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Determinants of Intention to Purchase Energy-Efficient Appliances: Extended Technology Acceptance Model

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ABSTRACT

Energy is the most important factor for our daily lives, but traditional energy sources like coal, petroleum and gas were polluting the environment. To address this issue, people are considering energy-efficient technologies, which consume less energy and eco-friendly in nature. This paper investigates the factors influencing the intention to purchase of energy-efficient appliances in India. Utilizing the Technology Acceptance Model (TAM), the study examines how perceived ease of use, perceived usefulness, functional value, perceived cost, environmental concern affects their intention to purchase. Non-probability convenience sampling technique was applied. Based on the results, perceived ease of use, perceived usefulness, functional value, perceived cost, environmental concern positively influences the intention to purchase energy-efficient appliances. The eco-friendly purchasing behaviour has significant societal implications, including reduced carbon emissions, conservation of natural resources and environmental sustainability.

Keywords: Energy-Efficient Appliances, Technology Acceptance Model, Intention to Purchase, Functional Value, Perceived Cost, Environmental Concern

JEL Classifications: C12, D12, F64, P18, Q42

1. INTRODUCTION

Energy is the lifeblood of modern society. As the economy undergoes rapid development driven by industrialization, modernization, and population growth, there is a corresponding increase in the demand for energy (Warsame, 2022). According to the International Energy Agency (IEA), India ranks third globally in terms of greenhouse gas emissions. The nation's contribution is about 7% of global emissions or up to 2.5 billion metric tonnes of CO₂ (Akadiri and Adebayo, 2021). Over recent times, fossil fuels have become economically exploitative and ecologically destructive sources that are gaining popularity amongst industry and people at large (Bimanatya and Widodo, 2018). For this reason, there needs to be a change towards alternative sources of energy due to the limited supply and environmental damage

caused by fossil fuels (Dey et al., 2022). In order to ensure energy security, there should be effective changes in global energy policies regarding energy consumption (Zhang et al., 2017). Negative effects of climate change can be reduced by taking such measures by using renewable forms of energy like wind or solar power which are more efficient in terms of energy conservation and taking up clean technologies. These types of renewable energy use resources including solar radiation, winds, tidal waves, biomass, geothermal heat among others that do not harm nature (Maradin, 2021).

At present, people have become more aware of environmental issues such as pollution and climate change. This has resulted in the adaptation of eco-friendly products including solar energy systems, Electric vehicles and chargers, LED bulbs, Smart

motion sensors, heat pumps and reusable packaging by consumers (Alam et al., 2019). People are aware of using energy-saving appliances which can prevent environmental degradation and minimize power consumption (Hua and Wang, 2019). The use of renewable energy solutions in homes coupled with efficient use of energy could make a significant contribution towards the reduction of greenhouse gas emissions (Li and Just, 2018). In view of changing consumer attitudes, firms and scholars are placing greater emphasis on environmentally friendly product design and technology development. In addition to environmental concerns, the adoption of energy-saving technologies is influenced by other factors such as social and economic ones (Trotta, 2018). Through adopting eco-friendly technologies up to 30% of greenhouse gases are avoided while at the same time leading to sustainable development (Fatima et al., 2022). Innovative energy-efficient technology may cause continual improvement in energy efficiency over a long period (Luiten and Blok, 2003). Energy-efficient technologies support economic growth, industrial innovation, job creation as well as reducing carbon emissions (Pehlivanoglu et al., 2021).

Engagement in social activities positively associates with environmentally responsible behaviour, as individuals with strong environmental values tend to invest more in energy-saving appliances (Fachrudin and Fachrudin, 2021). Furthermore, household energy usage and conservation practices are shaped by daily habits, routines. Moreover, the adoption of household appliances is impacted by energy costs and favourable policy settings (Ameli and Brandt, 2015). In this study, the Technology Acceptance Model (TAM) is applied to investigate individuals' intention to purchase energy-efficient appliance. TAM provides insights into how people perceive and support new technologies, with this intention being influenced by two key components: Perceived usefulness (PU) and perceived ease of use (PEU) (Caffaro et al., 2020; Nguyen et al., 2023). Additionally, factors like perceived cost (Ali and Naushad, 2023), functional value (Sweeney and Soutar, 2001) and environmental concern (Malik et al., 2020) are essential for understanding and promoting the adoption of energy-efficient appliances. This study proposed three research questions to address the identified gap in research:

- RQ1 - What are the key determinants influencing consumers' intention to purchase energy-efficient appliances?
- RQ2 - How do perceived usefulness and perceived ease of use, as conceptualized by the Technology Acceptance Model (TAM), influence consumers' intention to purchase energy-efficient appliances?
- RQ3 - What other factors, such as perceived cost, functional value, and environmental concern, influence consumers' intention to purchase energy-efficient appliances?

Following a discussion of the research problem on intention to purchase energy-efficient appliances through the effect of TAM, a series of research hypotheses are proposed. They are presented in Part 2 and Part 3 explains the research methodology. Part 4 presents the data analysis and findings. Part 5 concludes the study with implications.

2. HYPOTHESIS FRAMEWORK

2.1. Perceived Ease of Use (PEOU) and Intention (INT)

Perceived ease of use is the perception that a system is simple and convenient. It significantly impacts adopting a new technology (Chen and Aklikokou, 2019). In the case of energy-efficient appliances with new technology, consumers' preference to own and use them is influenced by their perception of the products' ease of operation (Hua and Wang, 2019). Perceived ease of use had a significant relationship with intention to purchase renewable energy technology (Fatoki, 2022) and energy-efficient appliances (Hua and Wang, 2019).

H₁: PEOU significantly influences the intention to purchase energy-efficient appliances.

2.2. Perceived Usefulness (PU) and Intention (INT)

Perceived usefulness (PU) refers to the belief that a system enhances performance by simplifying work and improving accuracy (Chen and Aklikokou, 2019). This perception is influenced by both the product's ability to reduce working hours and improve efficiency. Perceived usefulness is associated with benefits such as cost savings and improved quality of life, with perceived ease of use also impacting this perception positively (Hua and Wang, 2019). It had a positive relation with the intention to purchase energy appliances (Fatoki, 2022).

H₂: PU significantly influences the intention to purchase energy-efficient appliances.

2.3. Functional Value (FV) and Intention (INT)

Functional value is associated with the product's ability to achieve practical goals, including factors like quality, availability, environmental impact, health benefits, and safety. Consumers perceive utility in making selections that align with these functional aspects of the product (Sweeney and Soutar, 2001). Products that include additional functional features would gain a competitive advantage in drawing in new markets and customers, thereby strengthening their sustainability (Zahid and Ahmed, 2017). Functional values served as primary motivators influencing consumers' choices. Individuals who adopted energy-efficient technology appliances not only had the benefit of standard functional values such as performance but also gained extra advantages, including monetary and convenience benefits (Han et al., 2017).

H₃: FV significantly influences the intention to purchase energy-efficient appliances.

2.4. Perceived cost (PC) and Intention (INT)

The cost of a product was closely associated with the effectiveness obtained from its usage. The cost played a significant role in influencing the adoption of new products or technology (Suhud and Willson, 2019). While making purchasing decisions, customers assessed both the perceived cost and the usefulness of the product. If the perceived benefits outweighed the cost, customers were more

likely to buy the product (Elmustapha et al., 2018; Lin et al., 2020). This cost-effectiveness analysis was a psychological and economic process, where consumers mentally evaluated the balance between their monetary investment and the perceived benefits gained from a product. In this decision-making process, individuals compared different options to determine which one offered the best value for the money spent (Akroush et al., 2019).

H₄: PC significantly influences the intention to purchase energy-efficient appliances.

2.5. Environmental Concern (EC) and Intention (INT)

Environmental concern involved expressing anxiety about environmental risks and a commitment to protecting nature. Nowadays, environmental concerns gained attention due to their association with eco-friendly behaviour (Ahmed et al., 2020). Individuals with environmental concern displayed characteristics such as high perceived consumer action against pollution, openness to new ideas, interest in product functionality, satisfaction of curiosity and a strong need for personal safety. Various dimensions, including sensitivity to environmental change, awareness of clean energy and alternative sources, and energy conservation, served as explicit measures of environmental concern (Arisal and Atalar, 2016). In the environmental domain, most research indicated that environmental concern directly influenced environmental purchase intentions (Newton et al., 2015). This suggested that individuals who showed a high level of environmental concern were more likely to express an intention to engage in environmentally oriented consumer behaviour, reflecting a growing awareness of the environmental impact of one's decisions in society at that time (De Canio et al., 2021).

H₅: EC significantly influences the intention to purchase energy-efficient appliances.

3. RESEARCH METHODOLOGY

In this study, a cross-sectional research design was used, employing a survey questionnaire to collect data. The questionnaire featured closed-ended questions arranged on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). To effectively collect data in India, the electronic survey questionnaire was selected as the most suitable method.

3.1. Measures

The constructs and items for this study were identified from existing literature. These constructs and items were modified to associate with the specific objectives of the study. PEOU (3 items) and PU (3 items) were adopted from (Wu et al., 2019; Fatoki, 2022). FV (4 items) was adopted from Sweeney and Soutar 2001; Zhang et al. 2020. PC (5 items) was adopted from Masukujjaman et al., 2021. EC (7 items) and Intention to purchase (3 items) were adopted from Fatoki, 2022.

3.2. Sampling and Data Collection

The present study examined the purchase intention of energy-efficient appliances in India. The present study opted for a non-probability convenience sampling method, to select the

respondents with the awareness about energy-efficient appliance. Online survey questionnaires were distributed via email and social media platforms, totalling 470 questionnaires. Of these, only 301 respondents completed the entire survey. The sample consisted of 36% males and 64% females. The demographic profile by age group was as follows: 21-30 years old (61.5%); 31-40 years old (16.3%); 41-50 years old (13.6%); and over 50 years old (8.6%). Respondents were well educated, with 83% holding a university degree. Additionally, 59% of the respondents resided in urban areas.

4. DATA ANALYSIS AND FINDINGS

The collected data was analysed by using the Structural Equation Model (SEM) technique, utilizing partial least squares (PLS), with assistance from SmartPLS 4 software. Through SEM, the study explored the relationships between exogenous variables such as PEOU, PU, FV, PC, EC on the endogenous variable which is intention to purchase was shown in Figure 1. This analysis helped in assessing the extent to which these variables impact the purchase intention of energy-efficient appliance.

4.1. Measurement Model

In this study, the primary analysis focuses on evaluating the indicators used to measure latent variables to determine their suitability and adequacy. This assessment involved examining the standard loading factor values of each indicator, indicating their level of contribution to the measured latent variable. For an indicator to be considered appropriate and relevant, its standard loading factor value should surpass 0.6 (Chen and Tsai, 2007). Table 1 shows factor loadings, which ranged from 0.689 to 0.898, demonstrating strong associations between the observed items and their underlying constructs. Reliability can be evaluated using methods such as Cronbach's Alpha coefficient and Composite Reliability, which measure the consistency and dependability of the indicators in measuring the latent variable. The results showed that the composite reliability for each latent constructs exceeded 0.712, higher than the recommended value of 0.7 and indicating good reliability. Cronbach's coefficient alpha reported values above 0.713, exceeding the minimum acceptable value of 0.7, indicating strong internal consistency and reliability (Nunnally, 1994). Furthermore, the validity of variables was examined through convergent and discriminant validity analyses, which assessed the correlation between indicators and the latent variable. The value of average variance extracted (AVE) exceeding 0.616 for each variable, higher than the recommended value of 0.5, Convergent validity was established (Hair et al., 2020). Discriminant validity was established, using the Fornell-Larcker criterion methods. Table 2 displays the results of the Fornell-Larcker criterion, indicating that the square root of AVE for each construct exceeded the correlation coefficients between that construct and all others (Hair et al., 2020). The Variation Inflation Factor (VIF) values for all variables ranged from 1.243 to 2.972, which is less than the recommended value of 5, recommending that multicollinearity was not a significant issue in the dataset (Hair et al., 2020). Therefore, the study concluded that the model demonstrated an acceptable overall fit. The coefficient of determination (R²) indicates the extent to which one variable's variance can be explained by another.

Table 1: Measurement model

Variables	Items	Outer loadings	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)	VIF
PEOU	PEOU 1	0.786	0.713	0.712	0.636	1.559
	PEOU 2	0.759				1.251
	PEOU 3	0.846				1.734
PU	PU 1	0.843	0.739	0.739	0.655	1.943
	PU 2	0.774				1.243
	PU 3	0.809				1.811
FV	FV 1	0.845	0.867	0.873	0.716	2.156
	FV 2	0.898				2.972
	FV 3	0.796				1.796
	FV 4	0.842				2.336
PC	PC 1	0.763	0.830	0.837	0.598	1.853
	PC 2	0.879				2.642
	PC 3	0.689				1.456
	PC 4	0.773				1.854
	PC 5	0.751				1.631
EC	EC 1	0.719	0.896	0.904	0.616	2.339
	EC 2	0.835				2.740
	EC 3	0.832				2.790
	EC 4	0.747				2.606
	EC 5	0.843				2.745
	EC 6	0.757				2.149
	EC 7	0.753				2.576
INT	INT 1	0.876	0.851	0.851	0.771	2.077
	INT 2	0.873				2.006
	INT 3	0.884				2.187

PEOU: Perceived ease of use, PU: Perceived usefulness, FV: Functional value, PC: Perceived cost, EC: Environmental concern, INT: Intention

Table 2: Discriminant validity

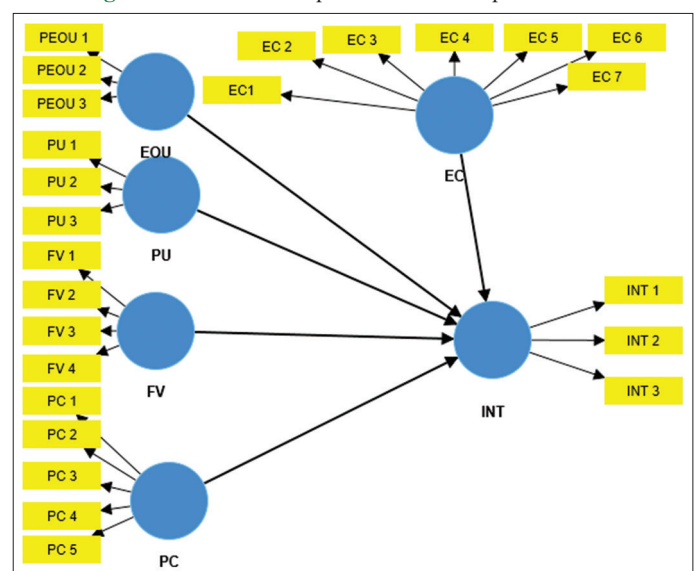
Constructs	EC	FV	INT	PC	PEOU	PU
EC	0.785					
FV	0.546	0.846				
INT	0.731	0.693	0.878			
PC	0.587	0.709	0.682	0.773		
PEOU	0.583	0.583	0.730	0.555	0.798	
PU	0.761	0.629	0.766	0.648	0.662	0.809

PEOU: Perceived ease of use, PU: Perceived usefulness, FV: Functional value, PC: Perceived cost, EC: Environmental concern, INT: Intention

Table 3: Hypotheses test

Relationship	Hypotheses	β	T statistics	P-values
PEOU \rightarrow INT	H1	0.280	5.139	0.000
PU \rightarrow INT	H2	0.200	3.361	0.001
FV \rightarrow INT	H3	0.184	3.268	0.001
PC \rightarrow INT	H4	0.124	2.280	0.023
EC \rightarrow INT	H5	0.243	4.524	0.000

PEOU: Perceived ease of use, PU: Perceived usefulness, FV: Functional value, PC: Perceived cost, EC: Environmental concern, INT: Intention

Figure 1: Partial least squares structural equation model


standardized estimated value of 0.200 ($P = 0.001$). This indicates that when people realize energy-efficient appliances as valuable and helpful, it strengthens their desire to buy them. They believe

that these appliances will meet their needs, provide useful benefits and save them money.

Hypothesis H₃: H₃: FV significantly influences the intention to purchase energy-efficient appliances. From Table 3, functional value positively influences the intention to purchase energy-efficient appliances with β value of 0.184 ($P = 0.001$). This finding indicates that when individuals recognize the practical benefits and suitability of energy-efficient products, they are more inclined to purchase them. It suggests that consumers prefer products that offer benefits relative to their cost and meet their specific functional needs.

Hypothesis H₄: PC significantly influences the intention to purchase energy-efficient appliances. The result shows a positive and significant relationship between perceived cost and intention to purchase with β value 0.124 ($P = 0.023$). This indicates that individuals' perception of cost influences their intention to buy, suggesting that affordability is a significant factor in their purchasing decision-making process.

Hypothesis H₅: EC significantly influences the intention to purchase energy-efficient appliances. Based on the results, EC has positive and significant impact on intention to purchase, with a β value of 0.243 ($P = 0.000$). This implies that people who care more about the nature are inclined to purchase eco-friendly products.

5. DISCUSSION, IMPLICATION AND CONCLUSION

5.1. Discussion

The study aims to identify the determinants of intention to purchase energy-efficient appliances. The various factors influencing consumers' intention to buy environmentally friendly appliances include PEOU, PU, FV, PC and EC. Perceived usefulness and perceived ease of use as conceptualized in TAM are key elements that affect consumers' intent to purchase energy-efficient technologies. This TAM framework posits that people adopt new technology and system if they see it as useful and convenient to use. Consequently, improving the usefulness and ease of use of energy-efficient products could enhance a consumer's intention to buy them. In addition, user-centred design and clear communication on the benefits of energy-efficient products can help in attracting consumers. This underlines the importance of designing for users and promoting energy efficiency attributes that will attract buyers using effective communication channels. Additionally, consumer's intentions towards purchasing energy-efficient appliances are driven by other aspects such as perceived cost, functional value, and environmental concern. Perceived cost involves to consumers' perceptions of the financial associations of buying energy-efficient appliances, whereas functional value shows how much these devices appear beneficial or useful to them. Environmental concern represents consumers' awareness and commitment to environment, which may lead their willingness to invest in energy-efficient technologies. Understanding the interplay between these factors is important in developing marketing strategies and policies for encouraging consumers to adopt energy-efficient technologies.

5.2. Theoretical Implication

This study contributes to the existing literature by using the TAM to investigate consumers' intentions toward purchasing energy-efficient appliances. This research also adds theoretical knowledge on how PEOU, PU, FV, PC and EC influence consumer intentions. Based on the study's findings, these determinants are important for businesses and policy makers who want to promote the use of energy efficient technology among customers. By identifying and addressing these factors, appropriate strategies can be developed to encourage consumers to prioritize energy efficiency in their purchasing decisions.

5.3. Conclusion

The study investigates how PEOU, PU, FV, PC and EC influence the intention to purchase energy-efficient appliances. The results indicate that these factors positively impact the purchase intention of energy-efficient appliances. The findings suggest that when consumers perceive energy-efficient products as easy to use, and capable of effectively meeting their needs, while providing tangible benefits in terms of efficiency and convenience, it enhances their inclination to purchase them, driven by personal ethical considerations. Additionally, recognizing the practical benefits and functionality of energy-efficient technologies motivates individuals to prioritize their purchases, as they value products that align with their specific functional requirements. Furthermore, perceiving energy-efficient products as cost-effective and providing long-term savings further influences their purchase intentions. Moreover, environmental consciousness stimulates individuals to express a stronger intention to buy energy-efficient appliances. This shift towards eco-friendly purchasing behaviour has significant societal implications, including reduced carbon emissions, conservation of natural resources, and overall environmental sustainability. Policymakers and governments should create awareness about energy-efficient technology. When consumers realize the need for energy savings, they tend to invest more in energy conservation measures. By promoting the intention to use energy-efficient technologies, individuals can contribute to collective efforts to fight against climate change and create a more sustainable future for generations to come.

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