H5. The path coefficient of “PV→AT” was 0.52 ( $p < 0.01$ ). PV had a positively significant effect on AT, supporting H6. The path coefficient of “EMV→AT” was 0.11 ( $p > 0.05$ ). EMV had no significant effect on AT, rejecting H7. The path coefficient of “SV→AT” was 0.05 ( $p > 0.05$ ). SV had no significant effect on AT, rejecting H8. The path coefficient of “EV→AT” was 0.32 ( $p < 0.01$ ). EV had a positively significant effect on AT, supporting H8. The path coefficient of “EA→AT” was 0.38 ( $p < 0.01$ ). EA had a positively significant effect on AT, supporting H9. Of the nine hypotheses proposed in this study, seven of them are supported and two of them are not.



**Figure 2.** Path analysis results.

## 5. Discussion and Implications

On the basis of TPB, perceived value theory, and environmental awareness theory, this model verified the effects of related factors on consumer intention to purchase energy-efficient home appliances. The functional value, price value, emotional value, social value, and environmental value as well as consumers' environmental awareness were employed as the antecedents of consumers' attitudes toward purchasing energy-efficient home appliances. The proposed research model exhibited a high explanatory power to depict the effects of relevant factors on the intention to purchase energy-efficient home appliances. The model explained 71% and 75% of the variances in purchase intention and attitude, respectively. Overall, this study provides the following contributions.

### 5.1. Theoretical Implications

Scholars have rarely integrated TPB, perceived value, and environmental awareness into a single model to explore the intention to purchase energy-efficient home appliances. It enables a better understanding of the relationship between TPB, perceived value, environmental awareness, and intention to purchase energy-efficient home appliances.

The results of this study indicated that price value is the most critical factor affecting consumers' attitudes, consistent with the findings by Ulusoy and Barretta [71], in which price value was revealed to be the most crucial factor affecting consumers' attitudes toward purchasing green products. In the face of global energy shortage and the rising electricity cost in Taiwan, consumers are concerned about the subsequent electricity bills following their purchase of home appliances [72,73]. In the long term, energy-efficient home appliances incur significantly lower electricity charges than non-energy-efficient ones. Furthermore, purchasing energy-efficient home appliances in Taiwan grants a refund on the reduced commodity tax amount, which is equivalent to a subsidy for the purchase [74]. When consumers perceive the financial benefits of purchasing energy-efficient home appliances, which incur lower electricity bills than non-energy-efficient ones, the perceived price value increases, enhancing consumers' attitudes toward purchasing energy-efficient home appliances.

Functional value is another key factor that affects consumers' attitudes toward purchasing energy-efficient home appliances. This finding is consistent with the findings by Suki [75] on the choice behavior related to green products, which indicated that consumers are more likely to purchase products with more stable and higher quality.

Emotional value does not significantly affect consumers' attitudes toward purchasing energy-efficient home appliances. This contrasts with the finding by Kim et al. [44], which indicated that emotional value positively affects consumers' attitudes toward purchasing green vehicles. Kim et al. [44] argued that this is because the low noise and low vibration in green vehicles bring a sense of pleasure and comfort to consumers. However, the finding in the present study is consistent with those by Zhang [13], which indicated that emotional value does not significantly affect consumers' attitudes toward purchasing energy-efficient home appliances. This may be attributed to the observation that consumers do not perceive strong positive emotions when purchasing these home appliances as they do when purchasing green vehicles.

Social value does not significantly affect consumers' attitudes toward purchasing energy-efficient home appliances. This contrasts with the findings by Mahadin [46], which indicated that social value positively affects consumers' attitudes toward purchasing green vehicles. However, it is consistent with those by Zhang [13], which indicated that social value does not significantly affect consumers' attitudes toward purchasing energy-efficient home appliances. This is possibly because green home appliances are private household goods, whereas vehicles are products that can be noticed by other people. Consumers' use of private household goods cannot be known to people outside of their households and does not significantly raise their social status. Therefore, consumers do not perceive high social value in purchasing energy-efficient home appliances.

Environmental value is another factor that critically affects consumers' attitudes toward energy-efficient home appliances; it exerts a significant and positive effect on consumers' intention to purchase such home appliances. The findings of this study support Khan and Mohsin [76], who reported similar results in the choice behavior for green products. Khan and Mohsin [76] noted that consumers' attitudes toward green products improved as they perceived that purchasing such products would be conducive to the mitigation of environmental problems, such as resource exhaustion and environmental pollution.

Environmental awareness was found to have a significant and positive effect on consumers' intention to purchase energy-efficient home appliances. This is consistent with Xu et al. [18]. Numerous other researchers [19,56,77] have also suggested that individuals with a high level of environmental awareness have a greater intention of purchasing green products when they face a choice between different products. That is, environmental awareness prompts individuals to support environmentally friendly products with concrete actions.

Perceived behavioral control and subjective norms significantly and positively affected consumers' intention to purchase energy-efficient home appliances. This finding is consistent with those of Joshi et al. [36] and Yadav and Pathak [78]. Attitude was also observed to significantly and positively affect this intention. This finding is consistent with those of Han et al. [79] and Joshi et al. [36]. In addition, the effect of attitude on purchase intention was greater than those of perceived behavioral control and subjective norms. This finding is consistent with that of Han et al. [79].

## 5.2. Managerial Implications

We observed the significant and positive effect of perceived value on purchase intention. Among the factors in the perceived value dimension, price value, functional value, and environmental value significantly and positively affected attitudes toward the purchase of energy-efficient home appliances, whereas emotional value and social value exerted no significant effect. Price value exerted the largest effect on attitude, followed by functional value and environmental value. This indicated that commodity tax refunds and subsidies provided by governments to encourage the purchase of energy-efficient home appliances enable consumers to perceive the reduction in the cost of such appliances, which in turn increases their purchase attitude. Therefore, governments should continue to promote such incentives and collaborate with home appliance manufacturers to remind consumers that in the long run, such appliances can more effectively reduce electricity costs than conventional appliances that are not energy-efficient. This helps consumers perceive the benefits of energy-efficient home appliances, thereby increasing their perceived price value of such products. In addition, manufacturers should improve the functionality of energy-efficient home appliances, including energy efficiency, noise reduction, and endurance. This enables such appliances to meet consumers' functionality needs and improve their perceived functional value. Moreover, governments and manufacturers should advertise other benefits of energy-efficient home appliances, including the alleviation of energy depletion and carbon emission problems. This in turn increases consumers' perceived environmental value by helping them realize that using energy-efficient home appliances is a meaningful action that contributes to the environment.

Finally, we observed that environmental awareness significantly and positively affected consumers' attitudes toward purchasing energy-efficient home appliances. Therefore, governments should improve consumers' awareness of environmental problems such as energy depletion, carbon emissions, and climate change. This prompts consumers to convert their environmental awareness to physical actions, demonstrate behaviors conducive to environmental protection, and thereby consider energy-efficient functions an essential feature when selecting home appliances.

### 5.3. Limitations and Future Research

This study was conducted in Taiwan, and the analysis results are only applicable in Taiwan. However, as the intentions to purchase energy-efficient home appliances vary in various regions and countries, collecting research data from other countries, such as Western countries, to examine the differences between regions or countries will be of great worth.

## 6. Conclusions

Building on the existing literature, this study developed an integrative conceptual model based on the TPB, perceived value theory, and environmental awareness. Analyses were conducted to test the relationships between consumers' attitudes toward purchasing energy-efficient home appliances and functional value, price value, emotional value, social value, environmental value, and environmental awareness and to explore factors that affect consumer intention to purchase energy-efficient home appliances.

The results showed that consumers' attitudes toward purchasing energy-efficient home appliances, subjective norm, and perceived behavioral control significantly and positively affected their intention to purchase said appliances. Compared with perceived behavioral control and subjective norms, we identified attitude as the most influential factor affecting consumers' intention to purchase such appliances. In addition, the consumers' perceived functional value, price value, and environmental value of energy-efficient home appliances significantly and positively affected consumers' attitudes toward purchasing said appliances. However, consumers' emotional value and social value did not significantly affect consumers' purchase attitude, whereas consumers' environmental awareness significantly and positively affected their purchase attitude. Price value exerted the largest effect on attitude, followed by functional value and environmental awareness.

Accordingly, the government should continue putting forth incentives that encourage consumers to purchase energy-efficient home appliances and work with home appliance manufacturers to communicate to consumers the advantage of saving on electricity bills that energy-efficient home appliances have, thereby improving the price value of energy-efficient home appliances perceived by consumers. In addition, these manufacturers should strive to improve the functionality and quality of energy-efficient home appliances, such as quietness and durability, to enhance the consumer-perceived functional value of these home appliances. Moreover, the government should direct consumers' attention toward environmental issues to raise their environmental awareness and thereby boost their positive attitude toward purchasing energy-efficient home appliances.

**Author Contributions:** Conceptualization, C.-C.L.; methodology, C.-C.L.; investigation, C.-C.L.; resources, C.-C.L.; data curation, C.-M.D.; writing—original draft preparation; C.-C.L. writing—review and editing, C.-C.L. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** <https://tinyurl.com/j46f8hj4> (accessed on 18 January 2023).

**Conflicts of Interest:** The authors declare no conflict of interest. <https://tinyurl.com/4unxfj9> (accessed on 18 January 2023).

## Appendix A

Construct	Measurement Items	Sources
Attitude toward purchasing energy-efficient home appliances	<p>AT1: It is a great idea to purchase energy-efficient home appliances because of the numerous benefits they offer.</p> <p>AT2: Purchasing energy-efficient home appliances is a wise choice.</p> <p>AT3: I feel happy when purchasing energy-efficient home appliances because of the numerous benefits they offer.</p>	[15,20]

Construct	Measurement Items	Sources
Subjective norm	<p>SN1: My family or friends think that I should purchase energy-efficient home appliances instead of nonefficient ones.</p> <p>SN2: Most people I care about purchase energy-efficient home appliances instead of nonefficient ones.</p> <p>SN3: People I value think you should buy green products</p>	[15,20]
Perceived behavioral control	<p>PCB1: If I had a choice, I would purchase energy-efficient home appliances over nonefficient ones.</p> <p>PCB2: If I could, I would purchase energy-efficient home appliances instead of nonefficient ones.</p> <p>PCB3: It is mostly up to me whether or not to buy energy-efficient home appliances.</p>	[15,20]
Intention to purchase energy-efficient home appliances	<p>INT1: If I needed to purchase home appliances, I would purchase energy-efficient ones over nonefficient ones.</p> <p>INT2: I plan to purchase energy-efficient home appliances in the near future.</p> <p>INT3: If given the opportunity in the future, I would be willing to try to purchase energy-efficient home appliances.</p>	[15,20]
Functional value	<p>FV1: Energy-efficient home appliances feature advanced technology.</p> <p>FV2: Energy-efficient home appliances boast stable quality.</p> <p>FV3: Energy-efficient home appliances possess efficient functions.</p> <p>FV4: Energy-efficient home appliances are well made.</p>	[13,33,36]
Price value	<p>PV1: Energy-efficient home appliances save electricity costs.</p> <p>PV2: Energy-efficient home appliances are reasonably priced.</p> <p>PV3: You can apply for tax returns or government subsidies when purchasing energy-efficient home appliances, rendering them a great bargain.</p>	[13,32,36,41–43]
Emotional value	<p>EMV1: Buying energy-efficient home appliances brings more joy to me than buying regular home appliances does.</p> <p>EMV2: Buying energy-efficient home appliances rather than regular home appliances makes me feel like a better person.</p> <p>EMV3: Buying energy-efficient home appliances rather than regular home appliances makes me feel like I am contributing to something good.</p>	[32,33,36,43,44,80–82]
Social value	<p>SV1: Buying energy-efficient home appliances leaves a good impression on others.</p> <p>SV2: Buying energy-efficient home appliances enables me to feel recognized by others.</p> <p>SV3: Buying energy-efficient home appliances helps me create a positive image in my peer groups.</p>	[33,40,47,48,82,83]
Environmental value	<p>EV1: Using energy-efficient home appliances helps alleviate energy shortages.</p> <p>EV2: Using energy-efficient home appliances helps reduce carbon emissions.</p> <p>EV3: Using energy-efficient home appliances helps mitigate global warming problems.</p>	[13,49,50]
Environmental awareness	<p>EA1: I am concerned about energy shortage issues.</p> <p>EA2: I am concerned about carbon emission issues.</p> <p>EA3: I am concerned about climate change issues.</p> <p>EA4: I am willing to protect the environment to the best of my ability.</p>	[18,56,84]

## References

- Jean-Baptiste, P.; Ducroux, R. Energy policy and climate change. *Energy Policy* **2003**, *31*, 155–166. [[CrossRef](#)]
- Kardooni, R.; Yusoff, S.B.; Kari, F.B.; Moeenizadeh, L. Public opinion on renewable energy technologies and climate change in Peninsular Malaysia. *Renew. Energy* **2018**, *116*, 659–668. [[CrossRef](#)]
- Tsai, W.-T. Energy sustainability from analysis of sustainable development indicators: A case study in Taiwan. *Renew. Sustain. Energy Rev.* **2010**, *14*, 2131–2138. [[CrossRef](#)]

4. Moiceanu, G.; Dinca, M.N. Climate Change-Greenhouse Gas Emissions Analysis and Forecast in Romania. *Sustainability* **2021**, *13*, 12186. [[CrossRef](#)]
5. Manabe, S. Role of greenhouse gas in climate change. *Tellus A Dyn. Meteorol. Oceanogr.* **2019**, *71*, 1620078. [[CrossRef](#)]
6. Carrus, G.; Tiberio, L.; Mastandrea, S.; Chokrai, P.; Fritsche, I.; Kloeckner, C.A.; Masson, T.; Vesely, S.; Panno, A. Psychological predictors of energy saving behavior: A meta-analytic approach. *Front. Psychol.* **2021**, *12*, 648221. [[CrossRef](#)]
7. Ang, J.B. CO<sub>2</sub> emissions, energy consumption, and output in France. *Energy Policy* **2007**, *35*, 4772–4778. [[CrossRef](#)]
8. Bergquist, P.; Konisky, D.M.; Kotcher, J. Energy policy and public opinion: Patterns, trends and future directions. *Prog. Energy* **2020**, *2*, 032003. [[CrossRef](#)]
9. Abbas, S.Z.; Kousar, A.; Razaq, S.; Saeed, A.; Alam, M.; Mahmood, A. Energy management in South Asia. *Energy Strategy Rev.* **2018**, *21*, 25–34. [[CrossRef](#)]
10. Chen, W.-M.; Kim, H.; Yamaguchi, H. Renewable energy in eastern Asia: Renewable energy policy review and comparative SWOT analysis for promoting renewable energy in Japan, South Korea, and Taiwan. *Energy Policy* **2014**, *74*, 319–329. [[CrossRef](#)]
11. Lin, S.J.; Lu, I.J.; Lewis, C. Grey relation performance correlations among economics, energy use and carbon dioxide emission in Taiwan. *Energy Policy* **2007**, *35*, 1948–1955. [[CrossRef](#)]
12. Lin, M.-X.; Liou, H.M.; Chou, K.T. National energy transition framework toward SDG7 with legal reforms and policy bundles: The case of Taiwan and its comparison with Japan. *Energies* **2020**, *13*, 1387. [[CrossRef](#)]
13. Zhang, Y.; Xiao, C.; Zhou, G. Willingness to pay a price premium for energy-saving appliances: Role of perceived value and energy efficiency labeling. *J. Clean. Prod.* **2020**, *242*, 118555. [[CrossRef](#)]
14. Chen, Y.-T. The factors affecting electricity consumption and the consumption characteristics in the residential sector—A case example of Taiwan. *Sustainability* **2017**, *9*, 1484. [[CrossRef](#)]
15. Zhao, C.; Zhang, M.; Wang, W. Exploring the influence of severe haze pollution on residents' intention to purchase energy-saving appliances. *J. Clean. Prod.* **2019**, *212*, 1536–1543. [[CrossRef](#)]
16. Apipuchayakul, N.; Vassanadumrongdee, S. Factors affecting the consumption of energy-efficient lighting products: Exploring purchase behaviors of Thai consumers. *Sustainability* **2020**, *12*, 4887. [[CrossRef](#)]
17. Gaspar, R.; Antunes, D. Energy efficiency and appliance purchases in Europe: Consumer profiles and choice determinants. *Energy Policy* **2011**, *39*, 7335–7346. [[CrossRef](#)]
18. Xu, X.; Wang, S.; Yu, Y. Consumer's intention to purchase green furniture: Do health consciousness and environmental awareness matter? *Sci. Total Environ.* **2020**, *704*, 135275. [[CrossRef](#)]
19. Gulzari, A.; Wang, Y.; Prybutok, V. A green experience with eco-friendly cars: A young consumer electric vehicle rental behavioral model. *J. Retail. Consum. Serv.* **2022**, *65*, 102877. [[CrossRef](#)]
20. Kim, Y.G.; Woo, E.; Nam, J. Sharing economy perspective on an integrative framework of the NAM and TPB. *Int. J. Hosp. Manag.* **2018**, *72*, 109–117. [[CrossRef](#)]
21. Nugroho, A.; Najib, M.; Simanjuntak, M. Factors affecting consumer interest in electronic money usage with Theory of Planned Behavior (TPB). *J. Consum. Sci.* **2018**, *3*, 15–27. [[CrossRef](#)]
22. Fishbein, M.; Ajzen, I. Belief, attitude, intention, and behavior: An introduction to theory and research. *Philos. Rhetor.* **1977**, *10*, 130–132.
23. Park, E.; Kwon, S.J. What motivations drive sustainable energy-saving behavior?: An examination in South Korea. *Renew. Sustain. Energy Rev.* **2017**, *79*, 494–502. [[CrossRef](#)]
24. Ajzen, I. From intentions to actions: A theory of planned behavior. In *Action Control*; Springer: Berlin/Heidelberg, Germany, 1985; pp. 11–39.
25. Dutta, B.; Hwang, H.-G. Consumers Purchase Intentions of Green Electric Vehicles: The Influence of Consumers Technological and Environmental Considerations. *Sustainability* **2021**, *13*, 12025. [[CrossRef](#)]
26. Gunawan, I.; Redi, A.A.N.P.; Santosa, A.A.; Maghfiroh, M.F.N.; Pandyaswargo, A.H.; Kurniawan, A.C. Determinants of Customer Intentions to Use Electric Vehicle in Indonesia: An Integrated Model Analysis. *Sustainability* **2022**, *14*, 1972. [[CrossRef](#)]
27. Zeynalova, Z.; Namazova, N. Revealing Consumer Behavior toward Green Consumption. *Sustainability* **2022**, *14*, 5806. [[CrossRef](#)]
28. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [[CrossRef](#)]
29. Ajzen, I. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *J. Appl. Soc. Psychol.* **2002**, *32*, 665–683. [[CrossRef](#)]
30. Lee, M.-C. Factors influencing the adoption of internet banking: An integration of TAM and TPB with perceived risk and perceived benefit. *Electron. Commer. Res. Appl.* **2009**, *8*, 130–141. [[CrossRef](#)]
31. Zeithaml, V.A. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *J. Mark.* **1988**, *52*, 2–22. [[CrossRef](#)]
32. Sweeney, J.C.; Soutar, G.N. Consumer perceived value: The development of a multiple item scale. *J. Retail.* **2001**, *77*, 203–220. [[CrossRef](#)]
33. Sheth, J.N.; Newman, B.I.; Gross, B.L. Why we buy what we buy: A theory of consumption values. *J. Bus. Res.* **1991**, *22*, 159–170. [[CrossRef](#)]
34. Zahedi, S.; Batista-Foguet, J.M.; van Wunnik, L. Exploring the public's willingness to reduce air pollution and greenhouse gas emissions from private road transport in Catalonia. *Sci. Total Environ.* **2019**, *646*, 850–861. [[CrossRef](#)]

35. Ru, X.; Qin, H.; Wang, S. Young people's behaviour intentions towards reducing PM<sub>2.5</sub> in China: Extending the theory of planned behaviour. *Resour. Conserv. Recycl.* **2019**, *141*, 99–108. [[CrossRef](#)]
36. Joshi, Y.; Uniyal, D.P.; Sangroya, D. Investigating consumers' green purchase intention: Examining the role of economic value, emotional value and perceived marketplace influence. *J. Clean. Prod.* **2021**, *328*, 129638. [[CrossRef](#)]
37. Ajzen, I.; Fishbein, M. *Understanding Attitudes and Predicting Social Behavior*; Prentice-Hall: Englewood Cliffs, NJ, USA, 1980.
38. Wang, S.; Fan, J.; Zhao, D.; Yang, S.; Fu, Y. Predicting consumers' intention to adopt hybrid electric vehicles: Using an extended version of the theory of planned behavior model. *Transportation* **2016**, *43*, 123–143. [[CrossRef](#)]
39. Ling, H.-C.; Chen, H.-R.; Ho, K.K.W.; Hsiao, K.-L. Exploring the factors affecting customers' intention to purchase a smart speaker. *J. Retail. Consum. Serv.* **2021**, *59*, 102331. [[CrossRef](#)]
40. Danish, M.; Ali, S.; Ahmad, M.A.; Zahid, H. The influencing factors on choice behavior regarding green electronic products: Based on the green perceived value model. *Economies* **2019**, *7*, 99. [[CrossRef](#)]
41. Vafaei-Zadeh, A.; Wong, T.-K.; Hanifah, H.; Teoh, A.P.; Nawaser, K. Modelling electric vehicle purchase intention among generation Y consumers in Malaysia. *Res. Transp. Bus. Manag.* **2022**, *43*, 100784. [[CrossRef](#)]
42. Lau, L.-S.; Choong, Y.-O.; Wei, C.-Y.; Seow, A.-N.; Choong, C.-K.; Senadjki, A.; Ching, S.-L. Investigating nonusers' behavioural intention towards solar photovoltaic technology in Malaysia: The role of knowledge transmission and price value. *Energy Policy* **2020**, *144*, 111651. [[CrossRef](#)]
43. Teoh, C.W.; Mohd Noor, N.A. What affects Malaysian consumers' intention to purchase hybrid car? *Asian Soc. Sci.* **2015**, *11*, 11–26. [[CrossRef](#)]
44. Kim, M.-K.; Oh, J.; Park, J.-H.; Joo, C. Perceived value and adoption intention for electric vehicles in Korea: Moderating effects of environmental traits and government supports. *Energy* **2018**, *159*, 799–809. [[CrossRef](#)]
45. Biswas, A.; Roy, M. Green products: An exploratory study on the consumer behaviour in emerging economies of the East. *J. Clean. Prod.* **2015**, *87*, 463–468. [[CrossRef](#)]
46. Mahadin, B. Factors affecting customer switching behavior towards hybrid electrical vehicles (HEV's) from a customer perspective in Jordan. *Eur. J. Mark. Econ.* **2018**, *1*, 53–65. [[CrossRef](#)]
47. Suphasomboon, T.; Vassanadumrongdee, S. Toward sustainable consumption of green cosmetics and personal care products: The role of perceived value and ethical concern. *Sustain. Prod. Consum.* **2022**, *33*, 230–243. [[CrossRef](#)]
48. Doszhanov, A.; Ahmad, Z.A. Customers' intention to use green products: The impact of green brand dimensions and green perceived value. *SHS Web Conf.* **2015**, *18*, 01008. [[CrossRef](#)]
49. Bolden, J.; Abu-Lebdeh, T.; Fini, E. Utilization of recycled and waste materials in various construction applications. *Am. J. Environ. Sci.* **2013**, *9*, 14–24. [[CrossRef](#)]
50. Ding, Z.; Nie, W.; Wu, H. Investigating the connection between stakeholders' purchase intention and perceived value of construction and demolition waste recycled products. *Environ. Dev. Sustain.* **2022**, *24*, 9285–9303. [[CrossRef](#)]
51. Lillemo, S.C. Measuring the effect of procrastination and environmental awareness on households' energy-saving behaviours: An empirical approach. *Energy Policy* **2014**, *66*, 249–256. [[CrossRef](#)]
52. Mei, N.S.; Wai, C.W.; Ahamad, R. Environmental Awareness and Behaviour Index for Malaysia. *Procedia-Soc. Behav. Sci.* **2016**, *222*, 668–675. [[CrossRef](#)]
53. Kong, D.; Ytrehus, E.; Hvatum, A.J.; Lin, H. Survey on environmental awareness of Shanghai college students. *Environ. Sci. Pollut. Res.* **2014**, *21*, 13672–13683. [[CrossRef](#)] [[PubMed](#)]
54. Hoque, F.; Yasin, R.M.; Sopian, K. Revisiting Education for Sustainable Development: Methods to Inspire Secondary School Students toward Renewable Energy. *Sustainability* **2022**, *14*, 8296. [[CrossRef](#)]
55. Shutaleva, A.; Martyushev, N.; Nikonova, Z.; Savchenko, I.; Abramova, S.; Lubimova, V.; Novgorodtseva, A. Environmental Behavior of Youth and Sustainable Development. *Sustainability* **2022**, *14*, 250. [[CrossRef](#)]
56. De Groot, J.; Steg, L. General Beliefs and the Theory of Planned Behavior: The Role of Environmental Concerns in the TPB. *J. Appl. Soc. Psychol.* **2007**, *37*, 1817–1836. [[CrossRef](#)]
57. Boomsma, A. The robustness of LISREL against small sample sizes in factor analysis models. *Syst. Under Indirect Obs. Causality Struct. Predict.* **1982**, *1*, 149–173.
58. Nunnally, J. *Psychometric Methods*; McGraw-Hill: New York, NY, USA, 1967.
59. Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.-Y.; Podsakoff, N.P. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **2003**, *88*, 879. [[CrossRef](#)]
60. Yu-Yuan, C. Taiwan Home Appliance Consumer Reports. *Ind. Technol.* **2021**, *352*, 36–37. (In Chinese)
61. Ramayah, T.; Cheah, J.; Chuah, F.; Ting, H.; Memon, M.A. *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using smartPLS 3.0: An Updated Guide and Practical Guide to Statistical Analysis*, 2nd ed.; Pearson: Kuala Lumpur, Malaysia, 2018.
62. Hair, J.F.; Risher, J.J.; Sarstedt, M.; Ringle, C.M. When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* **2019**, *31*, 2–24. [[CrossRef](#)]
63. Sarstedt, M.; Ringle, C.M.; Hair, J.F. Partial least squares structural equation modeling. In *Handbook of Market Research*; Springer: Berlin/Heidelberg, Germany, 2021; pp. 587–632.
64. Straub, D.; Boudreau, M.-C.; Gefen, D. Validation guidelines for IS positivist research. *Commun. Assoc. Inf. Syst.* **2004**, *13*, 24. [[CrossRef](#)]

65. Anderson, J.C.; Gerbing, D.W. Structural equation modeling in practice: A review and recommended two-step approach. *Psychol. Bull.* **1988**, *103*, 411. [[CrossRef](#)]
66. Hair Jr, J.F.; Sarstedt, M.; Hopkins, L.; Kuppelwieser, V.G. Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *Eur. Bus. Rev.* **2014**, *26*, 106–121. [[CrossRef](#)]
67. Fornell, C.; Larcker, D.F. *Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics*; Sage Publications Sage CA: Los Angeles, CA, USA, 1981.
68. Bagozzi, R.P.; Yi, Y. On the evaluation of structural equation models. *J. Acad. Mark. Sci.* **1988**, *16*, 74–94. [[CrossRef](#)]
69. Ab Hamid, M.R.; Sami, W.; Mohamad Sidek, M.H. Discriminant Validity Assessment: Use of Fornell & Larcker criterion versus HTMT Criterion. *J. Phys. Conf. Ser.* **2017**, *890*, 012163. [[CrossRef](#)]
70. Sarstedt, M.; Hair Jr, J.F.; Cheah, J.-H.; Becker, J.-M.; Ringle, C.M. How to specify, estimate, and validate higher-order constructs in PLS-SEM. *Australas. Mark. J. (AMJ)* **2019**, *27*, 197–211. [[CrossRef](#)]
71. Ulusoy, E.; Barretta, P.G. How green are you, really? Consumers' skepticism toward brands with green claims. *J. Glob. Responsib.* **2016**, *7*, 72–83. [[CrossRef](#)]
72. Wu, K.-Y.; Huang, Y.-H.; Wu, J.-H. Impact of electricity shortages during energy transitions in Taiwan. *Energy* **2018**, *151*, 622–632. [[CrossRef](#)]
73. Wen, L.-C.; Lin, J.-S. Green energy policy with rising oil and electricity prices. *Econ. Outlook Q.* **2012**, *141*, 15–18. (In Chinese) [[CrossRef](#)]
74. Chen, J.-Y. Household Energy Equipment and Appliances: Replacement Evaluation and Influence Correlation with Energy Label. *Bull. China Jr. Coll. Med. Technol.* **2019**, *51*, 1–15. (In Chinese)
75. Suki, N.M. Consumer environmental concern and green product purchase in Malaysia: Structural effects of consumption values. *J. Clean. Prod.* **2016**, *132*, 204–214. [[CrossRef](#)]
76. Khan, S.N.; Mohsin, M. The power of emotional value: Exploring the effects of values on green product consumer choice behavior. *J. Clean. Prod.* **2017**, *150*, 65–74. [[CrossRef](#)]
77. Liu, P.; Segovia, M.; Tse, E.C.-Y.; Nayga, R.M. Become an environmentally responsible customer by choosing low-carbon footprint products at restaurants: Integrating the elaboration likelihood model (ELM) and the theory of planned behavior (TPB). *J. Hosp. Tour. Manag.* **2022**, *52*, 346–355. [[CrossRef](#)]
78. Yadav, R.; Pathak, G.S. Determinants of consumers' green purchase behavior in a developing nation: Applying and extending the theory of planned behavior. *Ecol. Econ.* **2017**, *134*, 114–122. [[CrossRef](#)]
79. Han, H.; Hsu, L.T.; Sheu, C. Application of the Theory of Planned Behavior to green hotel choice: Testing the effect of environmental friendly activities. *Tour. Manag.* **2010**, *31*, 325–334. [[CrossRef](#)]
80. Woo, E.; Kim, Y.G. Consumer attitudes and buying behavior for green food products. *Br. Food J.* **2019**, *121*, 320–332. [[CrossRef](#)]
81. Biswas, A.; Roy, M. Leveraging factors for sustained green consumption behavior based on consumption value perceptions: Testing the structural model. *J. Clean. Prod.* **2015**, *95*, 332–340. [[CrossRef](#)]
82. Smith, J.R.; McSweeney, A. Charitable giving: The effectiveness of a revised theory of planned behaviour model in predicting donating intentions and behaviour. *J. Community Appl. Soc. Psychol.* **2007**, *17*, 363–386. [[CrossRef](#)]
83. Shin, Y.H.; Im, J.; Jung, S.E.; Severt, K. Motivations behind Consumers' Organic Menu Choices: The Role of Environmental Concern, Social Value, and Health Consciousness. *J. Qual. Assur. Hosp. Tour.* **2019**, *20*, 107–122. [[CrossRef](#)]
84. Xu, L.; Prybutok, V.; Blankson, C. An environmental awareness purchasing intention model. *Ind. Manag. Data Syst.* **2018**, *119*, 367–381. [[CrossRef](#)]

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.