Situational factor affecting energy-saving behavior in direct approaches in Hanoi City. The role of socio-demographics

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Abstract: Recently, scholars worldwide have been focusing on conducting studies on energy-saving behavior to promote efficient usage and conservation of energy. However, in Vietnam and some other developing countries, the research on energy-saving behavior is still limited, especially for the residence and household sectors. This research involved the conducting of a survey on the factors that affect the energy-saving behavior of households in Hanoi city. With 698 randomly collected samples, this research aimed to investigate the mechanism of the direct impact of external factors, such as policy, energy cost, energy-saving products’ quality, and social norms. The analysis was carried out using structural equation modeling (SEM); the present results showed that the quality of energy-efficient appliances and social norms affect energy-saving behavior positively. Meanwhile, energy cost and energy-related policies do not affect the energy-saving behavior directly but rather indirectly. Demographic factors, such as gender, income, educational level act as stimulant factors, promote the formation of energy-saving behavior. This research would help policy-makers in the field of energy get a more specific view on the effects of external factors on energy-saving behavior and thence establish more sustainable and environment-friendly energy-saving policies.

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PUBLIC INTEREST STATEMENT

Energy consumption for on resident, industries, and all fields is increasing and markedly. In the digital age, most equipment directly or indirectly consumes energy increases the cost of electricity for each individual or an organization, or business. Saving energy is a necessity, but how to do it effectively, not everyone understands.

Energy-saving behavior of each individual is assessed to have a great influence on the total energy consumption of households. This study examines the influence of factors such as energy-saving product’ quality; social norm; external factors; policy; energy cost on energy-saving behavior of individuals in the household. From there, there are interesting results, helping readers or researchers have more correct judgments about energy-saving behavior.

In addition, recommendations can help consumers change their behavior. Enterprises and organizations are oriented in implementing the program on economical and efficient use of energy.
1. Introduction
Climate change has become more and more visible, creating significant impacts on production activities as well as the livelihood of people around the world. Countries have agreed on the necessity of changing the energy usage structure to mitigate climate change as well as promote sustainable development. Such a process of change depends on the energy source as well as the financial capability of the nation.

In the early years of the 21st century, Vietnam was at risk of heavy air pollution due to rapid industrialization and urbanization, especially in large cities (Ho et al., 2020; Nguyen et al., 2017a). This shows that the control and use of energy are ineffective. Besides, Vietnam also faces an energy shortage due to high world oil prices and a decline in hydroelectricity due to unfavorable weather. Electricity consumption of Vietnam tends to increase over the years from 2010 to 2019 due to structural changes between economic sectors. The “convenience” of electricity has prompted the shift from the harness of other fuels to such of electricity, for example, each household owns a lot of appliances that consume electricity such as electric cookers; television; fridge; washing machine; air-conditioner; phone; computer …. In that context, the National Target Program on economical and efficient use of energy (referred to as VNEEP) for the 2006–2010 period is designed to promote the economical and efficient use of energy sources, and to reduce electricity consumption by 3–5% of the total commercial energy consumption. In the span of 2011–2015, the amount of energy saved is 10,610 KTOE, equivalent to 5.65% of the total final energy consumption of the whole period. The VNEEP 3 program (from 2019 to 2030) is the inheritance, setting an overall goal of saving 5.0–7.0% of the total energy consumption in the years 2019–2025; 8.0–10.0% of total energy consumption in the years 2025–2030.

In efforts to reduce greenhouse gas emissions, the target groups of households need to pay special attention. Household energy usage contributes significantly to greenhouse gas emissions. Faced with the reality of increasingly depleting energy resources, energy efficiency has become important in many areas for all countries of the world to achieve sustainable development (Cai et al., 2019). Many countries around the world have implemented various processes to promote energy conservation through a variety of measures. In the field of scientific researches for sustainable economic development, scholars pay much attention to energy-saving behavior (Hong et al., 2019; Wang et al., 2011; Webb et al., 2013; Yue et al., 2013a; Zhang et al., 2018). People’s daily behaviors include the ownership behavior of energy-consuming and end-use usage behavior which is more heterogeneous and difficult to regulate than in other industries. Population is always a challenging topic for policymakers (Hong et al., 2019). The difference between the nature and culture of life leads to the energy consumption behavior of each household in each area. Due to this, energy-saving policies are difficult to be implemented, so studying the behavior, cultural lifestyles of each region and implementing individual measures and policies will be more effective.

Lopes et al. (2012), which studied energy-using behaviors and modeling behavior approach, has concluded that the energy behavior is relatively complex, it depends on the individual, the context in question, as well as many other factors, and is related to numerous specialized fields like sociology, psychology, economics, and engineering. Especially, there are studies that bare relevance to our research area (Belaid, 2017; Sardianou, 2007; Wang et al., 2011).
The most recent study looked at the role of social demographic factors and policy interventions on energy-saving behaviors in the population (Tang et al., 2019a). According to (Tang et al., 2019a), factors that affect residential energy efficiency could be divided into three categories: social demographic factors, policy interventions, and psychological factors. The research has shown that demographic variables including age, gender, size of household, and education level are the significant factors that influence behaviors and activities household energy efficiency (Frederiks et al., 2015; Yang et al., 2016). Policy interventions such as taxes and subsidies, money, discounts or rewards, and feedback have also been found to be significantly related to household energy-saving behaviors (Mizobuchi & Takeuchi, 2013). Furthermore, energy-saving behaviors are also influenced by social norms and attitudes (Ding et al., 2016; Wang et al., 2018).

In France, many case studies have been conducted on energy-saving behaviors (Belaïd, 2018, 2017; Belaïd & Garcia, 2016; Belaïd et al., 2020; Lévy & Belaïd, 2018). The outstanding study conducted by Belaïd and Garcia (2016) based on a multivariate statistical approach using data from surveys assessed the impacts of 5 factors: energy price, household income, education level, age of head of household and dwelling energy performance on energy-saving behaviors. The results show that energy price possesses a significant impact on energy-saving behaviors and income; there is no effect to change the energy consuming habits of households. The male is believed to have a negative influence on energy-saving behaviors. Attitudes towards investment behavior are encouraged by educational attainment factors. However, this study mainly evaluated the residential area of the building. There is a need for more researches to expand the scope of the households such as the diversity of housing sizes, the cultural interference among central areas such as urban and peri-urban areas, and to diverse gathering places such as residential or industrial concentrations.

China is also a country with orientations to increase energy consumption, there are many studies on energy-saving behaviors and energy-saving intentions among the population, especially among households (An et al., 2014; Bai et al., 2018; Cai et al., 2019; Chen et al., 2013; Ding et al., 2017a; Hong et al., 2019; Ru et al., 2018; Tan et al., 2017; Wang et al., 2018; Wang et al., 2011; Zhang et al., 2018; Zhao et al., 2019). (Zhang et al., 2018) applied the SEM model to explore how factors affect urban household energy-saving behavior in Shandong province and provide insights to know more comprehensively about the impact mechanism of external influences and energy-saving intentions on energy-saving behaviors. External influencing factors include quality of energy efficiency products, publicity, and education, social norms and policies, and regulations that have a significant impact on adopting energy-saving behavior. While the social demographic factors are not very statistically significant. This study has shown the indirect and direct effects of potential variables on energy-saving behaviors. However, this study still possesses many limitations such as the small number of survey samples, which have not shown the characteristic diversity of representative samples. The research has not yet specifically evaluated policies for behavior change.

In Vietnam, many scholars have recently expressed interest in improving energy efficiency Nguyen et al. (2019) in the survey of actual energy consumption of households has shown that occupant behavior depends on the financial status of the occupants. Many low-income families consume less energy because they cannot afford many electrical appliances. Le (2019), when conducting research on energy demand in Vietnam, suggested that low energy prices in Vietnam led to high energy demand, high power intensity index, and ineffectiveness. Nguyen (2019) explored the electricity demands of households in Vietnam in the period 2012–2016, and took into account the demographic variables are that households’ electricity demand is often in the short term, the electricity demand varies among ages in a family, and regarding families with increased income, electricity consumption demand also increases. However, these studies only stopped at the exploitation capacity and demands for energy, no study referred to the energy-saving behaviors of households that improve the efficiency of energy use.
In the present study, we considered the direct impact of external factors on the energy-saving behaviors of urban residents in Vietnam. More specifically, this study examined the impact of factors such as social norms, quality of energy-saving products, energy prices, and energy policies on energy-saving behaviors. This study carries out investigative surveys in Hanoi city. This is the second most populated city in Vietnam, with a total population of more than 8 million people and an urban population density of about 9,343 people/km² (this is also a predictor of increasing demand energy use). Besides, Hanoi City is also the capital and center of the socio-economic development of Vietnam.

We have expanded the scale of the survey compared to many previous studies (Belaïd, 2017; Belaïd & Journi, 2020; Belaïd et al., 2020; Wang et al., 2018), we have overcome the shortcomings of the studies done in some developed countries and conducted random household surveys throughout the city. The obtained data consist of 698 valid responses after data processing. This research made important contributions to the literature on energy-saving behaviors. Implementing this study in the less developed countries will expand existing energy efficiency literature. Besides, this study is expected to provide policymakers with in-depth insights into the energy-saving behaviors of urban residents in Vietnam as the research data on energy-saving behaviors exceptionally little amount. This study could benefit stakeholders involved in enhancing energy-saving behaviors in underdeveloped countries.

In the next section, the concept of energy-saving behavior and direct impact factors is introduced. We establish appropriate hypotheses and social demographic variables related to the energy-saving behaviors of people. After that we present the research methodology and description of the data to be collected. Finally, we display the main results and the relevant policies will be discussed. Some limitations and suggestions for future research have also been made.

2. Literature review and hypotheses development

2.1. Energy-saving behavior

There is a wide variety of energy-saving behavior within households, involving all of the energy-consuming activities such as lighting, cooking, air-conditioning, refrigerating, and entertainment (Leighty & Meier, 2011). Moreover, some researchers pointed out that the behavior-changing interventions are diverse that can be divided into different research directions, such as (1) research on behavior altering to change behavior for more efficient energy usage (Abrahamse et al., 2005; Attari et al., 2010; Barr et al., 2005; Black et al., 1985; Poortinga et al., 2003); (2) Behavior that relate to the reduction of the degree of usage or comfortability or satisfaction, convenience of the user, for example: turn off light, or reducing appliance usage (Karlin et al., 2014; Liu et al., 2012; Zhang et al., 2018).

2.2. Social norms

The Social norm is the social tendency to agree and disagree, which indicates the dos and don'ts. For example, there are social norms of waste disposal, smoking, singing, when to stand or sit, when to speak up or listen, and when to discuss. In reality, there are social norms of almost every aspect of human behavior (Sunstein, 1995).

The social norms are implemented via punishments; these punishments create a range of different emotional responses within the mind of the violator. If someone behaves does not follow social norms, the public rejection shall generate embarrassment and the urge of concealing.

The recent research conducted on the impact on energy-saving behavior is related to the effect of social norms (Wang et al., 2014), meaning, the socially expected behavioral models are applied to certain circumstances. The expectation of standardized individual behavior might come from family, friends, and other more general social norms (Martinsson et al., 2011). Barr et al. (2005) claimed that active participation in social activities shall impact the acceptance toward energy-saving behavior.
In the present study, we hypothesize that there is a positive relationship between social norms and energy-saving behavior (H1).

2.3. Quality of energy-saving product
The two major determinants that affect energy-saving behavior are purchasing behavior and habitual behavior (Yue et al.). Habitual behavior is driven by the lifestyle and culture of the consumer, this indicates stable consumption during a certain period. Some previous research on the energy-saving behavior of households mentioned the motivation of energy consumption within households, for example, economic factors, demographic factors, and awareness have been identified as the forming foundation of energy-saving behavior. Ha and Janda (2012) pointed out that the purchasing of energy-saving products is one of the most significant behaviors in reducing energy consumption. Nguyen et al., (2017b) studied the individual standards, attitude toward the environment, subjective standards and barriers of awareness, all of them affect behavior toward the environment, particularly considering the purchasing of energy-efficient appliances in Vietnam, the increase in procuring energy-saving products shows better responsible toward the environment. The research also pointed out the value of applying categorizing stamps for energy-saving products helped promote the purchasing behavior of Vietnamese consumers.

In the present study, we hypothesize that there is a positive relationship between the quality of energy-saving product and energy-saving behavior (H2).

2.4. Energy price
By applying a multivariate regression model, some scholars have discovered that increasing the price of energy significantly reduced the energy consumption of inhabitants; moreover, economic expense played a negative role in regulating energy consumption (Webb et al., 2013). Gyamfi and Krumdieck (2011) found that energy-saving behavior in New Zealand is mostly affected by economic factors like electricity price and financial aid.

In the present study, we hypothesize that there is a positive relationship between energy price and energy-saving behavior (H3).

2.5. Policy
Yang et al. (2016) studied the positive impact on energy-consuming behavior of the Chinese urban population of energy relating policies. The policy factor has an important impact on the energy-consuming behavior of the population, the impacts of economic expense and social technology are not to be disregarded. Wang et al. (2017) indicated that financial aid plays a considerable role in identifying the energy-saving behavior of Chinese households. Cao et al. (2015) discovered that informative policy tools might provide significant positive guidance for the rural population in adopting low carbon-based energy consumption by implementing cluster analysis base on the collected survey data of rural households in the ecological-economic region of Poyang lake.

Yao et al. (2014) applied the quantum regression function to studied the impact of financial aid policie and existing family asset behavior on the average per capita energy consumption. This research pointed out that the financial aid policies have a positive impact on the energy consumption of general rural and urban inhabitants. They also found that the aiding policies have a recovery impact on inhabitants’ total consumption, which leads to an increase in energy consumption. Yang and Zhao (2015) surveyed on 526 people on purchasing energy-saving appliances, the result showed that income had a positive regulating impact on the relationship between attitude and behavioral tendency. The notion of financial aid policies is still in high regard among low-income households.
Tang et al. (2019b) described the energy-saving affecting factors among inhabitants consist of three types: social demographic factors, policy interventions, and psychological factors; within which, demographic factors include major agents such as age, gender, income, education level, housing status. Policy interventions consist of agents like taxes, money, and feedback. For example, the policies of increasing carbon dioxide tax and other energy-related tax in Sweden have encouraged households to change their energy-consuming behavior into a more efficient fashion along with the application of different energy models (Martinsson et al., 2011). Besides, Sweden has applied different measures, the communication policy to provide households with information of visible economic value to encourage households to adopt more specific energy-saving practices.

In the present study, we hypothesize that there is a positive relationship between policy and energy-saving behavior (H4).

2.6. Demographic variable

Demographic variables are often added to behavioral research models as special variables. According to researches by various scholars around the world, demographic variables including gender, age, marital status, size of housing, and education level are important factors influencing energy-saving behaviors (Frederiks et al., 2015; Tang et al., 2019a; Yang et al., 2016; Yue et al., 2013a).

2.6.1. Gender

Many studies show differences between behaviors of males and females (Barr et al., 2005). Women tend to consider environmental concerns more often when making decisions. On the other hand, men are more interested in the number of functions and technical improvements of the equipment (Gaspar & Antunes, 2011). Furthermore, gender seems to have an impact on energy consumption and the tendency to change energy consumption habits because women tend to be slightly more energy efficient (Carlsson-Kanyama & Lindén, 2007; Ucal, 2017). Yang et al. (2016) shows that women's daily behavior of energy-saving and their intention to invest in energy efficiency is higher than that of men.

2.6.2. Age

Gaspar and Antunes (2011) found that elders have significantly higher concerns about environmental, social, resource, and long-term savings issues. Also regarding age, (Abrahamse and Steg, 2009; Chen et al., 2013; McLoughlin et al., 2012) suggest that older people have higher energy needs, such as more heating during winter and air conditioning during summer that increase electricity consumption. For households whose heads are over 50 years old, electricity consumption is about 3% higher (Zhou & Teng, 2013).

2.6.3. Income

A study in Sydney founds that income influences energy-saving behaviors because most wealthy families agree to pay for energy-efficient services and devices (Lenzen et al., 2006). Lower-income households often live in homes with older electrical appliances that consume more energy and are classified as low-efficiency energy consumers. Barr et al. (2005) found that household income and home-ownership affect energy-saving behavior. Families with low financial means want to reduce energy costs. People living in houses with great economic conditions tend to be more energy-efficient than people living in apartment buildings.

2.6.4. Highest education

Ucal (2017) studies the energy-saving behaviors of Turkish women, who use energy-consuming appliances at home. The results indicate that the highly educated women classify electrical appliance and possess more attentive attitude towards climate change. Families with higher education levels have higher electricity consumption than the middle or lower classes (McLoughlin et al., 2012; Zhou & Teng, 2013). The research model is presented in Figure 1.
3. Study method

3.1. Study design
The structural equation model (SEM) is a widely applied method among scholars. This model includes statistical methods (regression, factor analysis, analysis of variance), which explain complex relationships among factors. SEM, commonly known as the LISREL: Linear Structured Relations model, is a part of the second-generation powerful multivariable data analysis technique that can evaluate linear additive and causal models supported by hypothesis (Kline, 2015a).

According to Grace et al. (2010), SEM is more prominent than other models in estimating causal effects through the analysis of path relationships. One of the greatest advantages of the SEM is its ability to include latent variables (i.e., unobservable quantities such as real point variables or factors that underpin the variable observations) in causality models. Other advantages of SEM over regression techniques are the ability to simultaneously evaluate integrated causal networks (Lowry & Gaskin, 2014); and the capacity to integrate other multivariate regression models.

The questionnaire for each factor of the model was refered from the study of Zhang et al. (2018). The question sentences have been also modified after discussion with 05 energy-saving behavior research specialists and mock interviews with 10 households, the collected results gave the content of the questionnaire in Table 1. The applied scale for the questions was 5-point Likert scale with 1-strongly disagree; 2-disagree; 3-mutual; 4-agree; 5-strongly agree.

3.2. Sampling and data collecting method
We conducted a large number of surveys. For the model empirical survey, we carried out interviews in different districts of Hanoi city, collected a total of 698 complete questionnaires. The data collected between 2019 and 2020 are a combination of results using three different forms with three different respective approaches: local survey, internet survey, and a direct survey by phone. Random surveys are mainly conducted in densely populated areas such as shopping malls, parks, residential markets, and apartment complexes to find out how many people are interested in researching. The sample size of 698 completed questionnaires provided sufficient input for data collection and analysis of studies using the data analysis method. The detailed demography is presented in Table 2.
| Constructs                  | Questionnaire items                                                                 | Reference          |
|-----------------------------|------------------------------------------------------------------------------------|--------------------|
| **Social norms (SN)**       | SN1 You think that households need to be aware of energy-saving behavior.          | Zhang et al. (2018) |
|                             | SN2 You must take action to save energy because of mandatory regulations.          |                    |
|                             | SN3 If everyone around you engages in energy saving, you will be more involved in energy saving. |                    |
| **Quality of energy-saving product (QL)** | QL1 You will choose to purchase energy-labeled equipment firstly. | Zhang et al. (2018) |
|                             | QL2 Customer feedback on energy-efficient products is an important factor in your choice of purchasing the product. |                    |
|                             | QL3 You will be interested in the right product then the energy-saving product.    |                    |
| **Energy price (PR)**       | PR1 You will change transportation if gasoline or oil prices rise.                |                    |
|                             | PR2 You will change the habit of using electrical equipment when electricity prices rise. |                    |
| **Energy policy (PO)**      | PO1 Policies and regulations play an important role in promoting and encouraging me to improve and change energy-saving behaviors. | Zhang et al. (2018) |
|                             | PO2 Your energy-saving behavior because of the relevant policies and regulations. | Zhang et al. (2018) |
| **Energy-saving behavior (BE)** | BE1 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. | Zhang et al. (2018) |
|                             | BE2 You will use curtains to reduce room temperature.                             |                    |
|                             | BE3 You will use public transport daily.                                         |                    |
|                             | BE4 You will use the shower in the bathroom to save water.                         |                    |
3.3. Data analysis method
Multivariate analysis was applied in analyzing the studied data. The samples were applied to a reliability assessment scale. The selecting standard was the Cronbach Alpha coefficient being higher than 0.7 (Hair et al., 2014; Nguyen et al., 2016), the total variable correlation bigger than 0.3 (Nunnally & Bernstein, 1994). The confirmatory factor analysis (CFA) was applied to assess the converging value, distinctive value and compatibility of the model to the actual data. The research hypotheses were verified using structural equation modeling (SEM) at the mean level of 5%. The compatible standards of the model include Chi-square/df lower than 3.0; comparative fix index (CFI), Tucker-Lewis index (TLI), incremental fit index (IFI) larger than 0.9, root mean square errors of approximation (RMSEA) smaller than 0.08 (Hair et al., 2014; Hooper et al., 2008; Kline, 2015b). Weighted factors larger than 0.5 of each factor were considered to reach convergence and the square-root of the extracted variance being larger than the correlation between the research concepts were the concepts that gained discriminant value (Hair et al., 2014).

4. Result and discussions

4.1. Reliability assessment
The Cronbach’s Alpha coefficients were larger than 0.6 indicating that the scales after removing the items with Corrected items—total Correlation smaller than 0.3 are reliable (SN1, BE1, BE3 were removed when the Corrected items—total Correlation were smaller than 0.3).

Confirmation Factor Analysis (CFA) is a statistical technique applied to confirm the factor establishment of a series of observed variables. CFA enables the researcher to inspect the hypothesis of the existence of a relationship between observed variables and their underlying structure. The researcher, using knowledge of theory, experimental research, or both, gives a prior correlation model and then statistically examines the hypothesis.
The CFA result showed that the data reached convergence with weighted factors larger than 0.5. The total reliability was bigger than 0.7 and the average variance extracted (AVE) being larger than 50 showed that all research concepts were reliable (Table 3).

The correlation coefficient between the variables were smaller than square-root of the AVE indicating that the factors reached discriminant value (Table 4).

Discriminant validity is the prerequisite to inspect the relationship among the potential variables. Discriminant validity is a term mentioned by Hair Jr et al. (2016) to consider the difference between two constructs in terms of statistical correlation. To test Discriminant validity, Fornell and Larcker (1981) proposed using the square root of AVE in each latent structure. Therefore, we check if this AVE value belonging to each latent variable is much greater than any correlation among the underlying structure pairs.

Finally, the model compatibility values CFI = 0.992; TLI = 0.986 and IFI = 0.992 were larger than 0.9, RMSEA = 0.036 smaller than 0.08, and Chi-square/df = 1.992 smaller than 3.0 showed that the data of the study were compatible with the data of the market. The CFA result is presented in Figure 2.

| Table 3. The reliability test |
|-------------------------------|
| Factors | Cronbach's Alpha | λ | Composite reliability | AVE |
| QL2 ← QL | 0.789 | 0.795 | 0.802 | 0.758 |
| QL1 ← QL | 0.738 | 0.740 | 0.724 | 0.755 |
| QL3 ← QL | 0.719 | 0.815 | 0.727 | 0.840 |
| PR2 ← PR | 0.826 | 0.830 | 0.827 | 0.840 |
| PR1 ← PR | 0.689 | 0.749 | 0.827 | 0.840 |
| PO2 ← PO | 0.726 | 0.731 | 0.728 | 0.756 |
| PO1 ← PO | 0.781 | 0.816 | 0.819 | 0.862 |
| SN2 ← SN | 0.714 | 0.760 | 0.712 | 0.743 |
| SN3 ← SN | 0.726 | 0.816 | 0.862 | 0.862 |
| BE2 ← BE | 0.714 | 0.760 | 0.712 | 0.743 |
| BE4 ← BE | 0.726 | 0.816 | 0.862 | 0.862 |

QL: Quality of energy-saving product; PR: Energy price; PO: Energy policy; SN: Social norms; BE: Energy-saving behavior

| Table 4. Discriminant validity |
|-------------------------------|
| Mean | QL | PR | SN | PO | BE |
| QL | 3.844 | 0.871 | 0.869 | 0.916 | 0.862 |
| PR | 3.605 | 0.678 | 0.703 | 0.743 | 0.819 |
| SN | 3.916 | 0.816 | 0.693 | 0.819 | 0.763 |
| PO | 3.809 | 0.800 | 0.701 | 0.743 | 0.862 |
| BE | 3.842 | 0.862 | 0.819 | 0.763 | 0.862 |
4.2. **SEM model analysis result**

SEM model result provided the values in table below and Figure 3.

The result pointed out that the quality of energy-saving products had the strongest and most positive impact on energy-saving behavior ($\beta_{QL} = 0.685$ and $p$-value = 0.000). Subsequently, the social norms had the second strongest and most positive impact on energy-saving behavior ($\beta_{QL} = 0.192$ and $p$-value = 0.045). Factors like price and policies did not directly affect the energy-saving behavior of households. It can be explained that ongoing policies in Vietnam have been fairly stable, with no sudden changes in energy prices. Therefore, when we did the survey, the results show that there is not much influence from the above factors. Gender factor had a direct impact on energy-saving behavior with $\beta_{QL} = 0.065$ and $p$-value = 0.032 respectively. This result indicated that women have the tendency to save more energy than men (male coded as 1; female coded as 2).

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**Figure 2. CFA analysis result.**

![CFA analysis result](image1)

**Figure 3. SEM analysis result.**

![SEM analysis result](image2)
Table 5. The SEM analysis result

|  | Standard beta | S.E. | P-value |
|---|---------------|------|---------|
| BE <!--| QL | 0.685 | 0.099 | 0.000 |
| BE | PR | 0.106 | 0.056 | 0.112 |
| BE | SN | 0.192 | 0.097 | 0.045 |
| BE | PO | -0.008 | 0.07 | 0.924 |
| BE | Gender | 0.065 | 0.043 | 0.032 |
| BE | Age | -0.023 | 0.001 | 0.451 |
| BE | Edu | 0.015 | 0.028 | 0.630 |
| BE | Income | 0.014 | 0.025 | 0.640 |

coded as 2). Regarding the factor of age, academic background, and income, these factors did not affect households’ energy-saving behavior (p-value > 0.05). The SEM result is presented in Table 5.

5. Conclusion and policy implications

The present study has introduced a model to evaluate the direct impact of external factors on energy-saving behavior in households. The results of the present model that have been tested by applying the SEM analysis method showed the role of external impact factors as follows: the quality of energy-saving products plays a core role in identifying energy-saving behaviors, particularly behaviors of purchasing energy-saving products. Moreover, the factor of social norms shows the role in forming the consensus of society about the importance of energy-saving behavior. The social environment is a necessary place to disseminate energy-saving products and promote buying behavior among consumers. An interesting finding in the present study when considering demographic factors is that gender positively affects energy-saving behaviors, specifically that women tend to practice energy-saving behavior more than men. Since most households in Hanoi city are more active during the evening, the woman plays an important role in using energy-consuming equipment such as cooking, boil water, refrigerators usage, washing machines, water heaters. These suggestions could also be found in the research of Ucal (2017).

Besides, we have found that energy-saving policies in Hanoi city are not effective, the application of the law on economical and efficient use of energy has been implemented in Vietnam since 2012 for service activities and households but has not fundamentally changed consumers’ energy-saving behavior. The new measures are merely encouragement, there has been no specific solution. For example, the government encourages households to design housing that can take advantage of natural light and ventilation. The government needs to organize activities to disseminate knowledge about energy use and how to save energy indoor. For each type of household, it is necessary to design and use appropriate equipment.

This study has made significant contributions in terms of the research methodology. Firstly, we did preliminary evaluations: evaluation of variance and standard deviation to determine the reliability of the model. We then evaluated the correlations between the independent and the dependent variables. Finally, we performed regression analysis to test our hypotheses.

Based on the results and analysis of why Vietnam’s energy-saving policies applying to households have no significant effect on consumers’ energy-saving behavior, hence we introduce the following policy recommendations.
Firstly, the government needs to implement supporting policies for energy-efficient devices. Stimulate the consumption of energy-saving devices, disseminate knowledge to consumers to form green consumption habits, acquire long-term buying experience in the market and get acquainted with buying energy-saving equipment; this could be a long-term benefit in terms of making energy-efficient devices more common. Residential energy-consuming products have recently been labeled with energy for classification, e.g., energy-efficient air-conditioning products, refrigerators using energy-saving technologies, and energy-saving fans. However, most consumers are still unable to identify the benefits of using energy-saving products, or simply because the market is still infested with replicated products with quality that have energy-saving labels. This causes a loss of trust from consumers.

Furthermore, different incentive programs can be deployed simultaneously. Especially the combination of renewable energy products such as rooftop solar power, solar water heaters should receive price support from the government to directly encourage people to install and use. This would contribute to energy conservation and sustainable energy development.

Besides, given the strong influence of energy-saving products, the government can develop a process for subsidizing energy-saving products, along with focusing more on the management and monitoring of support programs. The government should also strengthen international cooperation to share information and experiences, optimize positive impacts, and share lessons learned that have been summarized from other countries. This would be the lever that drives energy efficiency practices and energy labeling.

Finally, the government needs to increase publicity efforts on energy conservation and environmental protection to improve people’s environmental awareness. We make use of the full coverage of the internet and the popularity of communication mediums such as television, smartphone, taking advantage of social media is also common. Most importantly, we adhere to the national development strategy through science and education; strengthen the country’s science and technology capability, organize many scientific activities and conferences to improve the scientific and cultural quality of the entire country.

6. Limitation and future research
In this study, we used descriptive statistical methods to identify the relationship among external factors that directly affect energy-saving behavior. Besides, we considered the role of social demographics variables. It can be observed that this study has investigated, surveyed, and evaluated the mechanisms in the form of energy-saving behaviors. However, it is necessary for a longer period in order to maximize the data accuracy. Furthermore, the scope of assessment needs to be expanded in terms of indirect effects from other factors.

In Vietnam, the climate also acts as an important factor in increasing energy demand and forming energy-saving behaviors. In the near future, we will carry out further studies to evaluate the role of climate change factors. The technological factor also requires to be considered more carefully as culture, socio-economy are progressively developing, due to the 4.0 industrial revolution.

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