



Awareness on Energy Efficient Products as Prediction on Intention to Subscribe to and Purchase Energy Efficient Services and Products

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Abstract. Issues related to high energy consumption is contemporary and concerning socio-politic situation in this country. Thus, the study aims at gauging public awareness on energy efficient products that have been in the market and how this awareness may indicate the future intentions of consumers in subscribing to and purchasing energy efficient services and products. The data were gathered from an online survey that had been distributed using common social media, which received 548 responses from all over Malaysia. A questionnaire was developed in three sections that focus on demography information, energy efficient products (EEP) and energy awareness. Smart PLS Version 3.0 was used to determine the influence of the different constructs on sample's attitude and intentions to purchase energy efficient products. The final analysis indicates that there is awareness on EEP label and other energy efficient products, environmental concern and perceived benefits and prices of the energy efficient product that have moderate correlation by R^2 0.692. Consumers attitude also has a moderate correlation of 64% in prediction intention to purchase of the consumer by R^2 0.644. Thus, the study shows that public already have good awareness on the energy efficient product and has started to purchase EEP. The study predict that consumer will purchase more energy efficient services and products in future.

Keywords: EE product · Environmental concern · Consumer attitude

1 Introduction

Malaysia is moving towards sustainable energy development to reduce the use of conventional energy that produces CO₂ emission. Tenaga Nasional Berhad (TNB) has pledged to support sustainability pathway with an aspiration to achieve net zero emissions by 2050, as a bold move towards decarbonisation and Renewable Energy (RE) [1]. In 2017, Malaysia's residential sector has been recorded to emit 2,347,538 tonnes of CO₂ and is expected to increase to 11,689,308 tonnes in few years [2, 3]. Households' energy efficiency behaviour is directly related to the monthly cost of energy which mean they have more direct control over energy consumption and the potential for savings through

behaviour change [4, 5]. On January 1, 2014, residential customers have seen an increase in electricity consumption of 10.6% on average which also showed the increase of tariff in the last decade [5, 6]. Hence, renewable energy resources have emerged as a viable option for achieving Malaysia's long-term energy development [6, 7]. Thus, it is important to take a step forward in educating the public regarding their energy consumption habits and cultivating a strategic mind set to conserve for sustainable living in the future [8, 9]. This is definitely a responsibility for all individuals in our society to be energy literate and wise consumers [10]. In line with Malaysia aspiration of revolutionizing the energy sectors in the aspect of smart grid, renewable energy and liberalization, it is important to make sure that the public is made aware and ready to move towards the direction that government is preparing. Since domestic consumer is the third biggest user of energy business, understanding the attitude and behavior pattern of the consumer is very important [2, 11, 12]. Thus, the study has two objectives that are i) to create public awareness on energy efficient products in the market and ii) to measure consumers' intention to purchase the energy efficient products in the future.

2 Energy Efficiency, Energy Efficiency Product and Consumer Behavior

The terms energy conservation, energy efficiency and renewable energy (RE) are often interchangeable as to lessen demand for energy and to safeguard the fast-depleting natural fossil fuel resources and to preserve the environment from harmful carbon emission [13]. Energy efficiency (EE) is recognized worldwide as the most powerful and cost-effective strategy for achieving goals of sustainable development [12]. Function of EE label is to promote consumers to buy energy efficient product and to encourage manufacturers to produce more EE appliances. In Malaysia 5 domestic appliances are issued with EE Star rating label Certification of Approval (COA) which are domestic fans, domestic lights, air conditioning units, refrigerator and TV. Performance Standards, Minimum Energy Performance Standards (MEPS), are types of energy measurements and class-average for energy efficient product manufactured [5]. Rating starts with 2 Star (minimum level of EE) and the highest is 5 Star (highest level of EE) [10]. Energy labels are informative labels to describe the manufactured product's energy performance in the form of energy use, efficiency, or energy cost [5]. The EE label is issued by the Energy Commission to manufacturers of electrical appliances who comply with the standards and requirements of the energy performance test for a star [14].

Households' electricity consumption varies more directly with household composition and social standing, and thus may be more responsive to behaviour change programs [15]. Kollmuss and Agyeman [16] conclude that behavior is the result of a complex interplay of demographic factors, external factors (including institutional, economic, and social and cultural factors), and internal factors (including motivation, environmental knowledge, values, attitudes, environmental awareness, environmental involvement, locus of control, and others). Psychological ownership and behavioral models are necessary to understand what consumers do, and why they do so [17–19]. It is predicted that social and emotional influences, issues of learning and awareness, and access to technologies will all play a role in formulating effective behavioral change among Malaysia's

domestic consumer [20]. Thus, by identifying the factors that influence consumers' attitude, may influence their intention in purchasing energy efficient product.

3 Study Design and Methodology

This study frames its conceptual framework from the theory of planned behavior (TPB) and electricity saving intention (ESI) concept developed in [22]. Based on the theory and concept, a questionnaire was designed and distributed.

3.1 Theory of Planned Behavior (TPB) and Electricity Saving Intention (ESI)

TPB is the theory that most typically used to anticipate pro-environment behavior [21, 22]. Ajzen [23] who championed the TPB theory explained that intention can predict actual behavior. Intention in turn is motivated by attitude, subjective norms, and perceived behavior control. TPB allows other variables to be added to the framework as long as they explain a wide range of behavior [24–26]. ESI can be explained as individual commitment to perform certain behavior that facilitates electricity saving. Many studies on attitude on electricity saving intention found that a positive attitude towards a certain behavior resulted in a stronger intention to perform the behavior [27], such as attitude toward green product [25, 26]. In our study there is a total seven variables that is grouped under the ESI attitude (eg. energy efficient product, consumer attitude), subjective norm (eg. environment awareness, environment concern) and perceived behavior control (eg. perceived benefits, perceived price, purchase intention). Figure 1 shows how the current study used several foundations of this theory to develop the conceptual framework. The environmental awareness (EA), environmental concern (EC), energy efficient product (EEP), perceived benefits (PB) and perceived price (PP) are the independent variables that make the consumer attitude (CA), which will influence the dependent variable of purchase intention of energy efficient product (PIEP).

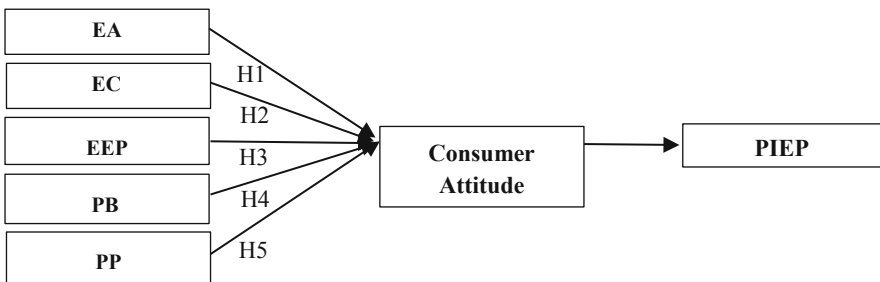


Fig. 1. Study framework and hypothesis

Attitude is a determinant as a product of psychological evaluation on the electric saving behavior that could lead to purchase intention of energy efficient product [16], subjective norm is how much consumers perceived that they are being pressured to conform to certain social expectation [23, 28]. Consumers are more likely to perform or

refrain from performing specific behaviors based on whether or not the behavior meets social expectations [26, 29]. Perceived behavior control (PBC) is described as perceived difficulty or ease of conducting a behavior [30]. Several studies have found a positive causal relationship between PBC and purchase intention in a variety of contexts, including green products [24], energy-saving intention [17] and environmentally conscious consumption behavior [23, 31]. The paragraphs below describe the variables involved in the conceptual framework.

Energy Awareness (EA). High level of awareness about energy challenges can predict consumer orientation toward energy conservation behaviour [32] this may lead to consumers' positive attitudes toward changing their behaviour in response to energy challenges [26].

Environmental Concern (EC). Environmental concern is described as the extent to which people are aware of environmental issues and want to help solve or contribute to environmental on a personal level [33]. [34, 35] found that consumers' intentions to purchase energy efficient products are significantly influenced by EC.

Energy Efficient Product (EEP). People had higher chances of performing positive behavior towards environmental when they actually believed that they could do something about the matters through their action at personal level [26] such as purchasing EEP may indicate this environmentally responsible behavior.

Perceived Benefits (PB). [24, 27, 36] emphasized that people's willingness to buy environmentally friendly products can be influenced by perceived benefits. Consumers are more likely to buy a product if they believe there will be advantages to doing so. Akroush, et al. [36] discovered that perceived benefits influence EA consumers' purchasing intentions.

Perceived Price (PP). Perceived price is attitudinal influence that an energy efficient product has upon consumer purchasing EEP [36]. Previous study indicated that the price of EEP could outperform the perceived quality of the EEP. Consumers typically will evaluate the cost and benefits subjectively prior to purchase.

Consumer Attitude (CA). Consumer attitude is defined as the degree to which a person has a favourable or unfavourable evaluation or approval of a specific behavior [23]. Many studies have found that consumer purchase intentions for EEP are heavily influenced by their attitude toward such products in terms of energy awareness, perceived benefits, and perceived price [36].

Purchase Intention (PI). The degree to which consumers believe they will purchase such products is referred to as purchase intention [32]. Consumers who have a strong desire to buy are more likely to engage in purchasing behaviour than those who have no desire to buy [25]. A strong desire to purchase and use a green product can lead to actual purchase and use [25, 37].

Based on the TPB theory and ESI concept, the study aligns EA, EC, EEP, PB and PP to form consumer attitude variable towards ESI and this will predict positive PBC

in the form of intention to purchase. To measure the relationship between each variable, the study will look at these hypotheses.

1. H1: Energy awareness have positive relationship with consumer attitude
2. H2: Environmental concern has positive relationship with consumer attitude
3. H3: Energy efficient product has positive relationship with consumer attitude
4. H4: Perceived benefits have positive relationship with consumer attitude
5. H5: Perceived price have positive relationship with consumer attitude
6. H6: Consumer attitude (EA, EC, EEP, PB, PP) has positive relationship with purchase intention

3.2 Questionnaire Design

Based on the above theory, a questionnaire was designed. The questionnaire was adopted from [21] and [36]. They were adjusted according to local need and the objectives of the study. The questionnaire is divided into three sections. Section A intended to collect the demographic information of the respondents. Section B, was arranged to gauge the awareness of EEP available in the market and C assessed the seven variables such as energy efficient product awareness, environmental concern, perceived prices of energy efficient product, perceived benefits of energy efficient product, and intention to purchase energy efficient product in the future as shown in Table 1.

Table 1. Questionnaire design.

Section	Description	Measurement
Section A	Demographics information	Descriptive
Section B	Energy efficient product in market	Descriptive
Section C	Energy efficient product awareness Energy awareness Environmental concern Perceived benefits Perceived price	Likert interval scale

3.3 Questionnaire Distribution

This quantitative study involved a set of self-administered questionnaires that are issued through online and social media channels; WhatsApp, Telegram, Facebook, Emails, Tweeter and Instagram. The survey questionnaire in Google Form was distributed around six weeks with every participant received Touch and Go e-voucher worth RM10 upon completion of the survey. The study uses simple random sampling methods targeting all population aged 18 and above.

4 Result and Analysis

A total of 553 responses received from which only 548 were usable responses received and analyzed. All statistical data were analyzed by using Smart PLS version 3.0 for correlational and regression. The data was analyzed to examine the study objectives which focus on:

1. public awareness on energy efficient products in the market and;
2. intention to purchase the energy efficient products in future.

Smart PLS Version 3.0 was used to conduct the inferential statistical analysis that determined the awareness of energy label, perceived benefits, energy awareness, environmental concern and perceived price influence, consumer attitude, and impact on purchase intention of energy products. The study used two phases of analysis. The first analysis is the descriptive analysis where it highlights the statistics and percentages of some of the variables. The second phase is the correlation and regression analyses that measure the possible and existing relationships between variables.

4.1 Validity and Reliability of the Study

Internal reliability and convergent validity tests were performed to validate the model. Internal reliability was evaluated using Cronbach’s alpha and composite reliability tests. The results showed that the constructs’ Cronbach’s alpha coefficients had a large vertical extent to predict. Table 2 showed that the values of all constructs were between 0.746 and 0.917. It was established that all the constructs achieved values higher than 70% for composite reliability, thus meeting the standard level of reliability. Composite reliability values were identified as it was appropriate for both to be considered and disclosed based on composite reliability table below.

Table 2. Composite reliability table

Construct	Items	Outer loading	Cronbach’s alpha	Composite reliability	Average variance extracted (AVE)
Energy efficient product	EEP1	0.827	0.777	0.857	0.601
	EEP2	0.833			
	EEP3	0.721			
	EEP4	0.713			
Perceived benefits	BEF1	0.828	0.909	0.929	0.687
	BEF2	0.848			

(continued)

Table 2. (continued)

Construct	Items	Outer loading	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
	BEF3	0.843			
	BEF4	0.790			
	BEF5	0.822			
	BEF6	0.841			
Consumer attitude	CA1	0.795	0.902	0.919	0.535
	CA10	0.670			
	CA2	0.760			
	CA3	0.820			
	CA4	0.812			
	CA5	0.728			
	CA6	0.673			
	CA7	0.737			
	CA8	0.719			
	CA9	0.568			
Energy awareness	EGAW1	0.670	0.749	0.833	0.502
	EGAW2	0.790			
	EGAW3	0.728			
	EGAW4	0.746			
	EGAW5	0.592			
Environmental concern	ENV1	0.840	0.845	0.897	0.685
	ENV2	0.871			
	ENV3	0.739			
	ENV4	0.856			
Purchase intention energy products	PI1	0.846	0.87	0.911	0.720
	PI2	0.800			
	PI3	0.903			
	PI4	0.841			
Perceived price	PRI1	0.939	0.917	0.947	0.857
	PRI2	0.911			
	PRI3	0.927			

4.2 Descriptive Analysis

The 548 valid returned responses consisted of almost equal gender distribution with 272 (49.6%) male and 276 (50.4%) female participants [30, 36]. Middle age adult of 29 to 38 years old group has been the main population of the study sample with 184 participants (33.6%). The majority of respondents have at least a bachelor's degree (284/51.8%) and also work in the private sectors (277/50.5%). The overall incomes of the majority of the respondents are in the range of between RM4000 to RM4850, which are in the B40 group living in a 3-bedroom double storey houses, with a minimum of 9 900 sq. ft. to 1200 sq. ft. The normal electricity bills that they have paid monthly are between RM51 and RM100. The gathered data also indicate that the study population is made up of educated people who are currently establishing their life in terms of work and financial status. They are also still having young children living together in the same residents.

It is worth to be noted that 153 respondents are satisfied with the Smart Meter that they have installed (27.9%). Another important input is that 40 respondents (7.3%) are satisfied with their solar panel system. Although majority is categorized in B40 groups, but the awareness regarding energy efficient product is high and this can be seen by their responses of product such as air conditioned, TV and refrigerator that they have already owned. Thus, it showed that the many respondents have certain level of awareness regarding energy efficiency as promoted by government. They are also keeping themselves updated with the sustainable technology like solar panel system and smart meter [3, 9, 11, 12].

4.3 Correlation and Regression

As described earlier, this study postulated six research hypotheses based on the developed conceptual research framework. The structural findings indicate that all of the hypotheses (H1-H6) are supported as shown in Table 3. For H2, the values of β -coefficient (0.388) and t (9.753) indicate the Environmental Concern (EC) as the primary determinant of Consumer Attitude (CA). Positive and significant relationships are also found between Energy Awareness (EA) and CA ($\beta = 0.093$, $t = 5.089$), Awareness on Energy Label (EA) and CA ($\beta = 0.187$, $t = 5.089$), Perceived Benefits (PB) and CA ($\beta = 0.158$, $t = 3.047$) and Perceived Price (PP) and CA ($\beta = 0.223$, $t = 7.656$), providing support for hypotheses H1, H3, H4 and H5. There is no negative relationship between the variables. For H6, it is supported by the strong relationship between CA and Purchase Intention of Energy Efficient Products (PIEP) ($\beta = 0.803$, $t = 52.588$). The correlation (R^2) result for CA is 0.692, which is considered moderate as it indicates that 69.2% of the variance in consumer attitude could be justified by energy awareness, environmental concern, awareness on energy label, perceived benefits and perceived price. Meanwhile, R^2 result for PIEP is 0.644, which is considered moderate as it indicates that 64.4% of the variance in purchase intention energy product could be justified by consumer attitude. This indicates that consumer attitude construct has a moderate connection with purchase intentions construct with R^2 for both construct values above 0.6.

Table 3. Hypotheses testing results

	Path	*Beta, β	Standard deviation	T statistics	**P- values	Result
H1	Energy efficient product → Consumer attitude	0.187	0.037	5.098	0.00	Supported
H2	Perceived benefits → Consumer attitude	0.158	0.052	3.047	0.00	Supported
H3	Energy awareness → Consumer attitude	0.093	0.039	2.36	0.00	Supported
H4	Environmental concern → Consumer attitude	0.388	0.04	9.753	0.00	Supported
H5	Perceived price → Consumer attitude	0.223	0.029	7.656	0.00	Supported
H6	Consumer attitude → Purchase intention energy products	0.803	0.015	52.588	0.00	Supported

* Standardised Beta Coefficients. ** Significant at $P < 0.05$

5 Conclusion

The purpose of this study is to examine the factors influencing consumers' attitudes toward energy efficient products. The impact of consumer attitudes on purchasing intentions for energy-efficient products was also investigated. A conceptual framework was developed based on the TPB theory and ESI concept by including the vital constructs. Findings of this study show that the attitude is a predictor for consumers' intention to purchase energy efficient products. The attitude variable is influenced by several independent variables such as the energy awareness, environmental concern, awareness on energy label, perceived benefits and perceived price and consumer attitude. From this study, we understand that the consumers' attitude has been notable in predicting the purchasing intention towards EEP. The results also show us that the consumers also take into consideration the price, energy label, benefits and energy consumption when deciding to purchase the green products. The five factors studied also have significant influence on the consumer attitude that leads to the intention to purchase the EEP in future. These factors can aid as the elements to be considered in promoting the use of energy efficient products and appliances more actively from the household perspective.

The percentage of those who are considering to adopt smart meters and solar panels are also impressive. Financial and environmental advantages of energy efficient products should be emphasized to consumers more directly in comparison with non-energy efficient appliances. These factors should be the highlights of EEP promotional and marketing strategies to win public trust and confidence in using EEP. It is worth to note few limitations in this study. The research is formed on a survey of Malaysian residents that was conducted online in a short period of time. Apart from that, the demographic factors such the classification of the area, i.e. urban and rural, is unknown. The limitations may influence the economic activities, level of awareness, belief and wider access to EEP.

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