

Understanding how perceived value enhances consumer loyalty toward energy-efficient appliances: the role of satisfaction and product category

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23

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Abstract

Purpose – Over energy consumption is one of the causes of global warming and climate change. To deal with this issue, using energy-efficient appliances is strongly encouraged and cultivating consumer loyalty toward energy-efficient appliances is crucial for long-term sustainability. This study investigates the effects of multiple dimensions of perceived value on consumer satisfaction and three outcomes of consumer loyalty (i.e. willingness to pay a premium, repurchase intention and word-of-mouth intention), considering the moderating role of the product category.

Design/methodology/approach – Quota sampling based on age and gender and snowball sampling methods were applied to recruit 423 participants for this study. A combination of partial least squares structural equation modeling (PLS-SEM), importance-performance map analysis (IPMA) and necessary condition analysis (NCA) was employed to examine the proposed model.

Findings – Functional, price, emotional and environmental values positively impact consumer satisfaction, enhancing the three dimensions of consumer loyalty. The product category moderates the effects of perceived value dimensions on consumer satisfaction. Moreover, the IPMA results highlight that functional value and environmental value are the most essential but underperforming value attributes. The NCA results indicate that social value is a necessary condition for consumer satisfaction.

Originality/value – This study is one of the pioneers in integrating PLS-SEM, IPMA and NCA approaches to comprehensively unpack the relationships between perceived value dimensions, consumer satisfaction and consumer loyalty in the context of energy-efficient appliances. The findings offer theoretical and practical importance for academics, retailers, producers and policymakers to encourage consumer loyalty toward energy-efficient appliances.

Keywords Consumer loyalty, Energy efficiency, Perceived value, Environmental value, Product category, Sustainability

Paper type Research paper

1. Introduction

Energy consumption is a significant source of greenhouse gas emissions that drives climate change (Asif *et al.*, 2022; Guan and Lin, 2024). Rising electricity use in homes, mainly from

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increased appliance usage, has made the residential sector a prime target for energy-saving policies (Asif *et al.*, 2022). Many countries now promote energy-efficient appliances to support the United Nations' Sustainable Development Goals (SDGs), including SDG7 (Affordable and clean energy), SDG12 (Responsible consumption and production), and SDG13 (Climate action) (Bhutto *et al.*, 2021). However, achieving sustainability requires ongoing consumer commitment to eco-friendly products beyond the initial purchase (Elhoushy and Jang, 2023). Therefore, understanding how to build consumer loyalty toward energy-saving appliances is crucial (Issock *et al.*, 2020).

Despite growing research on energy-efficient appliances (Asif *et al.*, 2022; Luo *et al.*, 2022), several research gaps remain. While studies have examined perceived value's impact on various consumer behaviors such as purchase intention (Si-Dai *et al.*, 2021), recommendation intention (Issock *et al.*, 2020), and willingness to pay (Zhang *et al.*, 2020), limited research explores its effect on multiple loyalty outcomes for energy-efficient appliances (Issock *et al.*, 2020). Additionally, existing literature has predominantly treated perceived value as a unidimensional construct (Waris and Hameed, 2021). However, scholars now argue that perceived value is a multifaceted concept that cannot be adequately captured by a single dimension (Slack *et al.*, 2022). In a similar vein, given that energy-efficient household appliances serve both practical and environmental purposes, examining perceived value through multiple dimensions can provide richer insights into business performance, as these dimensions often have varying effects (Slack *et al.*, 2022). Hence, this study's first purpose is to develop a research model explaining how multiple dimensions of perceived value influence consumer loyalty toward energy-efficient appliances.

Existing literature has widely confirmed consumer satisfaction as a strong connector between perceived value and loyalty (Cankül *et al.*, 2024). However, energy efficiency scholars have found that different dimensions of perceived value impact consumer satisfaction in varying ways, suggesting the need for moderating factors (Issock *et al.*, 2020; Luo *et al.*, 2022). Product category emerges as a potential moderator, as demonstrated by differing consumer behavior patterns (Asif *et al.*, 2022). For example, energy-saving features are prioritized differently between large appliances such as air-conditioners versus smaller ones like microwaves (Guan and Lin, 2024). While the product category's influence on perceived value and behavioral outcomes has been documented (Guan and Lin, 2024), its moderating role between perceived value dimensions and consumer satisfaction remains unexplored. Therefore, the second goal of this study is to examine how product category moderates the relationship between perceived value dimensions and consumer satisfaction for energy-efficient appliances.

A third research gap concerns using a multi-method approach to clarify the causal relationships among constructs. While partial least squares structural equation modeling (PLS-SEM) is widely used in consumer marketing research (Nguyen *et al.*, 2024; Tran, 2023; Tran *et al.*, 2024), researchers are increasingly interested in necessary condition analysis (NCA) (Koay *et al.*, 2022; Tiwari *et al.*, 2023). Richter *et al.* (2020) suggested that combining PLS-SEM (sufficiency logic) with NCA (necessity logic) helps identify factors that are both sufficient and necessary for forming endogenous constructs, improving explanatory power and predictive accuracy while deepening our understanding of consumer behavior. PLS-SEM analyzes relationships between variables by maximizing the explained variance of the dependent variables by independent variables, while NCA assists in identifying the requisite conditions for the occurrence of the outcome of interest (Richter *et al.*, 2020). In our study, PLS-SEM identifies determinants of consumer satisfaction with energy-efficient appliances through value perceptions, while NCA predicts the necessary level of these determinants for achieving consumer satisfaction. Furthermore, the importance-performance analysis (IPMA), which follows an additive sufficiency logic, offers valuable insights into precursor constructs and their managerial actions (Koay *et al.*, 2022). This approach helps avoid 'one size fits all' solutions (Hauff *et al.*, 2024). Despite these advantages, few green consumption studies integrate these three approaches. To address this gap, this study combines PLS-SEM, IPMA,

and NCA to comprehensively analyze how perceived values affect consumer satisfaction and loyalty toward energy-efficient appliances.

Our study advances the marketing literature in the following ways. First, it offers fresh insights into how consumer perceived value dimensions influence consumer loyalty outcomes, particularly in the post-purchase stage for energy-efficient appliances. This research responds to the call for more studies on consumer loyalty toward energy-efficient appliances (Elhoushy and Jang, 2023) while validating a model of perceived value dimensions for these understudied products. Second, this research pioneers in investigating product category as a moderating factor. Our findings reveal how perceived value dimensions affect consumer loyalty through satisfaction under different conditions. This understanding of how product categories moderate the relationship between perceived value dimensions and consumer satisfaction enables stakeholders to develop targeted strategies for promoting sustainable behavior. Third, from a methodological standpoint, this study enhances standard PLS-SEM analysis by incorporating IPMA and NCA into PLS-SEM, providing more nuanced and actionable insights than traditional SEM approaches (Hauff *et al.*, 2024).

The remainder of this paper proceeds as follows. Section 2 presents the theoretical foundation and develops hypotheses. Section 3 outlines the methodology, including sample data and analytical methods. Section 4 provides data analysis results. Section 5 discusses the main findings and their implications. The final section offers conclusions and suggestions for future research.

2. Literature review and hypotheses development

2.1 Theoretical underpinning

Prior research shows that businesses must create value for consumers to ensure their satisfaction and long-term positive behavioral outcomes (Cankül *et al.*, 2024). Scholars have examined consumer loyalty from the value perspective using various theoretical perspectives, including the theory of planned behavior (Lin and Dong, 2023), hierarchy of effects model (Rasoolimanesh *et al.*, 2022), expectancy confirmation theory (Pan *et al.*, 2024), and stimulus-organism-response theory (Wu and Huang, 2023). While research has identified multiple dimensions of perceived value that drive consumer loyalty, their impact varies across countries and product categories (Issock *et al.*, 2020; Luo *et al.*, 2022). To investigate key value dimensions affecting consumer loyalty toward energy-efficient appliances in the specific context of Vietnam, this study proposes and validates a model that integrates consumer perceived value theory (PERVAL) with loyalty chain stage theory. PERVAL was specifically developed to identify perceived value of durable goods such as household appliances (Sweeney and Soutar, 2001), while loyalty chain stage theory is widely applied in post-adoption research (Elhoushy and Jang, 2023). This combination of theoretical frameworks provides deeper insights into factors driving consumer green behaviors (Dang *et al.*, 2021).

Through the lens of PERVAL, consumer behavior is analyzed across rational (functional and price value), emotional, and social dimensions, which is especially relevant in collectivistic Asian cultures (Luong, 2021). Recent studies have expanded the PERVAL model by incorporating environmental value to better understand consumer perceptions of energy-saving products (Lin and Dong, 2023; Zhang *et al.*, 2020). Accordingly, this study measures consumer perceived value using environmental value alongside PERVAL's four original value dimensions.

Consumer loyalty remains a vital strategic goal for companies, fostering customer relationships and ensuring sustainable revenue (Cankül *et al.*, 2024). Oliver (1999) described consumer loyalty as a deep commitment to consistently repurchase or support a preferred product. His loyalty chain stage theory describes how loyalty develops from cognitive beginnings through emotional attachment to conative and action loyalty. The first three stages constitute attitudinal loyalty, often considered 'true loyalty', where consumers demonstrate commitment by speaking positively about products, even without purchasing (Ricardianto

et al., 2024). In accordance with the loyalty chain stage theory and prior studies (Cankül *et al.*, 2024), this study proposes that perceived value dimensions, representing cognitive evaluation, elicit consumer satisfaction (affective evaluation), which forms their loyalty to energy-efficient appliances. Over time, there is a consensus that consumer loyalty manifests through three key outcomes: repurchase intention, positive word-of-mouth, and willingness to pay a premium (Zhang *et al.*, 2023).

2.2 The relationship between multiple dimensions of perceived value and satisfaction

2.2.1 Functional value. Functional value pertains to the practical benefits of a product or service based on its anticipated physical performance (Roh *et al.*, 2022). Prior research has demonstrated that functional value is crucial in shaping consumer satisfaction. Consumers consider quality and performance when assessing household appliances (Luo *et al.*, 2022). Quality includes factors like stability, while performance covers elements such as low noise levels and effective cooling. Luo *et al.* (2022) demonstrated the positive influence of functional value on consumer satisfaction in China. However, Issock *et al.* (2020) found that, for energy-saving products, functional value had no significant impact on green satisfaction, as this type of satisfaction stems primarily from environmental attributes. Since our study approaches consumer satisfaction as a cumulative assessment of purchase experiences, we propose the following hypothesis:

H1. Functional value positively affects consumer satisfaction.

2.2.2 Price value. Price value is allied to the monetary benefits and cost advantages a consumer gains from purchasing one product compared to similar alternatives (Sweeney and Soutar, 2001). For energy-efficient appliances, this price value is reflected in the long-term electricity cost savings households can achieve by choosing these products (Issock *et al.*, 2020). Existing literature has lent credence to the positive association between price value and consumer satisfaction (Ofori *et al.*, 2022). From these arguments, we formulate the hypothesis below:

H2. Price value positively affects consumer satisfaction.

2.2.3 Emotional value. Sweeney and Soutar (2001) described emotional value as the benefits obtained from the enjoyment or pleasure a product can offer. Using energy-efficient appliances can save on electricity bills and contribute to environmental conservation, making consumers feel happy and altruistic (Lin and Dong, 2023). Since energy-efficient appliances are products of technological development, they usually come with advanced functions, such as noise reduction. Therefore, consumers can experience comfort and pleasure from using these products (Zhang *et al.*, 2020). Literature supports that when consumers obtain emotional value, such as joy and excitement, towards energy-efficient products, they tend to evaluate them positively (Lin and Dong, 2023; Zhang *et al.*, 2020). Similarly, Luo *et al.* (2022) highlighted that emotional value is a critical precursor of consumer satisfaction with energy-saving products. Thus, this study developed the following hypothesis:

H3. Emotional value positively affects consumer satisfaction.

2.2.4 Social value. Sweeney and Soutar (2001) characterized social value as an individual's perceived utility from a product's ability to contribute to their social self-concept and influence their social standing within their social circle. With the growing dependence on social networks, the influence of social factors on consumer perceptions is rising (Lu and Wang, 2020). Previous literature reported contrasting effects of social value on consumer satisfaction. According to Luo *et al.* (2022), consumers may not derive social value from energy-saving products, as these products are used privately. However, Issock *et al.* (2020) highlighted that social value can predict consumer satisfaction because these products can enhance their image as environmentally conscious and socially responsible individuals. Given these conflicting findings, the following hypothesis is formulated to examine the impact of social value on consumer satisfaction with energy-efficient appliances:

H4. Social value positively affects consumer satisfaction.

2.2.5 Environmental value. Environmental value represents a consumer's commitment to environmental protection through adopting and using eco-friendly products (Zhang *et al.*, 2020). Luo *et al.* (2022) found an association between environmental value and consumer satisfaction with energy-saving products in China while Issock *et al.* (2020) highlighted that environmental value influences consumer satisfaction with energy-efficient products in South Africa. The above arguments provide a rationale for the following hypothesis:

H5. Environmental value positively affects consumer satisfaction.

2.3 The relationship between satisfaction and consumer loyalty outcomes

Consumer satisfaction is fundamental to building sustainable customer relationships and is frequently highlighted in consumer loyalty research (Issock *et al.*, 2020). Satisfaction refers to a consumer's after-purchase assessment and emotional reaction to the overall experience with a product or service (Sebastián-Morillas *et al.*, 2024). Cumulative insights support the relationship between satisfaction and consumer loyalty toward energy-efficient appliances, as existing literature points to the fact that satisfied consumers are more likely to repeat a purchase and recommend the product to others (Issock *et al.*, 2020). Although energy-efficient appliances often come with higher price tags than conventional options, Homburg *et al.* (2005) found that satisfied consumers are more tolerant of these price premiums. Based on these arguments, we develop the hypotheses below:

H6. Consumer satisfaction positively affects willingness to pay a premium.

H7. Consumer satisfaction positively affects repurchase intention.

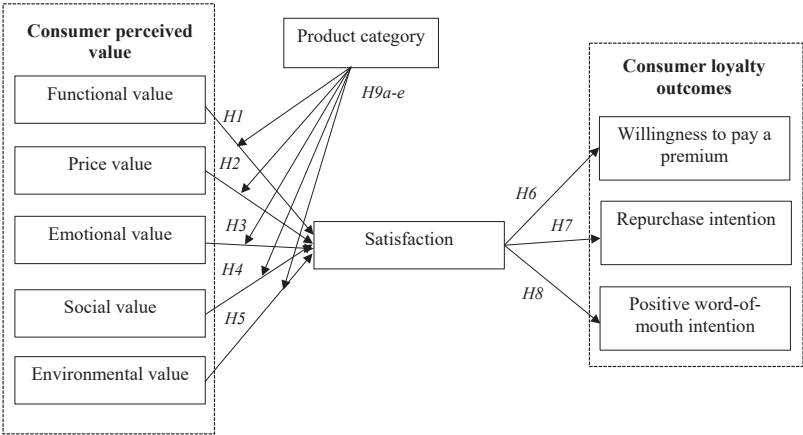
H8. Consumer satisfaction positively affects positive word-of-mouth intention.

2.4 Moderating effect of the product category

Energy-efficient appliances are broadly divided into large and small products based on their size, portability, and energy consumption level (Trotta, 2018). This study examines products subject to Vietnam's mandatory energy labeling requirements (Lai, 2012). Large appliances, including air conditioners, washing machines, refrigerators, and water heaters, are bigger, non-portable, and consume more energy, leading consumers to spend more time and effort on their purchases (Trotta, 2018; McDonald *et al.*, 2009). Small appliances include fans, rice cookers, televisions, and lighting products (Trotta, 2018; McDonald *et al.*, 2009). Extant literature has provided preliminary evidences of the moderating effect of product category in the association between perceived value dimensions and consumer responses. For example, Sonnenberg *et al.* (2011) reported that consumers are more concerned about functional aspects than price when buying large electrical appliances. Conversely, individuals are more concerned about potential cost savings when purchasing energy-saving air-conditioners than microwaves (Zhang *et al.*, 2021). McDonald *et al.* (2009) revealed that consumers might prioritize environmental criteria when purchasing major home appliances but do not consider them when buying small electrical products. Similarly, in this study, we argue that consumers who use different product groups have different preferences, thus affecting the path between perceived value dimensions and consumer satisfaction. The hypotheses below are developed:

H9. Product category moderates the effect of multiple dimensions of perceived value on consumer satisfaction, such that the influence of functional value (H9a), price value (H9b), emotional value (H9c), social value (H9d), and environmental value (H9e) on consumer satisfaction will be stronger for consumers who purchase large energy-efficient appliances rather than small energy-efficient appliances.

Figure 1 presents the conceptual model.



Source(s): Authors' analysis

Figure 1. Conceptual framework

3. Research methodology

3.1 Research context

This study validates the research model using sample data from Vietnam, a typical emerging economy experiencing rapid economic growth, high population growth, and significant urbanization and industrialization. These factors increase environmental pressures (Urban *et al.*, 2018). Over the past two decades, Vietnam has faced a sharp rise in CO₂ emissions, exacerbating climate change and a steadily growing energy demand (Urban *et al.*, 2018). Given that Vietnam has had to import energy since 2015, the country faces the risk of energy insecurity and the inability to fulfill its international environmental commitment (Nguyen, 2015). The Vietnamese government has been promoting energy-saving products through its mandatory energy-efficiency labeling program for selected home appliances (Nguyen *et al.*, 2016). Vietnam is an appropriate research context for this study because, while developed economies have historically contributed most to environmental degradation, developing economies are poised to surpass them in pollution-related activities unless proactive measures are taken (Waris and Hameed, 2021).

3.2 Measurement instrument and questionnaire design

This study followed a quantitative approach, employing a self-administered survey to gather data and examine the hypothesized relationships. Surveys are a commonly used tool in consumer research (Slack *et al.*, 2022) and often employed in studies focused on energy-efficiency behaviors (Le and Nguyen, 2024; Waris and Hameed, 2021). All measurement items were adopted from scales, which were validated in previous studies (see Appendix). Specifically, the scales for functional value (four items), price value (four items), emotional value (three items), social value (four items), and environmental value (four items) were adopted from Zhang *et al.* (2020). Five items measuring consumer satisfaction were adopted from Issock *et al.* (2020). The scale for willingness to pay a premium (three items) was adopted from Zhang *et al.* (2020). Four items measuring repurchase intention were adapted from De Toni *et al.* (2018). Four items measuring positive word-of-mouth intention were developed from Hameed *et al.* (2021). This study employed a 5-point Likert scale for measuring all items (1 = strongly disagree, 5 = strongly agree).

The questionnaire underwent a back-translation process between English and Vietnamese to ensure consistency and translation equivalence (Nguyen *et al.*, 2016). Before the main study, 11 experts, including marketing researchers, retailers, and manufacturers of energy-

efficient appliances, pretested the questionnaire to ensure its content validity (Lim, 2024). Subsequently, 121 consumers were recruited to participate in a pilot test to evaluate the validity of the instruments (Lim, 2024). The results indicated that all constructs had Cronbach's alpha values above 0.70, confirming their reliability (Hair *et al.*, 2019).

3.3 Sample and data collection

Vietnam employs a five-tier energy rating system for appliances (Taylor *et al.*, 2022). According to the energy rating label descriptions, only appliances with 4 or 5 stars are considered energy-efficient. Therefore, this study's participants were Vietnamese citizens, 18 years or older, who had purchased appliances bearing energy rating labels of at least 4 stars. This setup allowed for an in-depth examination of consumers' post-purchase behaviors regarding these products. Filtering questions were used to exclude ineligible respondents. In the absence of an appropriate sampling frame, non-probability quotas based on age and gender, and snowball sampling were used to obtain a research sample. Following Dillman's (2007) recommendations, the study employed a mixed-method approach, utilizing both paper and online surveys to ensure that all target populations could participate. Participants were given the option to complete either online or paper-based surveys according to their preferences. To reduce common method bias, respondents were informed in the introduction section of the questionnaire that they needed to choose the options that best described their experience and that the questionnaire had no correct or incorrect answers. The respondents' confidentiality and anonymity were also assured. Completing the questionnaire was considered as providing "informed content".

We began by inviting eligible people in our network to participate in the study. To mitigate sample bias, we selected initial respondents from diverse age groups, as recommended by Kirchherr and Charles (2018). These initial respondents were then invited to refer other qualified individuals within their network to participate in our survey. We purposely administered the survey to obtain a sample with a roughly equal proportion of men and women and varied categories concerning age, income, education, and marital status. The final number of usable responses in this study was 423. The demographic information of the respondents is presented in Table 1. The largest group of respondents (26.2%) was aged 30–39 years old, and the majority held a bachelor's degree, aligning with findings from prior green consumption studies in Vietnam (Nguyen *et al.*, 2016, 2022). The gender ratio was 48:52 male to female, resembling the proportions reported in the 2019 data from the General Statistics Office of Vietnam (Nguyen *et al.*, 2022). Our sample exhibited a marriage rate of approximately 62%, slightly lower than the 67% reported in the general population (Nguyen *et al.*, 2022). These demographic characteristics indicate that our sample is fairly representative of Vietnam's overall population.

3.4 Analysis methods

Initially, PLS-SEM with the help of SmartPLS software version 4.0 was utilized to test the proposed research model and hypotheses. This study employed a two-stage analytical procedure, as suggested by Anderson and Gerbing (1988), to first evaluate the measurement model and then examine the structural model to test hypothesized relationships. Next, the IPMA module implemented in SmartPLS 4.0 was applied to identify important yet underperforming constructs. Finally, the latent variable scores were used as inputs to conduct NCA, enabling us to understand the necessary conditions for consumer satisfaction and consumer loyalty. Before the assessment of the measurement and structural models, a common method bias test was conducted because the model was validated using data from a single-country setting and a one-time survey (Fuller *et al.*, 2016).

4. Results

4.1 Common method bias

Harman's single-factor test was used to check for common method bias (CMB) (Podsakoff *et al.*, 2003). The results indicated that the cumulative percentage of the first component was

Table 1. Demographic profile of the respondents (*n* = 423)

Category	Subcategory	Number of respondents	Percentages
Gender	Male	203	48.0
	Female	220	52.0
Age	18–29	93	22.0
	30–39	111	26.2
	40–49	98	23.2
	50–59	81	19.1
	60 and above	40	9.5
	High school or lesser	26	6.1
Educational level	Professional degree	57	13.5
	College degree	87	20.6
	Bachelor’s degree	193	45.6
	Master’s degree or higher	60	14.2
Household monthly income	Under VND 5 million	41	9.7
	VND 5 million – 10 million	92	21.7
	VND 11 million – 20 million	159	37.6
	VND 21 million – 30 million	59	13.9
	VND 31 million – 40 million	34	8.0
	VND 41 million – 50 million	25	5.9
	Over VND 50 million	13	3.1
Marital status	Single or never married	117	27.7
	Currently married	264	62.4
	Widowed	25	5.9
	Divorced or separated	17	4.0

Source(s): Authors’ analysis

below the recommended criterion of 50% (Podsakoff *et al.*, 2003). Additionally, variance inflation factor (VIF) values under 3.3 indicate that the sample data is free from CMB (Kock, 2015) and multicollinearity (Hair *et al.*, 2019). This study shows that all VIF values are below 3.0 in the full collinearity assessment, indicating that CMB may not be a problem and that no multicollinearity issue exists in this research.

4.2 Reliability and validity

As presented in Table 2, the outer loadings exhibited a range of 0.791–0.856, which was greater than the threshold of 0.708 (Hair *et al.*, 2019). All constructs achieved Cronbach’s alpha (CA) values above 0.70 (Hair *et al.*, 2019) and composite reliability (CR) values above 0.70 (Hair *et al.*, 2019), demonstrating acceptable internal consistency reliability. The average variance extracted (AVE) values for all variables surpassed the cutoff value of 0.50, confirming convergent validity (Hair *et al.*, 2019). Furthermore, discriminant validity was determined using the Heterotrait-Monotrait (HTMT) ratio approach. Table 3 shows that all HTMT values were below the recommended criterion of 0.85 (Henseler *et al.*, 2015), thus meeting the requirement for discriminant validity.

4.3 Hypothesis testing

A bootstrapping procedure with 5,000 resamples was performed to estimate the statistical significance of path coefficients (Henseler *et al.*, 2009). The hypothesis testing results (Table 4) showed that all perceived value dimensions had significant positive effects on consumer satisfaction (*p* < 0.05), except for social value (*p* = 0.268). Thus, hypotheses H1, H2, H3, and H5 were supported, while H4 was not supported. The analysis confirmed significant positive relationships (*p* < 0.001) between consumer satisfaction and three loyalty outcomes: willingness to pay, repurchase intention, and positive word-of-mouth intention. These results supported hypotheses H6, H7, and H8.

Table 2. Results of the measurement model

Constructs	Items	Outer loadings	CA	CR	AVE
Functional value (FUV)	FUV1	0.856	0.850	0.853	0.690
	FUV2	0.801			
	FUV3	0.823			
	FUV4	0.841			
Price value (PRV)	PRV1	0.851	0.866	0.866	0.713
	PRV2	0.835			
	PRV3	0.847			
	PRV4	0.845			
Emotional value (EMO)	EMO1	0.837	0.808	0.809	0.722
	EMO2	0.849			
	EMO3	0.864			
Social value (SV)	SV1	0.808	0.816	0.818	0.644
	SV2	0.804			
	SV3	0.807			
	SV4	0.791			
Environmental value (ENV)	ENV1	0.850	0.876	0.877	0.729
	ENV2	0.851			
	ENV3	0.856			
	ENV4	0.857			
Consumer satisfaction (SAT)	SAT1	0.799	0.877	0.877	0.670
	SAT2	0.796			
	SAT3	0.822			
	SAT4	0.846			
	SAT5	0.830			
Willingness to pay a premium (WTP)	WTP1	0.832	0.778	0.778	0.692
	WTP 2	0.850			
	WTP3	0.814			
Repurchase intention (RI)	RI1	0.828	0.850	0.850	0.689
	RI2	0.837			
	RI3	0.845			
	RI4	0.811			
Positive word-of-mouth intention (PWOM)	PWOM1	0.812	0.835	0.836	0.668
	PWOM2	0.830			
	PWOM3	0.799			
	PWOM4	0.829			

Source(s): Authors' analysis**Table 3.** Assessing discriminant validity of measurement model

	EMO	ENV	FUV	PRV	PWOM	RI	SAT	SV	WTP
EMO									
ENV	0.606								
FUV	0.709	0.747							
PRV	0.617	0.755	0.752						
PWOM	0.616	0.647	0.731	0.632					
RI	0.603	0.744	0.638	0.593	0.590				
SAT	0.745	0.774	0.834	0.741	0.688	0.735			
SV	0.696	0.644	0.632	0.631	0.592	0.641	0.651		
WTP	0.522	0.666	0.685	0.563	0.611	0.666	0.667	0.601	

Source(s): Authors' analysis

Table 4. Results of the structural model evaluation

Hypothesis	Path relationships	Coefficient	f^2	p -value	Result
H1	FUV → SAT	0.320	0.129	0.000	Supported
H2	PRV → SAT	0.142	0.026	0.022	Supported
H3	EMO → SAT	0.210	0.069	0.000	Supported
H4	SV → SAT	0.059	0.006	0.268	Not supported
H5	ENV → SAT	0.240	0.075	0.001	Supported
H6	SAT → WTP	0.552	0.437	0.000	Supported
H7	SAT → RI	0.636	0.678	0.000	Supported
H8	SAT → PWOM	0.589	0.533	0.000	Supported

Source(s): Authors' analysis

The R^2 value was 65.1% for consumer satisfaction, 30.4% for willingness to pay more, 40.4% for repurchase intention, and 34.8% for positive word-of-mouth intention. Thus, all the R^2 values reported an average to substantial level of predictive accuracy (Henseler *et al.*, 2009).

Stone Geisser's Q^2 value, which is generated using the blindfolding technique, is a key indicator of predictive relevance. The Q^2 values were 0.428 for consumer satisfaction, 0.206 for willingness to pay a premium, 0.275 for repurchase intention, and 0.229 for positive word-of-mouth intention, all greater than 0. Therefore, the proposed model demonstrated significant predictive relevance (Hair *et al.*, 2019).

The effect size (f^2) was evaluated using Cohen's (1988) recommended threshold. Based on Table 4, functional value (0.129), price value (0.026), emotional value (0.069), and environmental value (0.075) have minor impacts on consumer satisfaction, while social value (0.006) does not affect consumer satisfaction. On the other hand, consumer satisfaction has a large effect on willingness to pay a premium (0.552), repurchase intention (0.678), and positive word-of-mouth intention (0.533).

4.4 Moderation analysis

Multigroup analysis (MGA) was used to examine the moderating effects of product category on the association between multiple perceived value dimensions and consumer satisfaction. Following Henseler *et al.* (2016), we need to determine the measurement invariance for composite models (MICOM) prior to performing the multigroup analysis. This study divided the dataset into two groups: buyers of large energy-saving appliances ($n = 212$) and buyers of small energy-saving appliances ($n = 211$). Table 5 shows that the model passes the recommended criteria in the MICOM process, including configural invariance, compositional invariance, and equality of means and variances. Thus, full measurement invariance has been established for all the constructs (Henseler *et al.*, 2009).

After confirming the measurement invariance of the composites, both Henseler's MGA and the permutation test were employed to perform MGA (Henseler *et al.*, 2009). Table 6 indicates that both methods provided support for a significant difference between consumers who had bought large energy-efficient appliances and those who had bought small energy-efficient appliances in the relationships between functional, price, emotional, social value, and consumer satisfaction (p -value < 0.05). Specifically, functional and price value exerted a stronger influence on satisfaction for consumers of large energy-efficient appliances than consumers of small products, supporting H9a and H9b. In contrast, the satisfaction of consumers who bought small energy-saving products was more impacted by emotional value and social value than those who bought large products. Thus, H9c and H9d were not supported. Additionally, the p -value difference for the influence of environmental value on consumer satisfaction was above 0.05, rejecting H9e (Cheah *et al.*, 2020).

Table 5. Analysis of measurement invariance

Step 1 Construct	Configural invariance	Step 2 Original correlation	5% quantile	Compositional variance	Step 3a Equal mean assessment		Equal	Step 3b Equal variance assessment		Equal	Measurement invariance
					Differences	Confidence interval		Differences	Confidence interval		
FUV	Yes	1.000	0.999	Yes	0.062	(−0.199, 0.172)	Yes	−0.082	(−0.310, 0.310)	Yes	Full
PRV	Yes	1.000	0.999	Yes	0.016	(−0.189, 0.178)	Yes	0.030	(−0.326, 0.322)	Yes	Full
EMO	Yes	1.000	0.997	Yes	0.045	(−0.176, 0.183)	Yes	−0.285	(−0.368, 0.363)	Yes	Full
SV	Yes	0.999	0.996	Yes	0.031	(−0.183, 0.188)	Yes	−0.114	(−0.352, 0.362)	Yes	Full
ENV	Yes	1.000	0.999	Yes	0.020	(−0.190, 0.186)	Yes	−0.015	(−0.284, 0.302)	Yes	Full

Source(s): Authors' analysis

Table 6. Multigroup analysis results

Hypothesis	Paths	Path coefficient differences (large – small)	p-value Henseler’s MGA	p-value permutation test	Result
H9a	FUV → SAT	0.425	0.001	0.000	Supported
H9b	PRV → SAT	0.256	0.026	0.040	Supported
H9c	EMO → SAT	−0.288	0.011	0.012	Not supported
H9d	SV → SAT	−0.245	0.009	0.025	Not supported
H9e	ENV → SAT	−0.248	0.064	0.101	Not supported

Source(s): Authors’ analysis

4.5 Importance-performance map analysis (IPMA)

IPMA was subsequently conducted with consumer satisfaction (SAT) as the target construct. This analysis is useful for pinpointing important but underperforming constructs to highlight specific areas businesses can improve (Koay *et al.*, 2022). Based on IPMA results in Table 7 and Figure 2, functional value and environmental value are the most crucial determinants of consumer satisfaction toward energy-efficient appliances due to their high importance scores. However, a paradox exists as they are also the worst-performing factors due to low performance scores. Thus, practitioners should prioritize improving consumers’ perceived functional value and environmental value.

4.6 Necessary condition analysis (NCA)

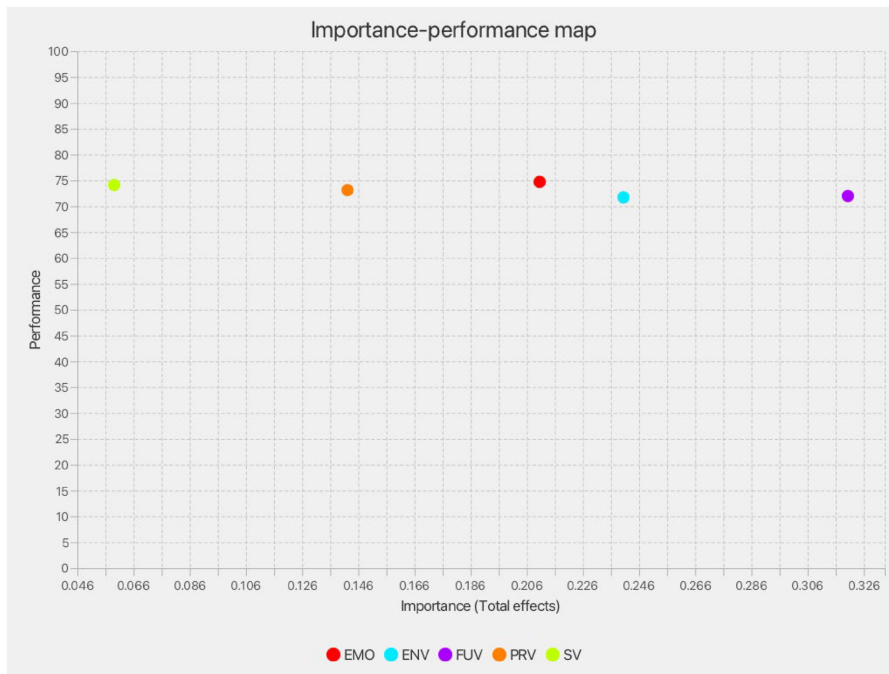
NCA was conducted to verify the must-have factors for consumer satisfaction (Richter *et al.*, 2020). NCA’s results in Table 8 showed that all five dimensions of perceived value are necessary conditions for consumer satisfaction because their effect sizes were meaningful ($d \geq 0.1$) and significant ($p < 0.05$). Notably, the results revealed that social value is seen as necessary, even though it does not significantly impact consumer satisfaction.

Moreover, this study applied the bottleneck analysis to determine the minimum requirement for each necessary condition to reach the target level of the endogenous construct. For energy-efficient appliance marketing managers to attain specific satisfaction levels, consumers must perceive minimum threshold values as shown in the bottleneck analysis. According to Table 9, achieving a 90% consumer satisfaction level requires five necessary conditions: functional value of at least 18.9%, price value of at least 23.6%, emotional value of at least 17.7%, social value of at least 18.9%, and environmental value of at least 21.3%.

Table 7. IPMA results

Construct	Importance (total effects)	Performance (index value)
Functional value	0.320	72.002
Price value	0.142	73.133
Emotional value	0.210	74.720
Social value	0.059	74.118
Environmental value	0.240	71.740

Source(s): Authors’ analysis



Source(s): Authors' analysis

Figure 2. IPMA graph

Table 8. NCA results

Construct	Consumer satisfaction Original effect size (d) (CE-FDH)	Permutation <i>p</i> -value
Functional value	0.127	0.000
Price value	0.180	0.000
Emotional value	0.161	0.000
Social value	0.182	0.000
Environmental value	0.146	0.000

Source(s): Authors' analysis

5. Discussion and implications

Growing environmental challenges and energy security concerns have heightened scholarly and practitioner interest in consumer loyalty toward energy-efficient appliances. This study examines the impact of consumer perceived value dimensions on consumer loyalty with the moderating role of product category. While previous works in this research strand using SEM could only assess the sufficiency of factors affecting consumer satisfaction (Issock *et al.*, 2020; Luo *et al.*, 2022), this study advances the field by determining the necessary conditions and the bottleneck, along with sufficient factors, that shape consumer satisfaction toward energy-efficient appliances. The findings of this study provide important theoretical and managerial implications.

5.1 Discussion of key findings and theoretical implications

First, our findings demonstrate that functional value, price value, emotional value, and environmental value significantly impact consumer satisfaction, aligning with previous

Table 9. Bottleneck table (%)

SAT	EMO	ENV	FUV	PRV	SV
0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
30	1.7	0.9	0.0	0.2	2.1
40	1.7	0.9	0.0	0.2	2.1
50	1.7	0.9	0.0	0.2	2.1
60	1.7	0.9	0.0	0.2	2.1
70	4.7	0.9	0.0	3.3	2.1
80	5.2	5.4	9.2	3.3	2.1
90	17.7	21.3	18.9	23.6	18.9
100	17.7	21.3	24.8	41.1	21.3

Source(s): Authors' analysis

research by [Luo et al. \(2022\)](#). Notably, functional value emerges as the dominant predictor of satisfaction, indicating that consumers primarily value energy-efficient appliances' performance and quality aspects. Interestingly, social value shows no significant effect on satisfaction, which contradicts the prior work of [Issock et al. \(2020\)](#). One possible explanation is that energy-efficient appliances are primarily purchased for utilitarian purposes ([Cabeza et al., 2018](#)) and their consumption lacks public visibility ([Bhutto et al., 2022](#)).

Second, this research sheds light on the moderating role of the product category in the relationship between perceived value dimensions and consumer satisfaction, which has not been determined in the prior literature. Specifically, consumers who purchase large energy-efficient products are more influenced by physical performance and cost-saving advantages. In contrast, those who purchase small energy-efficient products place greater emphasis on excitement and social image. Interestingly, although the effect of environmental value on satisfaction is stronger in the small product consumer group than the large product group, the difference between the two groups is not statistically significant. This may be because consumers prioritize other specific value dimensions when purchasing products in each category, causing environmental value to be overshadowed. Additionally, Vietnamese consumers receive uniform environmental benefit signals through standardized energy labels (more stars mean more efficient) ([Taylor et al., 2022](#)). Notably, purchasers of small energy-efficient appliances show greater sensitivity to emotional and social value, likely because small appliances such as lighting and televisions serve dual purposes in entertainment and home decoration, reflecting owners' lifestyles while generating positive emotions. These findings extend previous studies (e.g. [Issock et al., 2020](#); [Luo et al., 2022](#)) by providing evidence on the boundary conditions on causal relationships among perceived value, satisfaction, and loyalty in consumer behavior.

Third, this study advances consumer behavior marketing theory by integrating PERVAL theory with loyalty chain stage theory in two key ways. It extends PERVAL theory by empirically demonstrating hierarchical relationships between value dimensions, satisfaction, and loyalty outcomes in energy-efficient products. It also enhances loyalty chain stage theory by breaking down the conative loyalty stage into three distinct behavioral outcomes: willingness to pay premium prices, repurchase intention, and positive word-of-mouth intention.

The last contribution comes from the methodological perspective. The findings of this research confirmed the great potential of NCA and IPMA as complementary analyses to PLS-SEM, extending methodological approaches in sustainable consumption research. The necessity of social value for satisfaction reflects Vietnam's collectivistic culture, where consumers strongly identify with groups, making social image critical for behavioral outcomes ([Luong, 2021](#)). The NCA results showed that all dimensions of perceived value are

essential for consumer satisfaction, with these dimensions acting as complements rather than substitutes. While social value proved insufficient from a sufficiency perspective, it remains necessary for consumer satisfaction, highlighting the importance of this finding. The IPMA results further demonstrated that functional value and environmental value are the most crucial value attributes examined, despite carrying the least weight for performance. IPMA thus provides context-specific practical insights by indicating which perceived value dimensions should be prioritized to improve consumer satisfaction. This study showcases the effectiveness of integrating NCA and IPMA with PLS-SEM in studying consumer behaviors, offering a helpful reference for future scholars pursuing multi-method quantitative analysis.

5.2 Practical implications

Given the findings on the essential role of functional and environmental value in building consumer satisfaction and loyalty despite their underperformance, energy-efficient appliance manufacturers should prioritize improving energy-saving products' durability, noise mitigation, and energy efficiency. Retailers and policymakers should highlight the environmental credentials of energy-saving products, such as reducing energy consumption and carbon emissions, to consumers. Furthermore, given the vital role of emotional and price value, consumers should be provided with clear information about the comfort these products offer and the potential monetary savings they can achieve. To reinforce the connection between consumer satisfaction and loyalty outcomes, retailers and manufacturers of energy-efficient appliances should provide prompt after-sales support, including installation and repair services.

Given the importance of consumer perceived value dimensions in shaping consumer satisfaction and loyalty, retailers and manufacturers of energy-efficient appliances need to meet specific levels of these factors to achieve desirable outcomes. Moreover, the bottleneck analysis identifies the critical value perception thresholds required for various levels of consumer satisfaction. Companies should meet these baseline requirements before investing in additional value dimensions. Additionally, it reveals how efficiently retailers and manufacturers of energy-saving products allocate their resources. For instance, companies that have over-invested in certain areas can redirect their resources toward value perceptions that fall below necessary threshold levels for achieving desired outcomes.

The moderating effect of the product category on the association between perceived value dimensions and consumer satisfaction calls for tailored communication strategies. For large energy-efficient products, marketing messages should emphasize functionality and potential cost savings, positioning them as practical and reliable household solutions with advanced technological features and energy-saving benefits. In contrast, small energy-efficient appliances should be marketed for their emotional benefits and social value as lifestyle-enhancing products that provide comfort and pleasure. Retailers should promote the environmental value of small products by communicating how their use can contribute to a greener environment and social well-being, despite their size. Sales staff should receive thorough training on energy-efficient appliances' benefits, as their support significantly strengthens the impact of energy information on consumers (Solà *et al.*, 2023). To effectively promote consumer satisfaction and loyalty, informational campaigns should highlight each product category's most relevant value dimensions. Policymakers should provide clear guidance for product selection, energy label interpretation, and optimal usage patterns. However, it is worth noting that even energy-efficient appliances may not achieve their full savings potential if used excessively (Huh *et al.*, 2019).

The findings have important societal implications. Given that consumers are interested in repurchasing and recommending energy-efficient appliances but hold unbalanced value perceptions, pro-environmental organizations and communities need to develop educational programs that promote energy-efficient appliances and directly address consumers' hesitations about adopting more efficient options. Moreover, energy policies would work better by incorporating clear, accessible information about cost savings and environmental benefits in energy label designs, which would boost public acceptance of these products.

6. Conclusions, limitations, and future research

This study is among the first to comprehensively determine the effect of perceived values on consumer satisfaction and consumer loyalty using sufficiency and necessity logic based on PLS-SEM, IPMA, and NCA. The findings illuminate that all perceived value dimensions are important factors of consumer satisfaction, although social value is not a must-have factor. The moderating mechanism of product category on the relationship between consumer perceived values and satisfaction is also investigated. The findings, therefore, provide academics with a deeper understanding of the complexities within the proposed relationships and offer practitioners insights to pay attention to critical dimensions that can raise consumer satisfaction and loyalty toward energy-efficient appliances.

Some limitations should be acknowledged in this research. First, the use of non-probability sampling techniques may limit the sample's representativeness. Future studies could enhance this by accessing a customer database from energy-efficient appliance retailers, which can serve as a sampling frame for a probability sampling technique. Second, this study collected data from the Vietnamese market, which might constrain the generalizability of the findings. Hence, future research could scrutinize the proposed model in other countries with different cultures. Third, relying on cross-sectional data might be a drawback when attempting to establish causality among the study constructs. This limitation can be addressed by designing longitudinal or experimental research in the future. Another avenue for future research is to treat consumer loyalty outcomes as second-order construct and explore the mechanisms under the effect of multiple dimensions of perceived value on consumer loyalty. Finally, future researchers should broaden the research framework of this study by incorporating other potential moderators, such as consumer identities (e.g. frugality, wastefulness) or perceived barriers (e.g. skepticism toward energy labels).

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Appendix

Table A1. Measurement scales

Scales	Sources
<i>Functional value</i>	<i>Zhang et al. (2020)</i>
FUV1	Advanced technology is featured in energy-saving appliances
FUV2	Energy-saving appliances are known for their consistent quality
FUV3	Energy-saving appliances are well-made
FUV4	Energy-saving appliances have good functions
<i>Price value</i>	<i>Zhang et al. (2020)</i>
PRV1	Energy-saving appliances provide cost-effective value
PRV2	Energy-saving appliances offer reasonable pricing
PRV3	Energy-saving appliances are cost-saving in the long term
PRV4	Energy-saving appliances offer excellent value for the price paid
<i>Emotional value</i>	<i>Zhang et al. (2020)</i>
EMO1	I like to use energy-efficient appliances
EMO2	The use of energy-efficient appliances brings me joy
EMO3	I feel good about using energy-efficient appliances
<i>Social value</i>	<i>Zhang et al. (2020)</i>
SV1	Using energy-efficient appliances would enhance my reputation
SV2	Using energy-efficient appliances would leave a positive impression on other people
SV3	Owners of energy-efficient appliances would get social acceptance
SV4	Having energy-efficient appliances would make me feel more accepted by people
<i>Environmental value</i>	<i>Zhang et al. (2020)</i>
ENV1	One way to prevent global warming is to use energy-saving appliances
ENV2	Using energy-efficient appliances helps to lower pollution levels in the environment
ENV3	Energy-saving appliances are generally considered to be environmentally friendly
ENV4	My appliance is more environmentally-friendly than other appliances
<i>Consumer satisfaction</i>	<i>Issock et al. (2020)</i>
SAT1	My appliance uses less energy, which makes me happy that I purchased it
SAT2	Because this appliance uses less energy than other ones, I think I made a good choice to buy it
SAT3	I am pleased with how well my appliance uses energy
SAT4	Purchasing this appliance was the right choice in terms of energy efficiency
SAT5	The product exactly meets my needs
<i>Willingness to pay a premium</i>	<i>Zhang et al. (2020)</i>
WTP1	In my opinion, purchasing energy-efficient appliances is worthwhile even though they are more expensive
WTP2	I am willing to spend extra on energy-efficient appliances rather than ordinary appliances
WTP3	Even at a premium price, I am willing to buy energy-saving appliances

(continued)

Table A1. Continued

Scales	Sources	
<i>Repurchase intention</i>		
RI1	I will consider buying energy-efficient products in the future	De Toni <i>et al.</i> (2018)
RI2	I will try to buy energy-efficient products in the future	
RI3	I will consider these products as my first option for purchasing in relation to others	
RI4	I will consume energy-efficient products again	
<i>Positive word-of-mouth intention</i>		
PWOM1	I will encourage my friends and relatives to buy energy-efficient appliances	Hameed <i>et al.</i> (2021)
PWOM2	I talk about the benefits of household appliances with high energy-efficiency ratings	
PWOM3	When it comes to household appliances, I always recommend those with higher energy-efficiency ratings over those with lower ratings	
PWOM4	I feel proud to inform people that I use energy-efficient appliances in my home	
Source(s): The authors		

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