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The Relationship between the Factors Influencing Energy-Saving Behaviors in Households in Urban Vietnam

Kien Trung Duong*, Tung Thanh Nguyen*, +, Tuan Anh Do*, #, 1

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ABSTRACT

Research on energy-saving intentions (EI) and behaviors will provide appropriate policies to help raise the awareness of energy saving in households. Therefore, the present study assesses the factors influencing energy-saving intentions and behaviors in urban households. The authors evaluated 1037 samples gathered from homes in the Hanoi metropolitan region of Vietnam by utilizing a questionnaire to survey and household interviews based on the theory of planned behavior (TPB) and multivariate analytic techniques (scale reliability test, factor confirmation analysis). The Partial Least Squares – Structural Equation Modeling (PLS-SEM) model has shown that energy-saving awareness (EA) and situational factors (SF) both have strong influences on energy-saving behaviors (EB). In particular, the situational factor has a stronger impact on energy-saving behavior than the energy-saving awareness factor. As a result, the factor of energy-saving awareness plays an important role in shaping energy-saving intention and orientation of energy-saving behaviors. Moreover, energy-saving intention acts as an intermediary among factors that impact energy-saving behaviors. Consequently, numerous policies have been proposed to help raise the awareness of energy saving for urban households. Households need to adopt a more environment-friendly lifestyle. The results of this study shall be the theoretical base for other research in Vietnam about energy-saving behavior.

1. INTRODUCTION

Vietnam has been a globally successful country in developing its energy sector over the past few decades. Adapting to economic integration has aided Vietnam's transition from one of the world's poorest countries to one with a low average income. From 2002 to 2018, the average income increased from US $ 388 to US $ 2700. During the same period, Vietnam recorded a reduction in the poverty rate from over 70 percent to below 6 percent [1]. In 2019, Vietnam's population was estimated at 94.7 million people, equivalent to an increase of 1.06% compared to 2017. However, in parallel with economic development, the demand for energy consumption also increased. Specifically, the amount of electricity consumed in 2010 was about 85.5 TWh (GDP is 122.4 billion USD), and in 2015 is about 85.5 TWh (GDP is 122.4 billion USD) 151.5 TWh (GDP is 204.8 billion USD); by 2018, it is 192.9 TWh (GDP is 241.4 billion USD). In 2019, The world was heavily affected by the COVID-19 pandemic, and Vietnam was also heavily influenced. However, Vietnam has shown its ability to quickly recover from a pandemic, reflected in all areas such as rapid disease control, vaccine production research, food security, and energy security. Vietnam is one of the few countries that do not forecast an economic slowdown; the Vietnamese government has set a dual goal during the pandemic of fighting against epidemics and ensuring economic development, maintaining a GDP growth rate of 2.8 percent by 2020. With the economic development and population growth, the demand for energy consumption in Vietnam increases day by day. Therefore, energy use savings and efficiency are very important.

Developed countries worldwide have paid particular attention to the energy issue since the energy crisis. Using energy economically and efficiently is one of the sustainable solutions to ensure energy security for each country. Therefore, the research trend on energy-saving behavior is attractive to many scholars, typically among which are: Hamrin (1979) studied sustainable energy development by incorporating solar power apparatus into residential homes in suburban California [15]. As a result, the combination of renewable energy helps to decrease monthly electricity expenses for households. Dillman *et al.* (1983) [7] studied consumers in the United States who made behavioral and lifestyle changes to cut down energy consumption due to the

*Faculty of Industrial and Energy Management, Electric Power University, Hanoi, Vietnam.

+Faculty of Engineering Physics and Nanotechnology, VNU University of Engineering and Technology, Vietnam National University, Hanoi, Vietnam.

#National Center for Technological Progress, Vietnam Ministry of Science and Technology.

1 Corresponding author;
Tel: + 84 979 187 999.
E-mail: datuan@most.gov.vn

rising energy prices. Consequently, this study suggested that lifestyles positively affect energy-saving behaviors. However, they did not discuss energy conservation practices. Van Raaij and Verhallen (1983) [32] researched making the most out of utilities such as sunshades to reduce the indoor temperature and integrate climate controllers in rooms. The study mainly focused on residential areas and concluded that setting up proper equipment is the best strategy to promote more efficient energy use behaviors. As for electricity-saving behaviors, Ek and Söderholm (2010) [19] have shown that costs, attitudes toward the environment, and social interactions are the determinants of household energy-saving behavior. Lopes *et al.* (2012) [21] also suggested that energy behaviors are driving factors that promote efficient energy usage, and the potential for saving energy from appropriate behaviors could reach 20%. In the case of Latvia, a developed European country, Werff and Steg (2015) [31] pointed out that the potential of saving energy is 3.9 GJ/year in summer and is 3.2 GJ/year in winter by changing the energy-using behavior. Furthermore, households would pay no additional yearly cost and, at the same time, reduce emissions by approximately 5 Mt CO_2 GHG (greenhouse gas) from changing energy-consuming behaviors. Moreover, other factors such as psychology, values, social norms, and attitudes toward energy savings positively affect the energy-saving behavior of households [3], [8], [10], [23], [33]. Zhang *et al.* (2018) studied the energy-saving behavior of urban residents in the Shandong province of China with 297 data collection forms [38]. Zhang *et al.* used an extended TPB model to examine the relationship between energy-saving intention and energy-saving behaviors. In addition, the authors also added external factors such as policy, quality of energy-saving products, publicity, and education. The quality of energy-saving products has a significant influence on energy-saving behavior. In this study, the authors also considered the influence of external factors on energy-saving behavior in the Hanoi urban area of Vietnam.

Hanoi is the capital of Vietnam with comprehensive socio-economic development. With over 8 million people, Hanoi's regional gross domestic product (GRDP) growth rate reached 7.5%, higher than the country's gross domestic product (GDP) of 6.8%. With the rapid urbanization rate, people in Hanoi increasingly use energy from gas for cooking, gasoline for travel, or household electrical appliances daily. Easy access to energy has increased the city's energy consumption needs. Especially in the summer months, Hanoi city faces a shortage of electricity due to the high demand for cooling devices. Hanoi is a densely populated place, and recently many people have moved to the city to live and look for work. This has formed the diversity in the population and different forms of living. Therefore, studying energy-saving behaviors in Hanoi's urban population is a rather complicated issue. Households in Hanoi can often be assessed through several characteristics such as income, the number of people, electrical equipment, floor area, room area, awareness of members, and electricity user's behavior. It is the diversity that leads to differences in energy consumption. The authors considered the research context in urban Vietnam, with high energy demand and excellent energy-saving potential. The studies on energy saving behavior are mainly carried out in developed countries such as the US, China, and Europe, [4], [16], [30], [33], [38], While Vietnam is still a developing country, there are limited studies on saving-energy behavior. There has not been much research on energy-saving behavior, especially culture and economy, different from other countries. Therefore, the authors have studied the influencing mechanisms of factors on energy-saving behavior based on the extended theory of planned behavior (the proposed theoretical model is presented in Figure 1). The authors want to learn and examine the relationship between Intention and behavior, the influencing role of cognition, and behavioral regulation effects from external factors in the research context in urban Vietnam. In addition, this study also adds external factors: policies, social standards, quality of energy-saving products, and energy prices. There is an interest in this study when adding the energy price factor, which is lacking in the study of Zhang *et al.* (2018) [38]. Moreover, in Vietnam, the energy-saving product market is rampant with fake and poor-quality goods, affecting consumers' psychology and behavior. Therefore, this study has unique characteristics of Vietnam and can be considered a database for developing countries like Vietnam. The present results are an important part of Vietnam's energy policy-making process and an essential input for policymakers to develop sustainable energy in line with national energy development goals.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Theoretical Background

The present research applied the theory planned of behavior (TPB) to discover the impact of factors to the energy-saving behaviors of households. The TPB is an expansion of the theory of reasoned action [9]. Within the TPB framework, when someone has the intention of conducting a behavior, such intention shall be affected by the three following factors: Attitude toward a behavior, subjective norm (*i.e.*, the individual's perception of social pressure) [2], perceived behavioral control (*i.e.*, the perceived ease or difficulty of engaging the behavior). Recently, numerous researchers have expanded the TPB model by adding other factors such as external influencing factors or social demographic. TPB has been proven to be an effective model to anticipate behaviors, even when researchers want to anticipate the development of wind energy projects [25], implementation of rooftop solar power projects in residential areas [24], and energy-saving behaviors [17], [27].

2.2 Energy-saving Behaviors

Energy-saving behaviors, which are defined as home daily routines, focus on lowering energy consumption when it is not required, hence reducing energy resource

exhaustion. Energy savings can contribute to reducing energy shortages as well as mitigating environmental impacts [20]. Energy-saving behaviors are often divided into two basic types: habitual behavior (*e.g.*, reducing direct use and changing behaviors, changing usage habits), and purchasing activities (for example, purchase of devices with energy-saving technology) [18].

Purchasing activities reduced energy consumption by investing in technical equipment without making lifestyle changes [12]. Consumers are willing to pay more for energy-efficient appliances, replacing incandescent bulbs with LED bulbs to save more energy, or investing in smart home systems that will help optimize the electrical appliances in the house. However, the act of investing in equipment and technology would often be accompanied by financial problems. The one-time investment might cause the investors to lose a large initial expense. The second type of behavior is reduction behavior, which is a type of lifestyle change and awareness heightening (*e.g.*, turning off the lights when leaving the room, using water-saving showers, or adopting proper driving skills to reduce gasoline consumption). These factors influence energy-saving behaviors through actions on their energy-saving intentions [33]. In this study, the authors still proposed the hypothesis of the relationship between energy-saving intentions and energy-saving behaviors. This research was carried out with aims to test and assess the level of impact, indirect or direct impact in the context of research in Vietnam. Therefore, in the present study, it is hypothesize that:

H1: The energy-saving intentions has a positive effect on energy-saving behaviors.

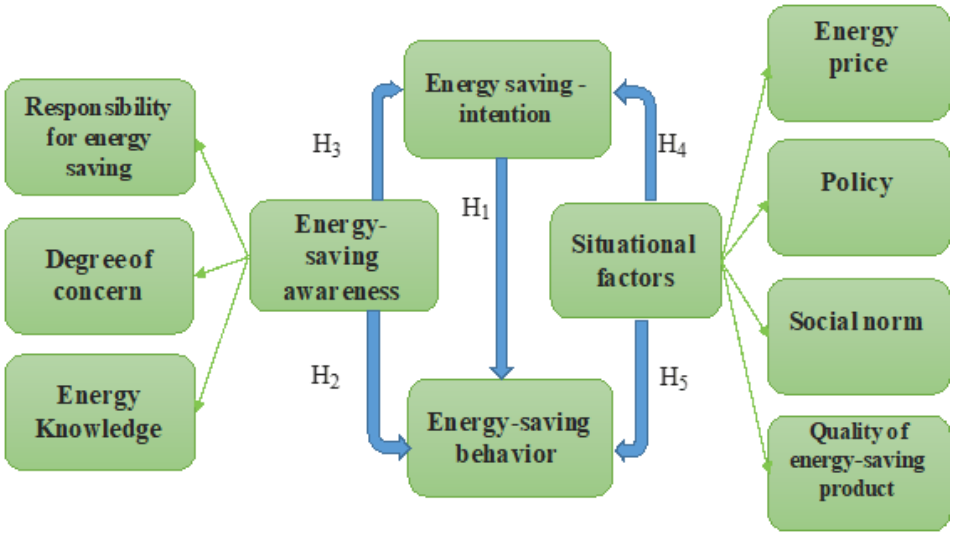

Fig. 1. Conceptual model the factors influencing energy-saving behavior in households in urban Vietnam.

2.3 Energy-saving Awareness

The energy-saving awareness mentioned the personal knowledge or awareness of the matter of energy-saving. Energy-saving awareness might improve the environment by reducing the green-house gas emission and as the result, air pollution [22]. Energy-saving awareness plays a crucial role as an encouragement to change the energy-saving behavior of each individual, the lack of awareness shall affect the energy-saving tendency, leading to the decrease in effectivity of households' energy usage. Yue *et al.* (2013) [37] explained that energy-saving awareness is a type of advanced knowledge of energy related issues. This study focused on exploring the impact of awareness on behavior at the psychological level. To understand the relationship between energy-saving awareness and energy-saving behavior, the following factors were observed and measured: responsibility for energy saving, the level of interest, and knowledge of energy. The hypotheses are set out as follows:

H2: The energy-saving awareness has a positive effect on energy-saving behaviors.

H3: The energy-saving awareness has a positive effect on energy-saving intentions.

2.4 Situational Factors

The situational factors are external factors, that is, the external environment and conditions impacting behaviors. Situational factors include policy factors, economic factors, cultural backgrounds, publicity, education, and social norms. These factors are mainly external influences on personal energy consumption behavior [17].

Cao *et al.* (2015) [5] demonstrated that policies and information tools can provide significant positive guidance for farmers on energy consumption, reducing carbon emissions based on survey data of farmers in the eco-economic zone of Lake Poyang. Moreover, Yang *et al.* (2016) [36] illustrated that energy consumption policies have a significant positive impact on the energy consumption behavior of urban dwellers in China. Nevertheless, Wang *et al.* (2011) [34] found that factors such as policies, social norms, and economic benefits have strong impacts on households' electricity saving behavior. In addition, Webb *et al.* (2013) [35] showed that the result of the increase in energy prices would

reduce people's energy consumption. By applying the multivariate regression model, it is found that the economic cost plays an important role in regulating energy consuming behavior.

In this study, to understand the impact mechanism of situational factors on energy-saving behaviors and energy-saving intentions, some major factors such as social norms, energy prices, policies, quality of product energy-saving is included in the model to measure situational factors. We propose the following hypothesis:

H4: The situational factor has a positive effect on energy-saving intentions.

H5: The situational factor has a positive effect on energy-saving intentions.

3. METHODOLOGY

3.1 Methods

This study is proposed to provide a model of factors affecting energy-saving behaviors in households of urban residents in Vietnam. The authors use mixed research methods, including qualitative and quantitative research. In which the qualitative research method, through in-depth interviews and interviews with experts, the authors were able to get very important comments in constructing the scale. With the quantitative research method, to evaluate the relationship between the factors or test the above hypotheses, the authors used Structural Equation Modeling (SEM). Statistical analysis techniques are developed to analyze multidimensional relationships between many variables in a model [26].

3.2 Data Collection and Sampling

The authors performed many pilots' investigational surveys. Surveys in several districts of Hanoi city for the model empirical survey, collecting 1037 completed questionnaires were conducted. Between July 2019 and January 2020, data was collected by utilizing three different survey forms and three different approaches: local survey, internet survey, and direct phone survey. To determine the number of persons interested in the study, random polls were conducted in populated areas such as shopping malls, parks, farmers markets, and apartment buildings. The sample size of 1037 completed questionnaires is sufficient for data gathering and study analysis utilizing the data analysis approach [29]. Analytical data of this study is simulated through Smart PLS 3.0 software.

3.3 Measurement

Data for research and analysis were collected from urban survey questionnaires in cities in Vietnam. The survey questionnaire is presented in Table 1. Using a Likert scale with 5 levels to evaluate the variables. In which: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. The scales are referenced from previous studies and adjusted to suit the culture in Vietnam. The measurement items are shown in the Appendix.

Based on previous studies, three factors were selected to represent the impact of energy-saving awareness on energy-saving behavior: responsibility for energy-saving; a degree of concern; energy knowledge [38]. Specifically, responsibility for energy-saving is defined as moral or duty sense when individual consuming energy [11]. Responsibility for energy-saving is assessed through questions such as: "You think that energy-saving behavior will contribute to the country's economic development", "You are willing to remind others to save energy and protect the environment", "You think that energy-saving behavior is to save resources for future generations".

The degree of concern is described similarly to environmental concerns. Respondents were asked to evaluate through items such as: "You are interested in the issues of energy informed by the media", "You pay attention to energy consumption and details about the use of energy consumption devices in the home", "You feel nervous when listening to or seeing energy-related problems (*eg.* Emissions from motorcycles, cars pollute the atmosphere)" [38]. Energy knowledge means to the knowledge and skills needed for the reasonable choice of energy-saving behavior. Respondents participated in evaluating following items: "I know the meaning of the labels affixed on the energy-efficient devices", "You know about everyday ways to save energy", "You will use renewable energy, Ex: Solar, wind, biomass".

To investigate the influence of situational factors on energy-saving behavior, the authors selected four factors to measure: quality of energy-saving product, social norms, energy price, policy [38]. The quality of energy-saving products is assessed through the items "You will choose to purchase energy-labeled equipment firstly", "Customer feedback on energy-efficient products is an important factor in your choice of purchasing the product", "You will be interested in the right product then the energy-saving product".

The acceptability behavior that an individual is required to conform to in each group, community, or culture is referred to as social norms. These norms often serve a useful purpose and create the foundation of correct behaviors. Respondents measured items such as: "You think that households need to be aware of energy-saving behavior", "The government actively advocates and implements low-carbon life "[33], "If everyone around you engages in energy saving, you will be more involved in energy-saving" [38].

Besides, energy price is assessed through the items "You will change transportation if gasoline or oil prices rise", "You will change the habit of using electrical equipment when electricity prices rise". The energy policies enacted to control energy use, households participating in the assessment through the items "Policies and regulations play an important role in promoting and encouraging me to improve and change energy-saving behaviors", "Your energy-saving behavior because of the relevant policies and regulations".

3.4 Data Analysis

Through confirmatory factor analysis (CFA) with 1037 samples, the measurement model was firstly tested for reliability and validity through composite reliabilities

(CR) and average variance extracted (AVE) those are greater than 0.5 and 50%, respectively. At the same time, the scales need to ensure convergent validity when the factor load factor is greater than 0.5. Moreover, variables need to achieve discriminant validity when the square roots of the AVE values are larger than the correlation coefficients between the variables. Finally, the research hypotheses are tested based on the PLS-SEM has been widely used in research fields of psychology, sociology [28]. Recently, this model has been also applied to consider the influence of factors on energy-saving behavior, [31], [33].

Table 1. Descriptive statistics of social demographic variables (N=1037).

		Frequency	Percentage (%)
Gender	Male	504	48.6
	Female	533	51.4
Education level	High school	85	8.2
	Intermediate college	72	6.9
	University degree	713	68.8
	Master	154	14.9
	Total	1024	98.7
	Missing	13	1.3
Work	Student	480	46.3
	Unemployment	12	1.2
	Worker	64	6.2
	Engineer	78	7.5
	Officer	304	29.3
	Lecture	30	2.9
	Other	66	6.4
	Total	1034	99.7
	Missing	3	0.3
Household income (Vietnam Dong - VND)	< 2 million	84	8.1
	From 2 - 5 million (((VN	116	11.2
	From 5 - 10 million (VND	324	31.2
	> 10 million	500	48.2
	Total	1024	98.7
	Missing	13	1.3
Home	Villa	14	1.4
	Apartment	152	14.7
	Residential house	470	45.3
	Community house	53	5.1
	Other	346	33.4
	Total	1035	99.8
	Missing	2	0.2
Total		1037	100.0

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4. RESULTS

4.1 Verify the Reliability of the Scale

Structural equation modeling (SEM) has been employed by using the partial least squares (PLS) for the measurement of the model. The PLS-SEM has been widely used in the behavioral sciences. This model not only handles numerous dependent variables at the same time but can be also expanded to combine and integrate with many other models to explore other variables. Two criteria for evaluating a factor that is reliable when

measuring through observed variables are Cronbach's alpha coefficient and the item-total correlation those are greater than 0.6 and 0.3, respectively. Observed variables with a total correlation coefficient of less than 0.3 will be excluded from the factor (see Table 2).

The considered load factors are greater than 0.5 to have convergence validity. The square root of the variance is greater than the correlation among research concepts with discriminant validity (see Table 3).

The square root of the factors' AVE is greater than the matching correlation coefficient, the factors are said to be discriminating. The results of this study's discriminant analysis demonstrate that all components are discriminatory (see Table 3) [14].

Table 2. Scales' evaluation.

Constructs	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Quality of energy-saving product (QP)	0.733	0.849	0.653
Social norms (SN)	0.786	0.875	0.701
Energy policy (EP)	0.814	0.915	0.843
Energy-saving behavior (EB)	0.671	0.820	0.606
Energy knowledge (EK)	0.709	0.835	0.630
Degree of concern (DC)	0.770	0.867	0.685
Energy price (P)	0.677	0.861	0.755
Responsibility for energy saving (RE)	0.816	0.891	0.732
Energy-saving intention (EI)	0.789	0.877	0.704

Table 3. Discriminant validity.

	QP	SN	EP	EB	EK	DC	P	RE	EI
QP	N/A								
SN	0.64	N/A							
EP	0.59	0.55	N/A						
EB	0.65	0.60	0.56	0.78					
EK	0.51	0.58	0.52	0.54	N/A				
DC	0.59	0.65	0.53	0.56	0.66	N/A			
P	0.50	0.47	0.51	0.48	0.42	0.45			
RE	0.63	0.73	0.60	0.65	0.60	0.67	0.50	N/A	
EI	0.69	0.67	0.54	0.63	0.58	0.61	0.50	0.73	0.84

Notes: 1st value = Correlation among variables (2-tailed t-test); Square root of AVE (bold diagonal); N/A: Square root of AVE is not applicable for formative constructs

4.2 Analysis Results

The present results of the PLS-SEM model have shown that both energy-saving behaviors and situational factors have positive effects on households' energy-saving intentions and behaviors (positive beta factor and small p-value factor less than 0.05). The intention for saving also has the same impact on energy-saving behavior (see Table 4).

The analysis result show that the external factors have the greatest influence on energy-saving behavior, the second is the energy-intentions and the last is the energy-saving awareness with the effect coefficients in turn decreasing as βSF-EB = 0.449; βEI-EB = 0.223; βEA-EB = 0.161 (details in Table 4).

Energy-saving awareness has a direct and indirect impact on energy-saving behavior through the factor of energy-saving intention. Similarly, situational factors directly and indirectly affect energy-saving behavior through energy-saving intentions.

(1) Effects of energy-saving awareness

In general, during the conduct of the study on the energy-saving behaviors in Vietnam, the authors have achieved satisfying results from the selection and application of the expanded TPB model. The impact of energy-saving awareness on energy-saving intentions and energy-saving behavior was illustrated by the coefficients of β(EA-EI) = 0.380 and β(EA-EB) = 0.161 that both stand for positive impact. When individuals in a household know energy-saving, they tend to consume energy more practical and efficient. Energy-saving knowledge acts as a catalyst for the process of conducting energy-saving behavior. In the research of Harland *et al.* (2007), the lack of energy-saving knowledge is equivalent to a fence that prevents the individuals from practicing energy-saving behaviors. Such statement is further solidified by considering the factors of degree of concern and sense of responsibility. If the individuals in households are aware of the energy

consumption and care about environmental issues, they shall establish plans for suitable consumption of energy in a more responsible fashion. For example, your family uses air conditioners, but you are willing to invest more money into using energy efficient air conditioner with refrigerant substances that friendlier to the atmosphere. This statement has been proved in the study of environmental and ethical consumer values, especially moral obligations and personal norms that shall be encouraged by factors such as universalism and altruism [6].

The energy-saving awareness factor is explained mainly by the influence of the Degree of Concern factor, followed by the Responsibility for energy-saving factor, and finally, the Energy knowledge factor. When people are interested in energy-saving and environmental issues, residents' awareness will direct them to energy-saving intentions.

Table 4. Path analysis -PLS-SEM results.

Model/path	Model 1	Model 2	Model 3		Model 4		Model 5	
	EA, SF– EI	EA, SF– EB	EA – EI – EB		SF – EI – EB		EA, SF – EI – EB	
Dependent variables	EI	EB	EI	EB	EI	EB	EI	EB
Independent variables								
EA	0.518c	0.362c	0.758c	0.502c			0.380c	0.161c
SF	0.311c	0.424c			0.711c	0.516c	0.445c	0.449c
EI				0.253c		0.264c		0.223c
Adjusted R2	0.613	0.547	0.574	0.510	0.506	0.530	0.615c	0.598c

Notes: EA: Energy-saving awareness; SF: Situational factors; EI: Energy-saving intention; EB: Energy-saving behavior: 1st value = standard beta coefficient; c denotes significance at 1% respectively (two-tailed t-test).

(2) Effect of situational factor

The situational factor included social norms, policy, energy price, quality of energy-saving products has a significant impact on energy-saving behaviors. External factors have more influence on energy-saving behavior with impact coefficient β(SF-EB) = 0.449 > β(SF-EI) = 0.445. Product quality factor plays the largest role in influencing external factors on energy-saving behavior. According to Table 1, most households in Hanoi have an average income of more than 10 million VND. They have a university education or higher, which shows that households in Hanoi are very interested in energy saving. They are willing to implement energy-saving behaviors through investment in energy-saving products. It has similar significance to the study of Smith *et al.*, 2013, Zhang *et al*. (2018) [13], [38].

The extrinsic factor is explained at least by the energy price factor with β = 0.719, showing that energy price have a little moderating effect on consumers' intention and behavior to save energy. However, households in Hanoi are always ready to invest in energy-saving products, which represents a very high and basic practical need in daily life, therefore when energy prices increase, it may not have much effect on the behavior change of households. The energy policies mildly affect the energy-saving behavior of households. For example, the "Energy-saving and efficient consumption regulation" mainly targeted the major energy consumers such as industrial business, and yet to be effective to households. The government, therefore, should focus on the establishment and guidance for individuals to change their energy consuming habit such as: change the habit of using personal vehicles, water-conserving usage.

5. CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Conclusions

Through model analysis of factors affecting energy-saving behavior in urban areas in Vietnam, this study can draw some main conclusions as follows:

Firstly, this study has built a theoretical model of factors affecting energy-saving behavior in urban areas, taking the context of the Hanoi urban area of Vietnam. This study shows differences in the implementation of energy-saving behaviors. It can be said that the implementation of energy-saving behaviors of urban people is still not exemplary. Although some individuals have become conscious of choosing energy-saving products, many households are still not interested in this form. Besides, urban residents are still saving energy at the individual and household level, not yet at the community level.

Second, there is a difference in the perception of urban people about energy saving. In particular, the perception of energy saving has a significant influence on the intention to save energy, and this impact is primarily recognized and reflected by the Degree of Concern element. As people's interest in energy-saving increases, people's intention to save energy will also increase. The level of interest can be promoted through communication campaigns about energy saving, advertising energy-saving products, and their benefits.

Third, from the descriptive statistical analysis of external factors, it can be seen that residents are positively affected by current social standards on energy saving and the popularity of such policies: energy-saving books and energy-saving product quality. Further analysis of the regulatory effects of external factors shows that, in addition to the price level of energy-saving products, the quality factor is a barrier to people's

implementation. Energy-saving behavior, willingness to implement energy-saving investment behaviors, and other external factors also show a positive impact on energy-saving behavior and willingness to implement energy-saving. Dissemination of economic policies and energy prices has significant regulatory effects on the willingness to engage in energy-saving behaviors concerning interpersonal and the prevalence of energy-saving behaviors.

Fourth, the energy-saving intention factor is an intermediary between energy-saving awareness and energy-saving behavior. To form good energy-saving habits for households, it is necessary to increase communication about the benefits of energy-saving, emphasizing the role of protecting the human living environment from pollution.

5.2 Policy Implications

The government has established numerous suitable energy models, schemes for economic development. Regulations and laws focus on energy-consuming industries. There is no suitable policy for residents. In the present study, the authors propose several solutions as follows:

Firstly, the energy price needs to be suitably modified to the consumption of residences. The average price of energy in Vietnam is $0.07/kWh, about 50% lower than the global average (Globalpetrolprices, 2018); the price of fuel is also lower than that of the world's average at $0.8/liter and $1.1/liter, respectively. The government is putting efforts into maintaining the low power price to ensure the average expense for low-income workforce. Vietnam's urban and rural areas have the same price of electricity while the demand is much higher in urban areas. In this case, the step-up power price scheme is a suitable solution while categorizing consumers. The low-income households who owning fewer electrical appliances will have a lower energy price and vice versa for high-income households. Moreover, the low-income households often possess old technological devices that consume more energy, and the high-income households possess energy-efficient appliances. Therefore, it is not entirely suitable for promoting energy-efficient consuming behavior.

The low energy prices in Vietnam have negative impacts on the energy industry such as: (1) The government must provide a lot of subsidies to energy producers to maintain low prices; (2) Enterprises have low development motivation to improve efficiency and quality; (3) The ineffective energy conservation-related activities cause low energy prices. Vietnam is not ready to promote energy conservation and energy efficiency to deal with energy shortages. Vietnam's government needs to quickly establish administrative agencies to directly support energy-saving projects.

- Establishing energy-saving offices and centers nationwide; promoting standards for energy-consuming devices; guiding households to improve their concern and energy knowledge to improve energy-saving behaviors.

-Developing environmental protection policies; establishing strategic goals for sustainable energy development; focusing on the rational use of resources; giving priority to the development of clean coal technology, renewable energy, and clean energy.

-Planning and developing green infrastructure for urban areas; Planning green space and shade to reduce air-conditioning use.

-Developing and promoting intelligent technologies for energy management in the home.

-Tax incentives, prices of energy-saving products will contribute to promoting the more economical and efficient use of energy. The government should have appropriate policies to support households for installing solar power. To reduce oil import dependence, enhancing energy-efficient vehicles by applying economic incentives and minimum efficiency standards should be focused on. Moreover, the present will businesses and organizations to approach and capture consumers' psychology for developing an energy-saving product market, stimulating consumer market demand, and increasing quality of life in urban areas. The government of Vietnam could learn experiments of developed countries in applying energy policies. The government of Japan regularly encourage people to use energy economically through online programs. The Singaporean government imposes high taxes on cars and encourages families to buy energy-efficient products.

Secondly, energy policymakers and planners can rely on the analysis from the perspective of energy-saving awareness to formulate long-term energy development plans and appropriate energy scenarios. It is necessary to apply for energy-saving programs in the education system for propagating and educating people at an early age.

Some recommendations for energy-saving programs such as mobilizing people with the slogan: "Turn off lights when not needed and before leaving the room" and "Set air conditioner at 25oC-27oC" could impact on the production market and encourage people to replace incandescent bulbs with fluorescent lamps, compact lamps, and LEDs by implementing labeling energy-saving electric appliances and encouraging people to use energy-saving devices. Moreover, people should use water for saving, avoiding waste and limiting the impact on the environment by conducting propaganda.

Thirdly, the present study was conducted with a relatively large number of 1037 samples. The present results, therefore, can be replicated and applied the model to many other fields such as energy-saving behavior in schools, hospitals, or industry in Vietnam.

Finally, scientific conferences should be organized to discuss energy development strategies and power generation structures for future and to invite the full participation of national and international scientists.

5.3 Limitation and Future Research Directions

This research has several drawbacks. To begin with, the study was done in a developing country from a methodological standpoint. To analyze household energy-saving behavior, research data from neighboring nations in the region should be surveyed. Considering Vietnam has four unique seasons (spring, summer,

autumn, and winter), the second restriction of the data should be examined within a year following the study because human behaviors may vary dramatically.

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APPENDIX

Constructs		Questionnaire items	References
Responsibility for energy-saving (RE)	RE1	You think that energy-saving behavior will contribute to the country's economic development.	[39]
	RE2	You are willing to remind others to save energy and protect the environment.	
	RE3	You think that the issue of energy has to do with society as a whole, and everyone has the responsibility to save energy	
Degree of concern (DC)	DC1	You are interested in the issues of energy informed by the media.	[39]
	DC2	You pay attention to energy consumption and details about the use of energy consumption devices in the home.	
	DC3	You feel nervous when listening to or seeing energy-related problems. Ex: Emissions from motorcycles, cars pollute the atmosphere ...	
Energy knowledge (EK)	EK1	I know the meaning of the labels affixed on the energy-efficient devices	[34]
	EK2	You know about everyday ways to save energy.	
	EK3	You will use renewable energy. Ex: Solar, wind, biomass ...	
Social norms (SN)	SN1	You think that households need to be aware of energy-saving behavior.	[33]
	SN2	The government actively advocates and implements low-carbon life.	[39]
	SN3	If everyone around you engages in energy saving, you will be more involved in energy saving.	
Quality of energy-saving product (QP)	QP1	You will choose to purchase energy-labeled equipment firstly.	
	QP2	Customer feedback on energy-efficient products is an important factor in your choice of purchasing the product.	
	QP3	You will be interested in the right product then the energy-saving product.	

Energy price (P)	P1	You will change transportation if gasoline or oil prices rise.	
	P2	You will change the habit of using electrical equipment when electricity prices rise.	
Energy policy (EP)	EP1	Subsidies for energy-efficient applieances	[33]
	EP2	"Energy Saving Publicity week"	
Energy-saving intention (EI)	EI1	You will make an effort to save energy in my daily life	[27]
	EI2	You will be more inclined to buy energy-saving and environment-friendly products.	[34]
	EI3	You intend to engage in energy-saving activities in the future	
Energy-saving behavior (EH)	EH1	When you do not use the device for a long time, you will turn off the device to reduce power consumption. Ex: Turn off the power of the television before going to bed or unplug the microwave if not frequently used.	[39]
	EH2	You will use curtains to reduce room temperature.	
	EH3	You will use public transport daily.	
	EH4	You will use the shower in the bathroom to save water.	