The Relationship of Awareness and Satisfaction to Consumer Motivation in Energy Consumption Behavior

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Abstract: In supporting United Nation Sustainable Development Goal (SDG), the government of Malaysia has implemented policy and initiative to improve energy efficiency. In spite of these initiates, the electricity consumption has increased yearly as reported by Malaysia Energy Commission (MEC). Hence, this study aims to (1) investigate factor on awareness in energy consumption and efficiency of residential users and their motivation to change their consumption behavior, and (2) examine the relationship between satisfaction of residential users as the moderating factor to their motivation to change user consumption behavior. A total of 400 residential energy users have participated in the survey and data was analyzed using Smart PLS. Results indicated that consumer awareness of monthly electrical bill and satisfaction towards energy efficient product has positive effect on consumer motivation about current energy issue. This may indicate that the increase in monthly electricity bill has an effect on consumer awareness on their electrical consumption. In addition, consumer satisfaction towards energy efficient product leads to higher motivation level of users to modify their energy consumption behavior.

Keywords: Consumption, Electric bill, Energy, Sustainable Development Goal

I. INTRODUCTION

One of the global issues that advocated by the United Nation is Energy conservation. In its United Nation Sustainable Development Goal (SDG) stipulated in goal number seven, 'Affordable and Clean Energy' aims to increase energy efficiency twice as high by the year 2030 [1]. In line with SDG, Malaysia has developed policy and initiatives to support this goal since a few decades ago.

Policy such as National Energy Policy 1979, National Energy Efficiency Policy and Energy Efficiency Plan in the Tenth Malaysia Plan which aim to conserve energy, promote energy efficiency, and remove any lavish and non-productive designs of energy usage [2]. In the Energy Efficiency Plan, many initiatives were introduced based on three categories of energy users that comprise residential, industrial and building.

Among the plans and initiatives to increase energy efficiency include replacing out of incandescent light bulbs, energy performance classification and introduction of Minimum Energy Performance Standards (MEPS) for selected household electric appliances, increase the use of energy efficiency of electrical apparatuses and electronic gear, wider adoption of the Green Building Index (GBI) and increase the use of thermal insulation for roofs in air conditioned buildings to save energy [2]. Despite these initiatives the electricity consumption has increased year by year as reported by Malaysia Energy Commission (MEC) [3]. The increase of the electricity usage was mainly associated with the increasing use of electrical appliances such as washing machines, TV, refrigerators, air-conditioner, refrigerator and many more from residential or household users. The top six most inefficient use of energy consumption include refrigerator-freezer, air-conditioner, washing machine, fan, rice cooker and iron [4].

Hence, the study on residential users are deem important as they are main users of these household appliances. Their energy consumption behaviour will have direct impact on total energy usage in the country. There are many factors that influence consumer energy consumption behavior. Socio-economic, demographics, housing/dwelling, household attitudes, household lifestyle and technology advancement are among of mostly discussed factors [5]. Therefore, consumer energy consumption behaviour would require imparting knowledge on how to save energy and how to use energy efficiently [6]. Past study revealed that changing consumer consumption behaviour would lead to decrease energy consumption [7]. Factors such as social, emotional influences, issue of learning and awareness, coupled with accessibility to technologies know how is predicted to have a central impact in formulating effective behavior modification of consumer in the residential sector in Malaysia [8]. To become a sustainable society, the world must consume less energy and this could reduce the confrontation of multi energy issues that are effecting the economic, security, environmental and social and can put the world energy sustainability at risk. [9].

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However, there is limited study that investigates energy consumption behavior on residential users. This study aims to (1) investigate awareness factor in energy consumption and efficiency of residential users and their motivation to change their consumption behavior, and (2) examine the relationship between satisfaction of residential users as the moderating factor to their motivation to change user consumption behavior.

II. LITERATURE REVIEW

There are two broad approaches of energy conservation study, namely i) structural energy conservation and ii) non-structural energy conservation approaches. In the structural energy conservation approach, capital investment is required since it uses the application of technology instruments, tools, or alternative energy resources. In contrast, non-structural energy conservation requires low capital investment as it emphasizes on improving or changing of the user's energy use behaviour to achieve energy reductions [9]. For the purpose of this study, a non-structural energy conservation approach is applied.

In a non-structural energy conservation approach, behavioral models are commonly used to understand consumer behavior which uncovers what consumers do, and why they do so. However, behavioural models vary widely by theory, concepts and applications [15]. In the study of behaviour and consumption practices, behavioural model indicated a more dynamic relationship between various factors due to the dynamic nature of human. Study on the relationship between behavioural programs and social marketing efforts have shown unfavourable relationship, where behaviour modification programmers has failed to reduce the consumption or demand for energy [10]. Hence, some countries have strategized to reduce energy consumption by other means, or the structural energy conservation approach. For instance, by introducing Minimum Energy Performance Standards (MEPS) regulation to promote energy efficient products. Consumers will only be given the choice to buy selected energy efficient electrical products in the market. The MEPS regulation has been implemented in 46 countries.

The non-structural energy conservation approach however, was successful in reducing energy consumption. Research shows that behavioural programmed has the potential to deliver significant savings through behavioural modifications such as turning off lights, using power strips, cold laundry, shorter showers and others. Study by American Council for an Energy-Efficient economy (ACEEE) revealed that most of the pilot studies have shown that even small-scale energy saving behavioral efforts delivers 5-15% reductions in energy use.

Therefore, it is imperative to understand the energy consumption behaviour of household users, this include contextual, socio-demographic and psycho-logical factors [10]. Koll muss and Agyeman, [11], concluded that demographic factors, external factors which comprise institutional, economic, and social and cultural factors; and internal factors which include motivation, environmental knowledge, values, attitudes, environmental awareness, environmental involvement, locus of control, and responsibility and priorities are the multiple factors that affect conservation behavior. Energy usage may be influenced by socio-demographic variables like income and household size and psychological variables, such as attitudes may be more important in determining changes in that use as suggested in other related research. While other past studies also failed to deal with the formation of habits and needs for comfort and ease in energy consumption. Other factor such as psychological ownership may be an unexplored factor that may influence change of consumption behavior [7]. Additionally, factor such as efficacy and effectiveness refer to person's aptitude to regulate their own desired behavior and its surrounding environment may be an important factor to influence behavior modification in electricity usage. [13]. This is because being a homeowner offers one a greater sense of control over one's environment and fulfills the individual's sense of place [14].

Awareness Impact on Motivation

According to Dumas [32], the increased usage of electricity was due to imprudent use of electricity caused by user's behaviour. Hansen [33] also mentions that more than half of the energy utilized by users is wasted. This irresponsible behavior has been reported by many researchers [8]. Therefore, besides the structural energy conservation through the invention of technology to curb consumption of electricity, the non-structural energy conservation approaches is also an important approach to energy saving. Thus, the essential ingredient in energy conservation efforts is human behavior itself. Research by Bream [34] shows that almost 10 percent of energy can be saved through user energy conserving behavior. Loosen and Moosdijk, [35] reveals that about 5- 10 percent of energy savings can be attained by improving energy user's behaviour. Another similar finding is proven in a study led by Ouyang, Gao, Yan, Hokao, & Ge, [36] of which 10 percent of electricity reduction simply reached by educating user's behaviour. Therefore, collective amount of energy cost saving can be achieved through energy management behavioural change.

Energy awareness refers to the knowledge about how much energy is consumed [16]. Energy awareness towards energy conservation requires a right attitude and human actions from the members of the household [17]. Awareness on energy conservation may include users' awareness on using the star rated electrical appliances [18]. In addition, creating awareness in consumers includes promoting energy efficient (EE) awareness campaign which it is believed to have a positive impact on reducing levels of electricity utilization [18]. The challenge is how to translate the awareness or knowledge into practice or everyday life. Thus, this study would like to investigate how consumer awareness can impact their motivation in conserving energy.

H1: Awareness is positively significant impact on motivation.

Moderating Factor: Satisfaction

A study by a marketing firm, J.D. Power and Associates [21]

suggests that there is a positive correlation between energy efficiency efforts of gas and electric utilities and customer satisfaction [21]. Consumers who understand that they have access to tools to help them manage their overall bills would be more satisfied than consumers who do not know how or where to find help. Regulators and utilities companies should provide assistance to user's in managing their bills through energy efficiency as consumer faced

pressure as utility rates increase [21]. Awareness of efficiency programmers was found to be statistically significant factor to customer's satisfaction for both residential and commercial users [20]. Customers who recalled receiving the targeted communications were more likely to perceive their electric and gas rates as reasonable and were also more likely to express satisfaction with the company's efforts to help customers save money on energy bills [21].

H2: Satisfaction is a moderator in relationship between awareness and motivation

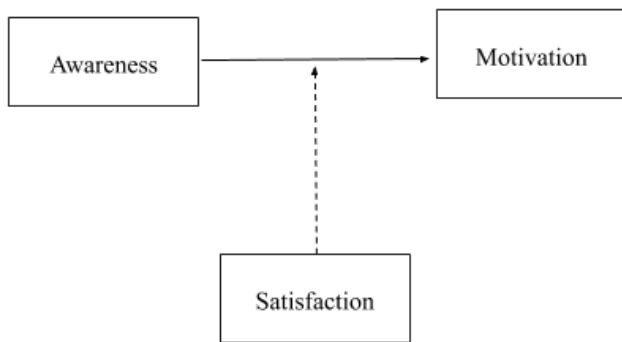Based on the literature review, the research model was developed as presented in Figure 1.

Fig. 1 Research Framework

III.   SAMPLE

The data for this research was collected from household living in Selangor, Kuala Lumpur and Putrajaya, as this housing area used the most energy consumption according to an interview with a representative from Tenaga Nasional Berhad (TNB). The data was collected using a questionnaire survey through simple random sampling and snowballing method. In simple random sampling, a researcher selects participants for the sample so that any individual has an equal probability of being selected from the population. Sampling are to provide meaningful information about the total population where each sample has the main characteristic that represent the entire population [37] [38]. Survey was conveniently administered through hardcopy at selected Kedai TNB and online questionnaire from Universiti Tenaga Nasional staff who live in Klang Valley. A total of 400 usable survey respondents have participated in the survey.

IV.   MEASURES

The instrument used was adopted from previous literatures and has been tested in our pilot study with a Cronbach alpha value range from 0.918 to 0.956. The purpose for test Cronbach alpha test is to measure the reliability of items in measuring the factor. The minimum

requirement for Cronbach alpha is 0.70. (Current Electric Consumption Behavior 0.931; Awareness 0.918; Motivation 0.956; Behavior Change 0.956). The questionnaires were evaluated on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

V.   ANALYSIS AND RESULTS

Demographic data shows that the majority of the study sample are adult female (31-40 years old) that work in the private sectors (187, 46.7%) with a monthly income around RM 2000 – RM 4000 (169, 42.2%). Most of the respondents have a degree qualification (224, 56%) and they pay their electricity bills by themselves (290, 72%). About half of the respondents are from the state of Selangor (196, 49%) living in a double-storey house (100, 25%) whom they owned (202, 50%), live with their family (342, 85.5%) and of more than five persons per household (108, 27%). The average amount of electricity bills that the respondents pay monthly is between RM101 and RM 150.

In assessing the measurement and structural model, PLS-SEM analysis technique was employed using SmartPLS 3.2.6 software. The reliability and validity of the instruments are tested using Composite Reliability (CR), Average Variance Extracted (AVE) and Discriminant Validity [22]. These results are provided in Table 1 on Measurement Model (Figure 2) and Table 2 for Discriminant Validity. The structural model (Figure 3) which showed the relationships between factors that were hypothesized [23]. Hair et al. [24] recommend looking at the R^2, effect sizes (f^2) and the predictive relevance (Q^2) to assess the structural model.
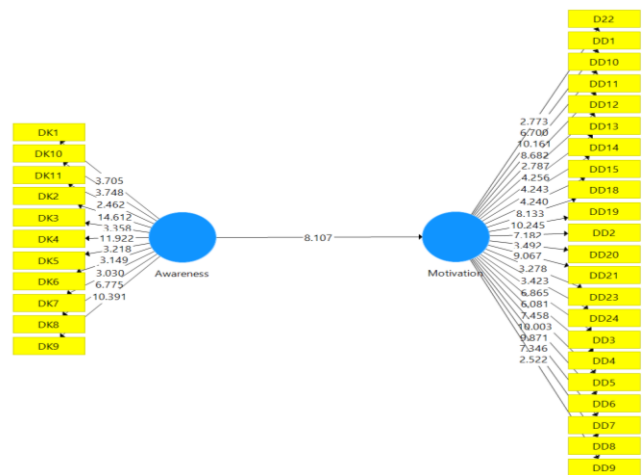

Fig. 2 Measurement model

There are two items (DD16 and DD17) were deleted due the low loadings are below than 0.50. According to Hair et al. [24] the factor loadings should be greater than 0.50 for better results. After deletion of the two items, the results of CR and AVE were improved. Hence, the deletion of these two items were based on statistical ground. The two items that were deleted include DD16 "I tried to reduce my electrical usage to save more money" and DD17 "I am happy with my monthly electrical bill charges".
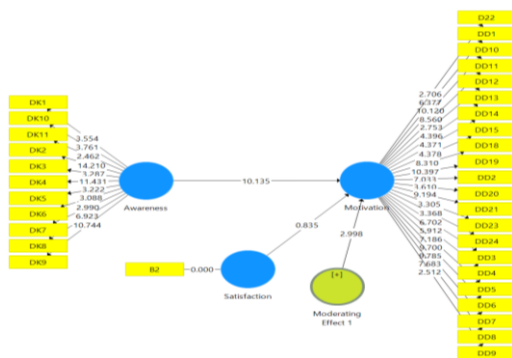
Table. 1 Measurement model

Variables	Cronbach Alpha	CR	AVE
Awareness	0.970	0.974	0.777
Motivation	0.991	0.992	0.800

Next, evaluating the discriminant validity results (Table 2), the outer loadings on correlated constructs are greater than all of its loadings on other constructs which validate the discriminant validity test.

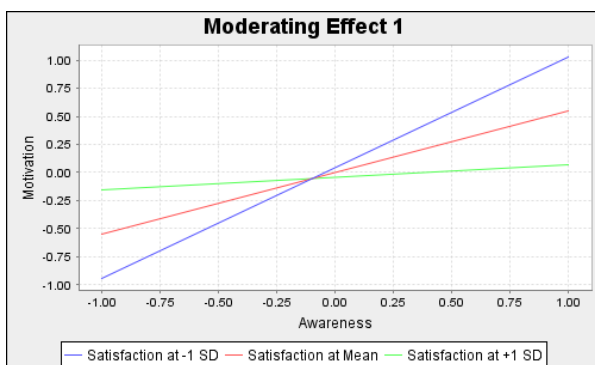**Table. 2 Discriminant validity**

Variables	Awareness	Motivation
Awareness	0.881	
Motivation	0.551	0.894

The structural model confirmed the relationship between awareness and motivation with satisfaction as moderator. The R^2 value was 0.96 suggesting that 96% of the variance in motivation could be explained by awareness. There was a positive relationship ($\beta = 0.551$, p =0.00) between awareness and motivation. Thus, supported the H1.

Fig. 3 Structural model

To examine the moderating role of satisfaction through awareness and motivation the interaction effect was calculated [25]. The interaction/moderating effect of satisfaction on motivation is statistically significant as provided in Figure 3 ($\beta = 0.594$, p=0.00). In addition, when the interaction effect was added into the model, the R^2 was increased to 0.97, giving an R^2 increase by 1.0%. Thus, explains the moderation effect of satisfaction to improve motivation. Thus, H2 was also supported.

Fig. 4 Interaction Plot Satisfaction

By comparing the constructs of satisfaction, the effect size (f^2) was also calculated to measure the impact of awareness and satisfaction on motivation. The f^2 values of 0.02, 0.15 and 0.35 are deemed as small, medium and large effect respectively [24]. This study, the f^2 of the interaction effect is 0.405 and regarded as a large effect [24]. Meanwhile, the relative impact of one construct versus another regarding the predictive relevance of an endogenous construct or q^2 is measured as follows, with q^2 values of 0.02, 0.15, and 0.35 suggesting that the exogenous construct has a small, medium, or large predictive relevance respectively [24]. The Q^2 value for this study is 0.652 suggesting that the model has large predictive relevance (Table 4). In short, the PLS-SEM analysis revealed that the relationship between awareness and motivation was stronger when moderated by satisfaction (Figure 4).

Table. 3 R^2, Q^2 and f^2 values.

Dependent Construct	Independent Construct	R^2	f^2	Q^2
Motivation	Awareness	0.97	0.405 (Effect: Large)	0.652 (Effect: Large)

Overall, the study shows that consumer awareness does have positive impact toward motivation of energy conservation. The moderating variable of consumer satisfaction toward the usage of energy efficient appliance also indicate positive relationship. Thus, it is shown that the more efficient the electrical appliance the more satisfied it is for users. The higher their level of satisfaction, the higher is their motivation level in continuing to use the energy efficient appliance to reduce their energy consumption. The feedback that consumer received from the electrical bill indicate that the appliance did help them save money in utility bills. So this create their awareness to be more efficient user. The result of this study is consistent with another experimental study on energy consumption, the study was carried out with the researcher left messages in door hangers at people's homes about their current energy usage [26]. This lead to a lot of homeowners to reduce their energy consumption. After sometimes, people make adjustments in energy consumption behaviour. Together, with the feedback the experimenter included an emoticon—a happy face for low-consumers or a frowning face for high-consumers—which communicated what people should be doing [27]; [28]. With the emoticons in place, not only did the high-consumers consume less but also the low-consumers remained low consumption [29].

VI. CONCLUSIONS

In conclusion, there are many energy conservation actions where consumers can reduce energy usage dramatically. Examples of energy conservation behavior include switching off the unnecessary lightings, thermostat control, turn off the monitor screen whenever not in use, turn the

computer into hibernate mode or sleep mode when leaving the computer for a short period, use stairs instead of lift as possible as could, as well as maximum use of the natural lighting [8]. With the such behaviour change in energy consumption, it will have great impact on reducing total energy use which further led to reduce carbon emissions. Whether this goal can be realised will depend upon individual understanding of why it is necessary and how it can be achieved [30]. Staddona, Cycil, Gouldenc, Leyguec and Spencec [10] have studied how information dissemination, feedback and rewards are important in influencing conservation behaviour. They also discussed how individual psychology and physical capacity can be both the motivation and the barrier in achieving the desired objective. They also suggest to look at all opportunity that is available such as social, cultural and environmental that can be used together to mitigate this challenge. Other suggestions include nine point of intervention that can be adopted such as education, persuasion, incentivization, environmental restructuring, modelling and enablement by increasing mean and reducing barrier.

ACKNOWLEDGEMENTS

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