



## Research Article

# A Dual-Theory Mediation Approach to Sustainable Behavior in the Context of Energy-Efficient Consumption

Yusra Memon<sup>1\*</sup> | Syed Zaheer Bukhari<sup>2</sup>

### Authors Information

<sup>1</sup>Department of Management Sciences,  
Virtual University of Pakistan, Islamabad,  
Pakistan  
Email: yusrajamil24@gmail.com

<sup>2</sup>Mehran University of Engineering and  
Technology, Jamshoro, Sindh, Pakistan  
Email: zaheer.bukhari@outlook.com

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The authors have professed no conflicts of interest regarding the research, authorship, and paper publication.

### Abstract

Growing environmental concerns have intensified the need to understand the psychological factors driving consumers' adoption of energy-efficient appliances. This study develops an integrated behavioral framework by combining the value-belief-norm theory with the theory of planned behavior to explain consumers' purchase intentions in Pakistan. Using survey data collected from 500 consumers and examined through structural equation modeling. The findings reveal that attitude is the strongest predictor of purchase intention, whereas perceived behavioral control and subjective norms do not exert significant effects. In contrast, the value-belief-norm framework receives substantial empirical support, demonstrating that biospheric and altruistic values enhance awareness of environmental consequences, which subsequently strengthens ascription of responsibility and personal norms, ultimately fostering consumers' intentions to purchase energy-efficient appliances. These findings suggest that moral and value-driven considerations provide greater explanatory power than social influence and perceived behavioral control in this context. Moreover, this study extends existing knowledge on sustainable consumption and offers a more comprehensive understanding of pro-environmental purchase intentions in an emerging market. The findings provide valuable implications for policymakers, marketers, and manufacturers seeking to accelerate the adoption of energy-efficient appliances through strategies that strengthen environmental awareness, personal responsibility, and value-based consumer engagement.

**Keywords:** Energy-efficient appliances; Purchase intention; Sustainable consumption; Value-belief-norm theory; Theory of planned behavior; Consumer behavior; Green marketing; Pakistan.

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## 1 INTRODUCTION

Environmental sustainability has become one of the defining global challenges of the twenty-first century, with rising energy consumption placing increasing pressure on natural resources and accelerating greenhouse gas emissions (Makki & Mosly, 2020; Achuo, 2022; Meng et al., 2018). Improving energy efficiency has therefore emerged as an essential strategy for reducing carbon emissions while supporting sustainable development. Tan et al. (2018) identify two complementary approaches to reducing household energy consumption: encouraging consumers to use existing electrical appliances more efficiently and promoting the adoption of energy-efficient appliances (EEAs). Although both approaches contribute to sustainable energy use, increasing consumer adoption of EEAs offers substantial long-term environmental benefits by reducing household energy demand and improving overall energy efficiency.

Over the past decade, growing scholarly attention has been devoted to understanding consumers' intentions to purchase energy-efficient appliances. Existing studies have primarily been conducted in developed economies, including the United Kingdom, Australia, the Netherlands, Switzerland, the United States, and Germany (Ek & Söderholm, 2010; Özkan, Alola, & Adebayo, 2023), while evidence from developing countries has focused mainly on China, Malaysia, South Korea, Vietnam, and India (Zhang et al., 2021). More recent research also continues to emphasize the importance of understanding consumer decision-making in the adoption of energy-efficient appliances, particularly in emerging markets where energy demand is increasing rapidly (Puspanathan & Mohd Suki, 2025; Nguyen, 2025). Nevertheless, empirical evidence from Pakistan remains relatively limited despite the country's growing energy challenges and increasing policy emphasis on sustainable consumption. Previous studies have largely examined consumers' purchase intentions through cognitive and rational perspectives, focusing on factors such as attitudes, beliefs, perceived behavioral control, and subjective norms (Waris & Hameed, 2020; Zhang et al., 2020; Koon, Chan, & Sharma, 2020). While these factors explain an important part of consumer decision-making, they provide only a partial understanding of pro-environmental behavior. Recent studies have increasingly suggested that moral values, environmental responsibility, and personal norms play an equally important role in shaping sustainable consumption decisions, indicating the need for more comprehensive behavioral frameworks that combine rational and ethical motivations.

Among the most influential behavioral theories, the theory of planned behavior (TPB) (Ajzen, 1991) explains behavioral intention through attitude, subjective norms, and perceived behavioral control, whereas the value-belief-norm theory (Stern et al., 1999) emphasizes the role of environmental values, awareness of consequences, ascription of responsibility, and personal norms in motivating pro-environmental behavior. Although both theories have independently demonstrated strong explanatory power, relatively few studies have integrated these complementary perspectives to explain consumers' intentions to purchase energy-efficient appliances, particularly within the context of developing economies such as Pakistan. Consequently, important questions remain regarding how rational evaluations and moral obligations jointly influence consumers' purchasing decisions. To address this gap, the present study develops an integrated behavioral framework by combining the TPB with the value-belief-norm theory to examine consumers' intentions to purchase energy-efficient appliances in Pakistan. Specifically, the study investigates how environmental values activate awareness of environmental consequences and personal moral obligations while simultaneously considering the influence of attitude, subjective norms, and perceived behavioral control on purchase intention. By integrating these two complementary perspectives, the study provides a more comprehensive explanation of consumers' pro-environmental purchasing decisions than either framework alone.

This study makes three important contributions. First, it extends the existing literature by integrating rational and value-based determinants into a unified behavioral model for explaining consumers' intentions to purchase energy-efficient appliances. Second, it provides empirical evidence from Pakistan, an emerging economy that remains underrepresented in the sustainable consumption literature despite facing significant energy and environmental challenges. Finally, the findings generate practical insights for policymakers, marketers, and manufacturers by identifying the psychological mechanisms that encourage the adoption of energy-efficient appliances, thereby supporting the achievement of the United Nations Sustainable Development Goals, particularly Goal 7 (Affordable and Clean Energy) and Goal 12 (Responsible Consumption and Production).

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 describes the research methodology, followed by the presentation of the empirical findings in Section 4. Section 5 discusses the results, outlines the theoretical and practical implications, and Section 6 concludes with the study's limitations and directions for future research.

## 2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

TPB has constantly established its worth in explanation and prediction of behaviors in a variety of backgrounds, counting substance utilization, recycling, transportation decisions, technology acceptance, and concern associated to privacy (Hirschey et al., 2021; McDermott et al., 2015). Lately, TPB has achieved extensive acknowledgment as a foremost frame to understand pro-environmental behaviors. It has been resourcefully used in areas similar to recycling (Echegaray & Hansstein, 2017; Cantaragiu & Ghinea, 2020), sustainable customer decision (Pop et al., 2022), and acquisition of energy-efficient appliances (Waris & Hameed, 2020; Waris, Hameed & Ali (2023)). VBN theory has emerged as a modern and significant model to inspect pro-environmental behavior (Özekici, 2022). VBN is established on the average that individuals may choose ecological behaviors even when these actions are not cost-driven (Wang et al., 2024). The research by Han et al., (2019) and Wang et al., (2024) have validated the VBN model's predictive ability and exposed that, contrast to TPB, it is mainly efficient in explanation of intentions and behaviors linked to low-cost environmental acts (Wang et al., 2023).

### 2.1 Biospheric Values and Awareness of Consequences

The theoretical frameworks (Stern & Dietz, 1995; De Groot & Steg, 2009) emphasize that pro-environmental behavior is essentially determined by biospheric values. These values serve to be the support for a widespread compilation of environmentally aware actions, akin to energy conservation decisions (Steg et al., 2006; Abrahamse & Steg, 2011; Fornara et al., 2016), urban transport option (Lind et al., 2015), plan to protect biodiversity and ecosystems (Fornara et al., 2016), altercation to nuclear weapons (Prati & Zani, 2013), and eco-friendly behavior by tourist at natural site (Zhang et al., 2014). These biospheric values have a significant division in determining personal norms, which then direct persons to engaging in pro-environmental behaviors (Ozekici, 2022). Making this understanding a base, the subsequent hypothesis is recommended:

*H1: Biospheric values have a positive and significant effect on awareness of consequences.*

### 2.2 Altruistic Values and Awareness of Consequences

Aguilar-Luzon et al. (2012) and Stern (2000) explain VBN theory as a structured model demonstrating how personal values like altruistic, biospheric, and egoistic orientations influence beliefs similar to awareness of consequences and ascription of responsibility, and personal norms that replicate internalized social expectations. These mechanisms are connected in a chronological chain that eventually drives behavioral intentions and actions. According to this structure, values persuade an individual's environmental view, which next shape personal norms vital predictor of equally intentions and environmentally responsible behaviors. These chains as well elevate one's feeling to environmental damage and support way of thinking of personal responsibility (Wynveen, Wynveen, & Sutton, 2015). Previous study has constantly confirmed that altruistic values have a positive impact on a person's awareness of environmental costs and their readiness to believe liability for tackling them (Han, 2015; Han et al., 2020; Park et al., 2022). Subsequent hypothesis is recommended:

*H2: Altruistic values have a positive and significant impact on awareness of consequences.*

### 2.3 Egoistic Values and Awareness of Consequences

Egoistic values give priority to person's welfare more than communal or group concern (Stern, 2000). Higher levels of environmental awareness, combined with strong egoistic values, have been linked to tourists' intentions to make a stay at green places that are environment friendly and have shown a positive impact on pro-environmental behaviors among travelers (Sharma & Gupta, 2020; Ghazali, Nguyen, Mutum, & Yap, 2019; Verma, Chandra, & Kumar, 2019). While some studies, such as Yeboah & Kaplowitz (2016), indicate that egoistic values negatively affect awareness of environmental consequences, other research, including Ciocirlan, Gregory-Smith, Manika, & Wells (2020), has found a positive and significant relationship between egoistic values and awareness of consequences. Considering these mixed findings, the research proposes the following hypothesis:

*H3: Egoistic values have a positive and significant impact on awareness of consequences.*

### 2.4 Materialistic Values and Awareness of Consequences

Materialistic values mirror the significance individuals place on acquiring property and their preference for material goods over other aspects of life (Richins, 2011). According to Gomes et al. (2022), when controlling for awareness of consequences and other relevant variables, materialistic, biospheric, altruistic, and egoistic values did not

show a significant association with the ascription of responsibility. Likewise, no major association was found between these value types and personal norms once other factors were accounted for. However, the findings suggest that materialistic values may influence how individuals perceive the consequences of their actions. Based on this understanding, the subsequent hypothesis is projected:

*H4: Materialistic values have a positive and significant impact on awareness of consequences.*

## 2.5 Attitude and Purchase Intention

TPB proposes that behavioral intentions are formed via three center elements: attitude for the behavior, subjective norms (apparent social pressure), and perceived behavioral control. These intentions are main variables to predict actual behavior (Beck & Ajzen, 1991; Verma & Chandra, 2018). Nevertheless, some scholars have questioned the strength of the relationship between attitudes and energy-efficient behavior, noting inconsistencies in this link (Tan, Ooi, & Goh, 2017; Abrahamse & Steg, 2009). However, the wide body of literature continue to aid a positive relationship between pro-environmental attitudes and the intention to purchase energy-efficient appliances (EEAs). Grounded on this, the resulting hypothesis is recommended:

*H5: Attitude has a positive influence on the intention to purchase EEAs.*

## 2.6 Subjective Norm and Intention

Preceding research has painted subjective norms as a significant factor of consumers' intentions to purchase energy-efficient appliances (EEAs) (Ha & Janda, 2012; Hori, Kondo, Nogata, & Ben, 2013). Likewise, Harjadi and Gunardi (2022) reports that social pressure has an optimistic role to determine intentions to purchase environment friendly products. Dating back to the 1980s, work has constantly associated subjective norms to energy conservation, putting emphasize on their significance in promotion of energy-efficient behaviors (Midden & Ritsema, 1983). Built on this evidence, the subsequent hypothesis is proposed:

*H6: Subjective norms have a positive influence on the intention to purchase EEAs.*

## 2.7 Perceived Behavioural Control and Intention

Lin and Dong (2023) establish those consumers' attitudes, their perceived control over the behavior, and social pressure all has an important and positive impact on their intention to purchase energy-efficient appliances. In environmental research, PBC is likewise inspected as the perceived rank of complexity or easiness in executing a specific behavior (Bamberg et al., 2007). Mamun et al. (2024) emphasize that PBC has a serious role in shaping both behavioral intentions and real behavior. Based on representation from this body of literature, the following hypothesis is proposed:

*H7: Perceived behavioral control positively influences the intention to purchase EEAs.*

## 2.8 Awareness of Consequences and Ascription of Responsibility

Psychological research has long recommended that when a person feels a sense of accountability, their consciousness of pessimistic outcome frequently prompt them to take remedial action (Sogin & Pallak, 1976). Highlighting the potential negative consequences and linking them to personal responsibility is, therefore, particularly impactful. According to Gao, Huang, and Zhang (2017), pro-environmental or prosocial behavior is likely to occur when individuals recognize the harmful impact their acts might have on others or the environment (awareness of consequences) and take accountability for those effects (ascription of responsibility). Likewise, understanding prospective concerns improves an individual's sense of responsibility, guiding to more accountable selections like choosing organic food (Shin et al., 2018). In this framework, the existing study examines the mediating relationship between these factors in the intention to purchase energy-efficient appliances (EEAs).

*H8: Awareness of consequences positively and significantly influences the ascription of responsibility*

## 2.9 Ascription of Responsibility and Personal Norms

Wang et al. (2023) explain that the Value-Belief-Norm (VBN) theory identifies personal norms shaped simultaneously by a person's values and beliefs as key determinants of pro-environmental behavior. These norms imitate a person's internalized logic of responsibility to involve in environmentally responsible actions (Fauzi et al., 2024) and are strongly affected by one's perceived obligations or responsibilities (Sia & Jose, 2019). In addition, people perspective

on environmental problems recognizes that an individual's deed can create either positive or negative outcome are formed by their altruistic, biospheric, and egoistic values (Özekici, 2022). Centered on this understanding, the subsequent hypothesis is proposed:

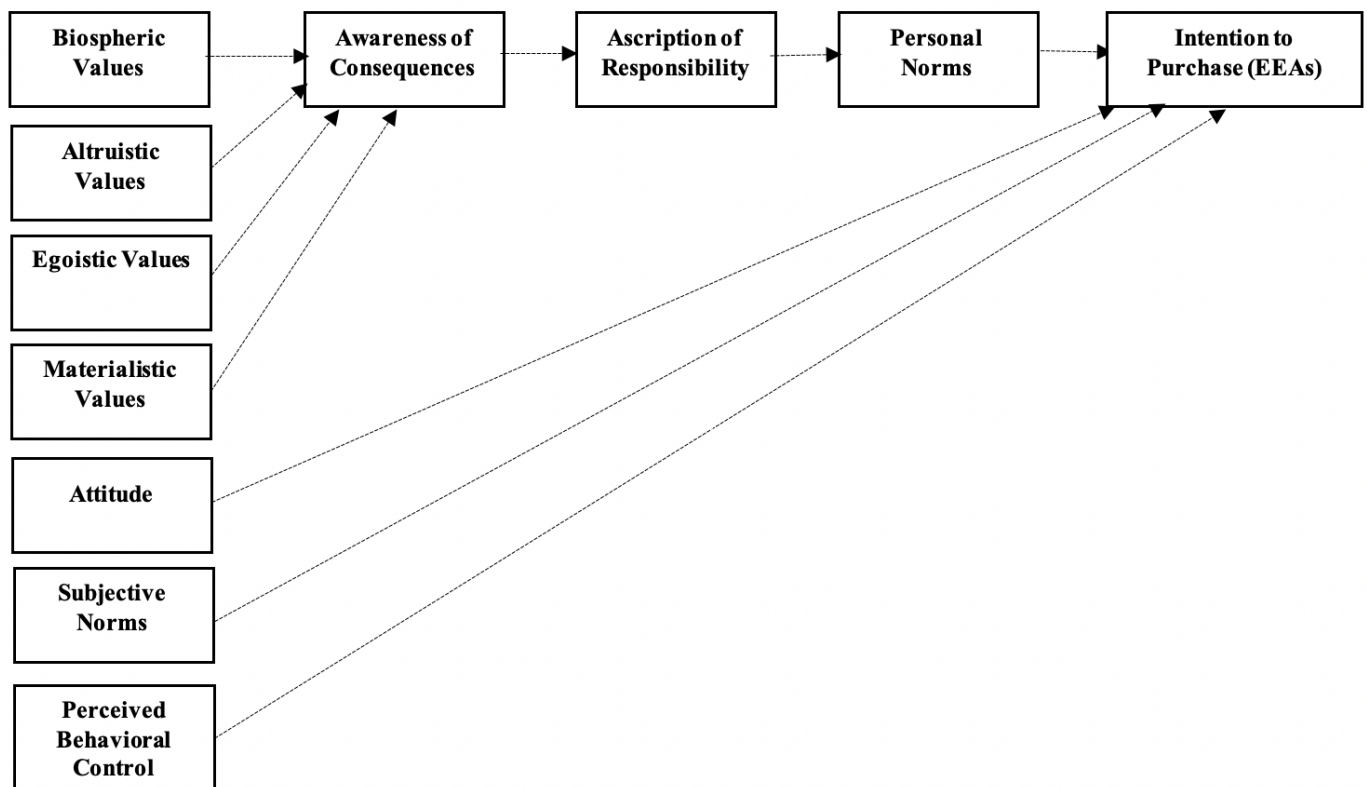
*H9: Ascription of responsibility has a positive and significant influence on personal norms.*

## 2.10 Personal Norms and Intention to Purchase EEAs

The VBN theory recommends that altruistic, biospheric, and egoistic or collectivistic values form individual environmental beliefs, which then impact their personal norms and compel pro-environmental intentions (Özekici, 2022). As per VBN, personal norms act as the most instant and dominant forecaster of environmentally mindful behavior (Wang et al., 2023). These norms are formed through the internalization of values and beliefs and reflect a person's moral responsibility to behave in an ecologically responsible way (Han & Hyun, 2018). Based on this theoretical foundation, the resulting hypothesis is proposed:

*H10: Personal norms have a positive influence on the intention to purchase energy-efficient appliances (EEAs).*

Figure 1 presenting the research framework of the study.



**Figure 1.** Proposed Research Model

**Source:** Author's own compilation

## 3 RESEARCH METHODOLOGY

The target population comprised household consumers in Pakistan, as the residential sector represents one of the country's largest consumers of electricity. Energy-efficient household appliances, including refrigerators, washing machines, televisions, and air conditioners, were selected because they account for a substantial share of residential electricity consumption. The study focused on consumers residing in major metropolitan cities, including Karachi, Islamabad, Lahore, Hyderabad, Multan, and Faisalabad, where awareness, availability, and adoption of energy-efficient appliances (EEAs) are relatively higher than in other regions. A convenience sampling technique was employed to collect the data. The sample included both existing users of EEAs and potential consumers intending to purchase such appliances, ensuring that respondents possessed sufficient knowledge and purchase experience to evaluate the study

constructs. Data were collected through both online and face-to-face surveys. After screening for completeness and consistency, a total of 500 valid questionnaires were retained for the final analysis. Consistent with survey research, the respondents served as key informants capable of representing the broader population of household consumers (Lavrakas, 2008).

### 3.1 Measurement of Variables

All constructs were measured using previously validated scales adapted from established studies to ensure content validity. Biospheric values, altruistic values, egoistic values, materialistic values, awareness of consequences, ascription of responsibility, and personal norms were adapted from the value–belief–norm literature (Stern et al., 1999; De Groot & Steg, 2009; Fornara et al., 2016). The constructs of attitude, subjective norms, perceived behavioral control, and purchase intention were measured using scales developed within the theory of planned behavior literature (Ajzen, 1991; Ha & Janda, 2012; Waris & Hameed, 2020). Each construct was measured using four observed items adapted to the context of energy-efficient appliances. A structured questionnaire was developed comprising two sections. The first section collected respondents' demographic information, including age, gender, education, and occupation. The second section measured the latent constructs using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Before the main survey, the questionnaire was reviewed to ensure the clarity, readability, and contextual suitability of the measurement items.

### 3.2 Data Analysis Technique

The data were analyzed using SPSS and AMOS. SPSS was employed for preliminary data screening, descriptive statistics, and reliability assessment. Subsequently, Structural Equation Modeling (SEM) was conducted using AMOS following the two-step procedure recommended by Anderson and Gerbing (1988). First, Confirmatory Factor Analysis (CFA) was performed to evaluate the measurement model by examining reliability, convergent validity, discriminant validity, and overall model fit. Second, the structural model was estimated to test the proposed hypotheses and examine the direct and mediating relationships among the study constructs.

## 4 RESULTS

### 4.1 Profile of Respondents

Table 1 presents the demographic characteristics of the respondents. The majority of participants (56.0%) were between 28 and 43 years of age, followed by those aged 44–59 years (24.4%) and 18–27 years (19.6%). This age distribution suggests that the sample primarily comprises economically active consumers who are more likely to make household purchasing decisions, including the purchase of energy-efficient appliances. The gender distribution was well balanced, with 51.6% male and 48.2% female respondents, indicating that the findings are unlikely to be influenced by gender imbalance. Regarding educational attainment, most respondents possessed a bachelor's degree (33.8%) or a master's degree (51.0%), reflecting a relatively well-educated sample capable of understanding issues related to energy efficiency and sustainable consumption. With respect to occupation, the respondents represented diverse professional backgrounds, including teachers (33.6%), government employees (30.4%), private-sector employees (27.4%), and students (8.6%). This diversity enhances the representativeness of the sample by capturing consumers with different socioeconomic backgrounds and purchasing experiences. Overall, the demographic profile indicates that the sample is appropriate for examining the factors influencing consumers' intentions to purchase energy-efficient appliances in the Pakistani context.

### 4.2 Measurement Model Assessment

Following the two-step approach recommended by Anderson and Gerbing (1988), the measurement model was first evaluated using Confirmatory Factor Analysis (CFA) with the maximum likelihood estimation method. The model comprised 12 latent constructs measured by 48 observed indicators, with each construct represented by four measurement items. Before testing the structural relationships, the measurement model was assessed to establish its overall fit, reliability, and validity. Table 2 presents the goodness-of-fit statistics for the measurement model. The results indicate that the proposed model demonstrates an excellent fit with the observed data. Although the chi-square statistic ( $CMIN = 2005.463$ ,  $DF = 1014$ ) was significant, the chi-square test is known to be sensitive to sample size (Turhan, 2020). Therefore, model adequacy was evaluated using multiple fit indices.

**Table 1.** Respondents profile

Category	Subcategory	n	%
Age Group	18–27	98	19.6
	28–43	280	56.0
	44–59	122	24.4
	Total	500	100.0
Gender	Male	258	51.6
	Female	241	48.2
	Prefer not to say	1	0.2
	Total	500	100.0
Education Level	Intermediate	57	11.4
	Bachelor's	169	33.8
	Master's	255	51.0
	PhD	19	3.8
	Total	500	100.0
Occupation	Teacher	168	33.6
	Student	43	8.6
	Private job	137	27.4
	Government employee	152	30.4
	Total	500	100.0

**Source:** Author's own compilation

The chi-square to degrees of freedom ratio ( $CMIN/DF = 1.978$ ) was below the recommended threshold of 3.0, while the Comparative Fit Index ( $CFI = 0.953$ ), Standardized Root Mean Square Residual ( $SRMR = 0.032$ ), and Root Mean Square Error of Approximation ( $RMSEA = 0.044$ ) all satisfied the recommended cutoff values. In addition, the  $PClose$  value of 1.000 further supports the close fit of the proposed model. All goodness-of-fit indices exceeded the recommended thresholds suggested by Hair et al. (2017), confirming that the measurement model provides a satisfactory representation of the observed data. These results indicate that the proposed measurement model is appropriate for subsequent reliability, validity, and structural model assessments.

**Table 2.** CFA Goodness-of-fit statistics

Measure	Estimate	Threshold	Interpretation
CMIN	2005.463	--	--
DF	1014	--	--
CMIN/DF	1.978	Between 1 and 3	Excellent
CFI	0.953	> 0.95	Excellent
SRMR	0.032	< 0.08	Excellent
RMSEA	0.044	< 0.06	Excellent
$PClose$	1.000	> 0.05	Excellent

**Note.**  $CMIN$  = chi-square value;  $DF$  = degrees of freedom;  $CMIN/DF$  = chi-square divided by degrees of freedom;  $CFI$  = comparative fit index;  $SRMR$  = standardized root mean square residual;  $RMSEA$  = root mean square error of approximation;  $PClose$  = probability of close fit. **Source:** Author's own compilation

Table 3 presents the results of the reliability and validity assessment for all measurement constructs. Internal consistency was first evaluated using Cronbach's alpha and composite reliability (CR). As shown in Table 3, Cronbach's alpha values ranged from 0.912 to 0.946, while composite reliability values ranged from 0.913 to 0.946, exceeding the recommended threshold of 0.70 (Hair et al., 2017). These results confirm satisfactory internal consistency and construct reliability. Convergent validity was assessed using standardized factor loadings and the average variance extracted (AVE). All measurement items exhibited factor loadings greater than 0.80, substantially exceeding the recommended minimum value of 0.50. Likewise, the AVE values ranged from 0.723 to 0.815, well above the threshold of 0.50 suggested by Bagozzi and Yi (1988), indicating that each construct explained a substantial proportion of the variance in its corresponding indicators. Furthermore, all squared multiple correlations (SMCs) exceeded the recommended value of 0.30, providing additional evidence of indicator reliability. The findings demonstrate that the measurement model

possesses satisfactory reliability and convergent validity, supporting the use of these constructs for subsequent discriminant validity assessment and structural model evaluation.

### 4.3 Structural Model Assessment

After establishing the adequacy of the measurement model, the structural model was estimated using the maximum likelihood estimation method to examine the proposed hypotheses. The model demonstrated satisfactory goodness-of-fit, indicating that it was appropriate for evaluating the hypothesized relationships among the study constructs. The results of the hypothesis testing are presented in Table 4. The findings reveal that biospheric values ( $\beta = 0.124$ ,  $p = 0.010$ ) and altruistic values ( $\beta = 0.099$ ,  $p = 0.033$ ) have significant positive effects on awareness of consequences, thereby supporting H1 and H4.

**Table 3.** Construct Reliability and Validity Statistics

Constructs	Scale Items	Factor Loadings	Squared Multiple Correlations (SMC)	Cronbach's Alpha	CR	AVE	AVE <sup>2</sup>
Materialistic Values	MV1	0.876	0.767	0.912	0.913	0.723	0.850
	MV2	0.854	0.730				
	MV3	0.849	0.721				
	MV4	0.821	0.674				
Purchase Intention	PI1	0.879	0.772	0.913	0.913	0.724	0.851
	PI2	0.849	0.720				
	PI3	0.823	0.677				
	PI4	0.853	0.728				
Altruistic Values	AL1	0.977	0.955	0.938	0.939	0.796	0.892
	AL2	0.826	0.683				
	AL3	0.863	0.744				
	AL4	0.895	0.801				
Attitude	ATT1	0.888	0.788	0.938	0.938	0.791	0.890
	ATT2	0.913	0.834				
	ATT3	0.877	0.768				
	ATT4	0.880	0.775				
Egoistic Values	EG1	0.958	0.917	0.934	0.935	0.782	0.885
	EG2	0.866	0.750				
	EG3	0.869	0.755				
	EG4	0.841	0.707				
Perceived Behavioral Control	PBC1	0.886	0.784	0.930	0.930	0.769	0.877
	PBC2	0.858	0.736				
	PBC3	0.873	0.762				
	PBC4	0.890	0.792				
Awareness of Consequences	AOC1	0.880	0.774	0.933	0.933	0.777	0.881
	AOC2	0.868	0.754				
	AOC3	0.866	0.749				
	AOC4	0.910	0.829				
Ascription of Responsibility	AOR1	0.876	0.767	0.927	0.927	0.761	0.872
	AOR2	0.890	0.791				
	AOR3	0.863	0.744				
	AOR4	0.861	0.742				
Personal Norm	PN1	0.830	0.688	0.923	0.932	0.775	0.880
	PN2	0.901	0.812				
	PN3	0.925	0.856				
	PN4	0.862	0.743				
Subjective Norm	SN1	0.884	0.781	0.946	0.946	0.815	0.903
	SN2	0.841	0.708				
	SN3	0.935	0.875				
	SN4	0.948	0.898				
Biospheric Values	BV1	0.882	0.778	0.937	0.937	0.788	0.888
	BV2	0.878	0.771				
	BV3	0.916	0.839				
	BV4	0.874	0.765				

**Source:** Author's own compilation

In contrast, egoistic values ( $\beta = 0.029$ ,  $p = 0.542$ ) and materialistic values ( $\beta = 0.025$ ,  $p = 0.610$ ) do not significantly influence awareness of consequences, leading to the rejection of H2 and H3. Consistent with the value–

belief–norm framework, awareness of consequences positively influences ascription of responsibility ( $\beta = 0.141$ ,  $p = 0.003$ ), while ascription of responsibility significantly strengthens personal norms ( $\beta = 0.237$ ,  $p < 0.001$ ), providing support for H5 and H6. These findings suggest that consumers who recognize the environmental consequences of their actions are more likely to develop a sense of personal responsibility, which subsequently reinforces their moral obligation toward environmentally responsible behavior. Regarding the theory of planned behavior, attitude exerts a significant positive effect on consumers' intention to purchase energy-efficient appliances ( $\beta = 0.152$ ,  $p = 0.002$ ), supporting H9. However, neither perceived behavioral control ( $\beta = 0.062$ ,  $p = 0.191$ ) nor subjective norms ( $\beta = -0.039$ ,  $p = 0.410$ ) significantly influence purchase intention. Therefore, H7 and H8 are not supported. Finally, personal norms positively influence consumers' intention to purchase energy-efficient appliances ( $\beta = 0.093$ ,  $p = 0.049$ ), supporting H10. These findings indicate that value-driven and moral factors provide stronger explanatory power for consumers' purchase intentions than perceived behavioral control and subjective norms. Specifically, biospheric and altruistic values indirectly foster purchase intentions by enhancing awareness of environmental consequences, strengthening personal responsibility, and activating personal norms, whereas attitude remains the only significant determinant derived from the theory of planned behavior.

**Table 5.** Hypotheses Testing Results

	Independent Variable → Dependent Variable	Estimate	S.E.	t- value	p-value	Standardized Regression Weight	R <sup>2</sup> (Variance Explained)	Decision (95% CI)
H1	Biospheric Values → Awareness of Consequences	0.119	0.046	2.587	0.010	0.124	0.0154	Supported
H2	Altruistic Values → Awareness of Consequences	0.105	0.050	2.127	0.033	0.099	0.0098	Supported
H3	Egoistic Values → Awareness of Consequences	0.031	0.051	0.611	0.542	0.029	0.0008	Not supported
H4	Materialistic Values → Awareness of Consequences	0.027	0.052	0.511	0.610	0.025	0.0006	Not Supported
H5	Awareness of Consequences → Ascription of Responsibility	0.148	0.050	2.948	0.003	0.141	0.0199	Supported
H6	Ascription of Responsibility → Personal Norms	0.216	0.043	4.981	***	0.237	0.0562	Supported
H7	Perceived Behavioral Control → Intention to Purchase EEAs	0.055	0.042	1.310	0.191	0.062	0.0038	Not Supported
H8	Subjective Norms → Intention to Purchase EEAs	-0.039	0.047	-0.824	0.410	-0.039	0.0015	Not Supported
H9	Attitude → Intention to Purchase EEAs	0.149	0.047	3.157	0.002	0.152	0.0231	Supported
H10	Personal Norms → Intention to Purchase EEAs	0.095	0.048	1.971	0.049	0.093	0.0086	Supported

*Source: Author's own compilation*

**Table 6.** Mediation Analysis Results

Relationship	Direct Effect	Indirect Effect	Lower Bound	Upper Bound	P- Value	Conclusion
Awareness of Consequences<- Biospheric Values	0.119	-	-	-	0.010	No Mediation
Awareness of Consequences<- Egoistic Values	0.031	-	-	-	0.542	No Mediation
Awareness of Consequences<- Materialistic Values	0.026	-	-	-	0.611	No Mediation
Awareness of Consequences<- Altruistic Values	0.105	-	-	-	0.033	No Mediation
Ascription of Responsibility<- Awareness of Consequences	0.148	0.024	0.000	0.044	0.003	Partial Mediation
Personal Norms<- Ascription of Responsibility	0.216	0.006	0.000	0.063	<0.001	Partial Mediation
Intention to Purchase EEAs<- Personal Norms	0.095	-	-	-	0.049	No Mediation

*Source: Author's own compilation*

To further examine the indirect relationships among the study constructs, mediation analysis was conducted using AMOS following the approach recommended by Hayes (2018). The results are presented in Table 6. The findings indicate that biospheric values and altruistic values exert significant direct effects on awareness of consequences, whereas egoistic values and materialistic values do not demonstrate significant effects. As these relationships represent

direct paths within the proposed framework, no indirect effects were identified. Regarding the mediating relationships, awareness of consequences exhibits a significant indirect effect on ascription of responsibility (indirect effect = 0.024, 95% CI = [0.000, 0.044]), indicating partial mediation. Similarly, ascription of responsibility demonstrates a significant indirect effect on personal norms (indirect effect = 0.006, 95% CI = [0.000, 0.063]), also supporting partial mediation. In both cases, the confidence intervals exclude negative values, providing evidence of statistically significant indirect effects. Finally, personal norms maintain a significant direct effect on consumers' intention to purchase energy-efficient appliances ( $\beta = 0.095$ ,  $p = 0.049$ ), with no additional indirect effect observed. Thus, the mediation results support the sequential mechanism proposed by the value-belief-norm theory, whereby awareness of consequences strengthens ascription of responsibility, which subsequently reinforces personal norms and ultimately contributes to consumers' intentions to purchase energy-efficient appliances. Figure 2 presents the estimated structural model and the standardized path coefficients obtained from the structural equation modeling analysis.

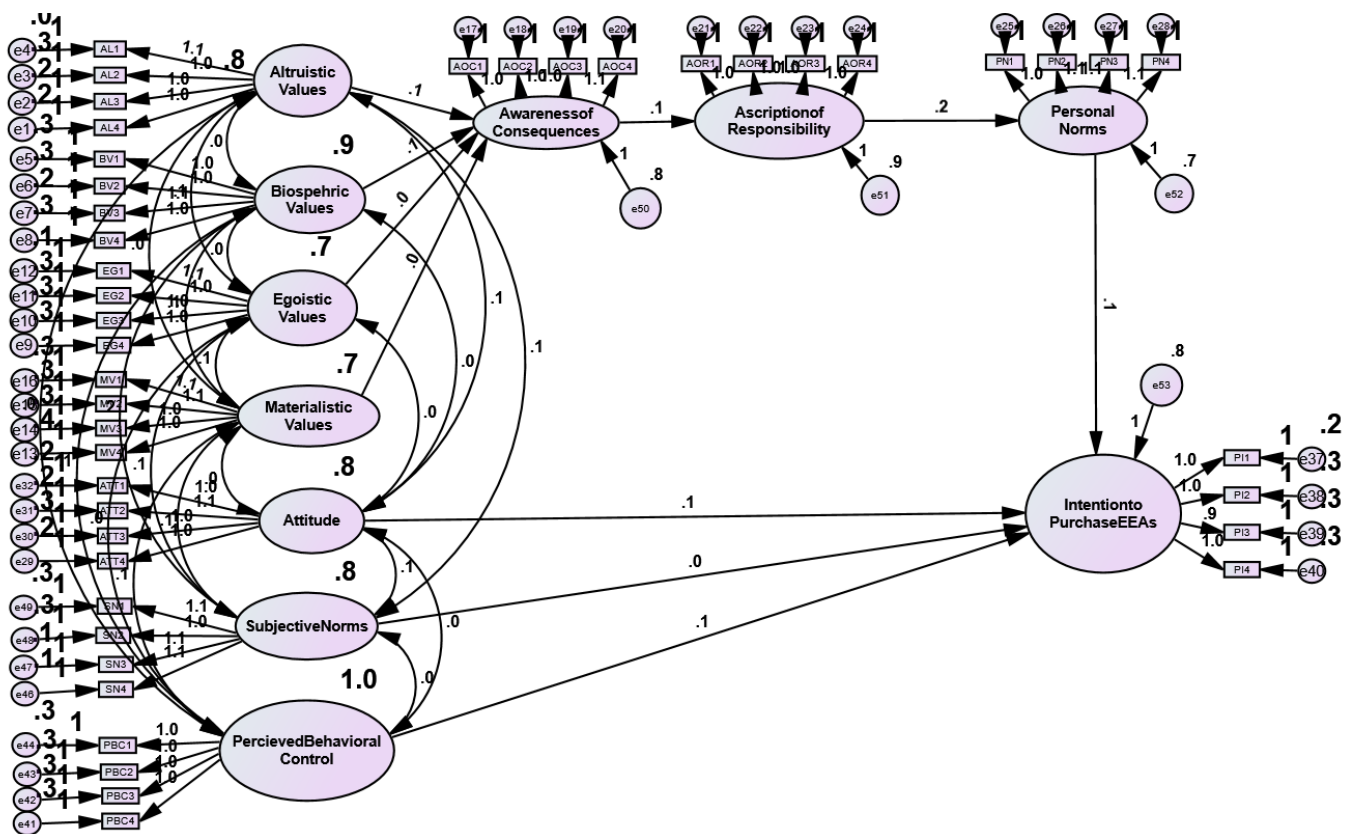


Figure 2. Structural Model Estimation in AMOS

Source: Author's own compilation

## 5 DISCUSSION

The findings demonstrate that integrating VBN and TPB provides a more comprehensive explanation of consumers' intentions to purchase EEAs in Pakistan. While both theoretical perspectives contribute to explaining pro-environmental purchase intentions, the results suggest that value-driven and moral determinants exert stronger influences than several conventional TPB constructs. This highlights the importance of incorporating both ethical and rational dimensions when explaining consumers' adoption of energy-efficient technologies in emerging economies. The VBN framework receives substantial empirical support. Biospheric and altruistic values significantly enhance consumers' awareness of environmental consequences, whereas egoistic and materialistic values do not exert significant effects. These findings suggest that consumers who prioritize environmental protection and social welfare are more likely to recognize the environmental implications of their purchasing decisions, while self-oriented and materialistic values appear less relevant in motivating environmentally responsible consumption. This evidence is consistent with

Gomes et al. (2022), Prakash et al. (2019), and the recent findings of Puspanathan and Mohd Suki (2025), who likewise reported that environmental values play a fundamental role in encouraging the adoption of EEAs.

The subsequent relationships within the VBN framework are also supported. Awareness of consequences significantly strengthens ascription of responsibility, which subsequently reinforces personal norms. These findings are fully consistent with the theoretical assumptions of VBN (Stern et al., 1999) and previous empirical evidence reported by Govaerts and Olsen (2022), He and Zhan (2018), and Setiawan et al. (2021). Furthermore, personal norms positively influence consumers' intentions to purchase EEAs, indicating that internal moral obligations remain an important driver of environmentally responsible purchasing behavior Shrum et al. (2013). This finding supports Du and Pan (2022), who emphasized that personal norms are among the strongest predictors of energy-saving behavior. The significant partial mediation effects further confirm the sequential psychological mechanism proposed by VBN, whereby environmental values influence purchase intentions through increased awareness, personal responsibility, and moral obligation.

The TPB presents a more selective pattern of relationships. Among its three antecedents, only attitude significantly influences consumers' intentions to purchase EEAs, confirming that favorable evaluations of environmentally friendly products remain a key determinant of purchase intention. This finding is consistent with Waris and Hameed (2020) and recent evidence reported by Puspanathan and Mohd Suki (2025), which similarly identified attitude as the strongest predictor of EEA adoption. In contrast, subjective norms and perceived behavioral control do not significantly influence purchase intention. These findings suggest that consumers' decisions are shaped primarily by their personal evaluations rather than social expectations or perceived behavioral control. A plausible explanation is that financial constraints, affordability concerns, and limited accessibility of EEAs reduce the practical influence of perceived behavioral control, while purchasing decisions remain largely individual rather than socially driven. Similar observations have been reported by Bhutto et al. (2022) and recent studies examining sustainable consumption in developing economies.

## 5.1 Theoretical Implications

This study makes several important theoretical contributions to the sustainable consumption literature. First, it extends previous research by integrating VBN and TPB into a unified framework for explaining consumers' intentions to purchase EEAs. While previous studies have predominantly applied these theories independently, the present findings demonstrate that combining moral and cognitive determinants provides a more comprehensive explanation of pro-environmental purchasing behavior, particularly in the context of an emerging economy. Second, the study provides additional empirical support for the VBN framework by confirming the sequential relationships among environmental values, awareness of consequences, ascription of responsibility, and personal norms. The significant mediation effects further validate the underlying psychological mechanism proposed by VBN, demonstrating that consumers' environmental values translate into purchase intentions through increased environmental awareness and moral obligation. Third, the findings offer new insights into the applicability of TPB in the context of EEAs. While attitude remains a significant predictor of purchase intention, the insignificant effects of subjective norms and perceived behavioral control suggest that not all TPB constructs contribute equally to consumers' pro-environmental purchasing decisions. This highlights the importance of considering contextual factors when applying TPB in developing economies. Finally, by providing empirical evidence from Pakistan, this study contributes to the limited body of research on sustainable consumer behavior in emerging markets. The findings broaden the geographical applicability of integrated behavioral models and provide a useful foundation for future studies examining the adoption of environmentally sustainable products across different cultural and economic contexts.

## 5.2 Practical Implications

The findings offer several practical implications for policymakers, manufacturers, and marketers seeking to promote the adoption of EEAs. Since biospheric values, altruistic values, and personal norms significantly influence consumers' purchase intentions, public awareness campaigns should focus on strengthening environmental responsibility and highlighting the long-term environmental benefits of energy-efficient technologies rather than relying solely on economic incentives. Educational initiatives that emphasize energy conservation, climate change mitigation, and individual responsibility can further enhance consumers' environmental awareness and encourage sustainable purchasing decisions. For manufacturers and marketers, the significant role of attitude suggests that marketing strategies should communicate the environmental, economic, and performance advantages of EEAs through credible and transparent information. Rather than emphasizing only product features, promotional campaigns should demonstrate how EEAs contribute to reducing energy consumption, lowering household electricity costs, and protecting the

environment. The insignificant effects of subjective norms indicate that social influence alone may be insufficient to motivate consumers. Therefore, marketing efforts should focus on building positive consumer attitudes and reinforcing personal environmental values instead of depending primarily on peer influence or social approval. The findings also provide important insights for policymakers. Financial barriers remain a potential obstacle to the adoption of EEAs, which may explain the insignificant effect of perceived behavioral control. Governments can therefore encourage wider adoption by introducing financial incentives such as subsidies, tax rebates, low-interest financing schemes, and energy-efficiency labeling programs. Strengthening national awareness campaigns and enforcing transparent energy-efficiency standards would further improve consumer confidence and accelerate the transition toward sustainable household energy consumption. Collectively, these initiatives can contribute to achieving the objectives of SDG 7 (Affordable and Clean Energy) and SDG 12 (Responsible Consumption and Production) by promoting more sustainable consumer behavior.

## 6 CONCLUSION

This study examined the factors influencing consumers' intentions to purchase EEAs by integrating VBN and TPB within the Pakistani context. By combining value-based and cognitive determinants into a single framework, the study provides a more comprehensive understanding of the psychological mechanisms underlying pro-environmental purchasing behavior. The findings demonstrate that biospheric and altruistic values significantly enhance consumers' awareness of environmental consequences, whereas egoistic and materialistic values do not exert significant effects. Furthermore, awareness of consequences positively influences ascription of responsibility, which subsequently strengthens personal norms. These results confirm the sequential relationships proposed by VBN and highlight the important role of moral obligations in shaping consumers' intentions to purchase EEAs. Within the TPB framework, attitude emerged as the only significant predictor of purchase intention, while subjective norms and perceived behavioral control did not exhibit significant effects. The mediation analysis further supports the indirect psychological mechanism through which environmental awareness and personal responsibility contribute to the development of pro-environmental purchase intentions. The study contributes to the sustainable consumption literature by demonstrating that integrating VBN and TPB provides greater explanatory power than applying either framework independently. The findings suggest that promoting EEAs requires more than improving product availability. Policymakers, manufacturers, and marketers should strengthen environmental awareness, reinforce consumers' sense of personal responsibility, and communicate the long-term environmental and economic benefits of EEAs through credible information and supportive policy initiatives. Such efforts can encourage more sustainable household consumption and contribute to achieving the broader objectives of energy conservation and environmental sustainability.

### 6.1 Limitations and Future Research

Despite its theoretical and practical contributions, this study has several limitations that should be acknowledged. First, the findings are based on cross-sectional survey data, which limit the ability to establish causal relationships among the study variables. Future research may adopt longitudinal or experimental research designs to examine changes in consumers' purchase intentions over time. Second, the study employed a convenience sampling technique and focused primarily on respondents from major metropolitan cities in Pakistan. Although these cities represent the country's principal consumer markets for EEAs, future studies should consider probability sampling and include rural and semi-urban populations to enhance the generalizability of the findings. Third, the study relied on self-reported data, which may be subject to common method bias and social desirability bias. Future research may combine survey responses with actual purchasing behavior or market data to improve the robustness of the findings. Finally, the proposed framework focused on the integration of VBN and TPB. Future studies could extend this model by incorporating additional factors, such as environmental knowledge, green trust, perceived consumer effectiveness, environmental concern, government incentives, eco-labeling, or energy-efficiency certifications. Comparative studies across different countries and cultural settings would also provide valuable insights into the generalizability of the integrated behavioral framework for explaining consumers' adoption of EEAs.

### DECLARATION ON THE USE OF ARTIFICIAL INTELLIGENCE (AI)

The authors declare that artificial intelligence (AI)-assisted tools, including ChatGPT, were used solely to improve the language, grammar, readability, and overall presentation of the manuscript. The authors carefully reviewed, verified, and take full responsibility for the accuracy, integrity, originality, and final content of the manuscript.

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