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# Critical Factors Affecting Rooftop Solar System Investment: An Empirical Study in Vietnam

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## Abstract

The economic development of most countries in the world has negatively impacted fossil energy resources. Fossil energy sources such as petroleum and coal are increasingly depleted. When energy sources are exhausted, renewable energy sources are growing strongly. Renewable energy development can help to replace diminishing fossil fuels. Furthermore, the usage of renewable energy can contribute to a green economy and sustainable development by protecting the environment. Solar power on the roof is one of the many renewable energy sources available. But at present, the investment in roof voltage systems has not developed strongly in Vietnam. This paper uses the SEM model to evaluate the factors affecting investment in rooftop solar power in some provinces of Vietnam. The article uses the household interview method. The article has given 8 factors affecting the decision to invest in rooftop solar power for households. Research results show that most of the factor variables have a positive impact on the decision to invest in rooftop solar power. Based on assessing the factors affecting the decision to invest in rooftop solar power, the article will provide conclusions and policy suggestions to increase investment in rooftop solar power in Vietnam.

**Keywords:** SEM, Rooftop Solar System, Environment, Energy, Investment

**JEL Classification Code:** E22, F63, O44, Q01, Q43

## 1. Introduction

Currently, in most countries of the world, the reserves of coal and other minerals used in the production of electricity are increasingly depleted. The strong economic growth of most countries in the world as well as the exploitation of fossil fuels, also depletes resources. Therefore, the reserves of fossil fuel sources such as coal and stone are increasingly depleted. Many countries have now turned to exploit renewable resources such as solar energy. Harnessing solar energy will help reduce the damaging effects on the environment. Energy is the infrastructure, the driving force for the socio-economic development of a country. An adequate and sustainable energy supply is one of the keys to economic growth. Many countries around the world have researched the use and exploitation of renewable energy sources o solve the future energy shortage and limit the negative impact on the environment.

Vietnam is one of the developing countries in Southeast Asia with an increasing demand for electricity to serve the industrialization of the country. However, the current electricity supply system of Vietnam is still mainly using fossil fuels such as coal, oil, and gas for power generation. This makes Vietnam face a shortage of fossil energy sources because reserves are gradually depleting and power plants are polluting, greatly affecting the environment. Meanwhile, Vietnam has a great potential for renewable energy sources, but currently, only a very small percentage is exploited and used because most of the renewable energy projects are low-profit, high-tech. The installation of rooftop solar systems for families is still complicated, so it is not attractive to both users and investors. So far, the number of large-scale renewable energy projects in Vietnam is still very small. The proportion of installed capacity of power plants produced

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from renewable energy in the total installed capacity of the whole system is still very modest.

According to the assessment of the Ministry of Industry and Trade of Vietnam (2014), the potential of solar energy in the territory of Vietnam is as follows: The North has 1681 hours of sunshine per year, reaching 3.4 kWh/$m^2$/day, the Central has 1980 hours of sunshine per year, respectively 3.8 kWh/$m^2$/day and the South has 2588 hours of sunshine per year, equivalent to 4.8 kWh/$m^2$/day (Ministry of Industry and Trade, 2014). However, despite its good potential, Vietnam has not yet taken advantage of this energy source and most of the solar power projects in Vietnam are still being developed on a small scale.

Solar power is increasingly used for many different purposes such as home lighting, public lighting, schools, medical stations, parks, traffic signal lights, broadcasting stations, umbrellas, etc. solar-powered cars and canoes .. and become a new development trend, even recognized in the Government's development promotion policy (Decision No. 11/2017/QD-TTg dated 11/4// 2017 and Decision No. 13/2020/QD-TTg dated April 6, 2020, of the Viet Nam Prime Minister).

The characteristics of solar power generation are not only based on the potential of solar energy but also on contact surface area. With more and more scarce land, it is also more difficult for large factories to invest in solar power production. So the new approach to investment from individuals, organizations, households ... becomes more and more effective rooftop solar power. This also opens up many opportunities for both consumption and production of renewable energy in Vietnam, as evidenced by the remarkable development of solar power projects in Vietnam in the 2018-2020 period. But many factors hinder the investment in rooftop solar power systems of households, such as finance and awareness.

It is necessary to have clear empirical studies on the investment decisions of households to promote the development of solar power, including rooftop solar power (Guta, 2018). The investment in rooftop solar power households is shaped by many specific socio-economic, institutional, and technological variables (Rahut et al., 2017). While many foreign scientists have researched this issue, it has not been done clearly in Vietnam. This can be done by using an econometric model with survey data on investment decisions to invest in solar power and analyzing the influence of the variables as the basis for the construction of solar power, and implementing policies to accelerate the transition of household energy to clean renewable energy.

To boost the development of rooftop solar electricity in Vietnam, examining the factors influencing investment decisions are required. In this case, policy mechanism elements are crucial. Furthermore, a better knowledge of investment behavior in this field is required to design appropriate regulations that provide the essential financial incentives for the growth of renewable energy sources.

The research behavior and investment decisions in both theory and practice to understand the factors affecting investors' behavior. This kind of research will help identify positive and potentially negative factors influencing investor behavior towards rooftop solar power projects. Thereby helping managers and policymakers make decisions to best meet investment needs in the market. With the above situation, this article will study the factors affecting investment decisions in rooftop solar power in Vietnam.

## 2. Literature Review and Hypotheses

### 2.1. Literature Review

The investment in the rooftop solar power system can be considered in many different aspects. The term "investment in rooftop power system" is not only reserved for power generation enterprises but is also used in the consumer sector (Shirizadeh & Quirion, 2022). As rooftop solar becomes more and more personalized (unlike buying electricity on the national grid produced by many different sources), households will consider whether to invest in a roof energy system. Therefore, there are many studies on the factors affecting investment decisions in the rooftop solar energy system.

Energy is always the most important issue in human life. The invention of electricity helps people enter a new era of development. Electricity has become an inevitable part of life. The ability to excel in the economic development of industrialized countries is completely dependent on energy (Vidadili et al., 2017). Energy has been known as a "strategic commodity," and any uncertainty about its supply could threaten economic performance, especially in developing economies. Every society requires energy to meet basic needs (Sen & Ganguly, 2017).

Kodysh et al. (2013) estimated the rooftop solar potential by analyzing high-resolution LiDAR data to generate a solar irradiance map and estimate the solar potential of each building. This method has been applied to many counties in the United States. LiDAR data were also used in an analysis of rooftop solar potential in Malaysia. The study of Abd Latif et al. (2012) was also processed to estimate the available roof area, solar radiation as well as information about the building and roof slope.

Dondariya et al. (2018) studied the barriers to the development of solar power generation that requires large investments to implement large-scale renewable energy programs, especially in developing countries such as India. That makes the centralized model of solar power generation with a relatively low capacity compared to using traditional energy and other alternative sources. It is very important to adopt a decentralized model of rooftop solar power invested by households and office buildings to accelerate energy production from solar energy. Rooftop solar power is one of the effective off-grid alternative models that has been successfully implemented in many countries such as Germany, Japan, and the US. Rooftop solar is an attractive option because of its low maintenance costs and its role in promoting energy self-reliance.

Yoomak et al. (2019) conducted research in Thailand. They found that the awareness level of Thailand's residential and private areas about the decentralized rooftop solar model is still very low. Therefore, the Government needs to initiate a policy to apply public solar energy on the rooftop to raise awareness and use of solar energy and promote investment in households. In addition, the study also recommends policies to encourage households to install solar panels and resell excess electricity to the grid to increase the energy supply in Thailand.

According to Sherwood's research, the US has developed several measures to promote solar power generation at various scales, including publishing renewable power portfolio standards and issuing accreditation certificates, applying credit policy for renewable energy investment, or production tax credit. Specifically, the tax credit increased by 30% in 2005 to develop household rooftop solar power and support the annual installation of 6,000 MW. The US develops rooftop solar power systems by offering a policy of reducing loan interest rates by 4% for families to install. At the same time, each household can borrow up to $20,000 in 10 years. The individual tax credit is implemented to support 30% of the installation costs of households for rooftop solar PV systems (U.S. Environmental Protection Agency, 2013). All these policies have attracted great interest from households in installing rooftop solar power. With this financial support, New York State is ranked 7th for cumulative installation of rooftop solar PV systems among states in the US (Sherwood, 2011).

Braito et al. (2017) surveyed households that accept and do not accept investment in rooftop energy systems in an area of Italy. Research shows that many households consider economic (financial) motivation to be a matter of consideration. In addition, the opportunity to generate income when investing in the rooftop solar power system of households is also mentioned as an important influencing factor. Malik and Ayop (2020) demonstrated that rooftop solar panels not only bring electricity to low-income households but also generate income for them. The generated electricity will be sold to licensed utility firms or sold to the grid if you invest in rooftop battery installation. This can be understood as a way to generate more income for households when they have a roof space that can absorb solar energy. This is an income-doubling opportunity for low-income households from 2014 to 2020 in Malaysia (Malik & Ayop, 2020).

Thus, there have been many studies on rooftop solar power systems and factors affecting investment decisions. However, there has not been a similar study in provinces in Vietnam. This is the research gap for the author during the research on rooftop solar power.

### 2.2. Research Hypothesis

Based on the results of the research review and expert methods to determine the factors affecting investment decisions on rooftop solar power, the author proposes research hypotheses including hypotheses to explore the relationship between factors affecting household investment decisions for rooftop solar power systems. Here, the author hypothesizes about the positive impact of these factors on the investment decisions of households. As follows:

***H1:*** *The level of risk positively affects investment decisions of rooftop solar power.*

***H2:*** *Environmental protection has a positive impact on investment decisions for rooftop solar power.*

***H3:*** *Social consumption trends have a positive impact on investment decisions of rooftop solar power.*

***H4:*** *Reference groups have a positive impact on investment decisions of rooftop solar power.*

***H5:*** *Government policy has a positive impact on investment decisions of rooftop solar power.*

***H6:*** *Demand and motivation positively influence investment decisions of rooftop solar power.*

***H7:*** *Product characteristics that are suitable for demand have a positive impact on investment decisions of rooftop solar power.*

***H8:*** *Economics affects investment decisions on rooftop solar power.*

## 3. Research Methods

This study uses a questionnaire survey method to evaluate the factors affecting the investment in rooftop solar energy systems. The questionnaire was sent to the respondents through means such as email, social networks, and even face-to-face methods. The team made more than 510 votes and collected 450 questionnaires. The survey sample was selected by the non-random sampling method, which is conveniently combined with the fractional sampling method. The author selects and conducts interviews with people who are or intend to install rooftop solar power systems in some provinces of Vietnam.

Below is the scale encoding table (Table 1).

**Table 1:** Table of Scales And Components of The Model

| No | Scale | | Code |
|---|---|---|---|
| | **Independent Variables** | | |
| 1 | *Risk* | | RR |
| 1.1 | I am very worried that spending a lot of money to install a rooftop solar power system will bring economic benefits or not | | RR1 |
| 1.2 | I don't know if my rooftop solar power information is complete | | RR1 |
| 1.3 | I am concerned about the complexity of ordering and installing a rooftop solar power system | | RR3 |
| 1.4 | I don't know if many businesses provide rooftop solar panels | | RR4 |
| 1.5 | I am worried about the warranty, exchange, and replacement of roof solar panels during use | | RR5 |
| 1.6 | I don't know where to find accurate information about rooftop solar power | | RR6 |
| 2 | *Environmental protection point of view* | | TN |
| 2.1 | I always have the consciousness to protect the environment when making consumption decisions | Poier (2021) | TN1 |
| 2.2 | Rooftop solar power is better for the environment than electricity from hydroelectricity and thermal power | | TN2 |
| 2.3 | Rooftop solar power is an endless source of renewable energy | | TN3 |
| 3 | *Social consumption trends* | | *XH* |
| 3.1 | Society is tending to consume environmentally friendly products | Rai and Robinson (2015) | XH1 |
| 3.2 | The trend of the world will be to replace electricity produced from non-renewable, harmful to the environment energy to clean renewable energy | | XH2 |
| 3.3 | Society will save electricity by producing its own electricity | | XH3 |
| 4 | *Reference group* | | *TK* |
| 4.1 | Opinions of relatives about the installation of rooftop solar power systems affect investment decisions | Wasi and Carson (2013) | TK1 |
| 4.2 | Referring to the experience of people familiar with the installation of rooftop solar power systems affects investment decisions | | TK2 |
| 4.3 | Referring to the reviews of people who have installed rooftop solar power systems on the mass media affects investment decisions | | TK3 |
| 4.4 | Referring to the introduction of rooftop solar power systems by suppliers affects investment decisions | | TK4 |
| 5 | *Government policies* | | *TH* |
| 5.1 | I am willing to install a rooftop solar power system if I get financial support from the government | Malik and Ayop (2020) Christine and Chernyakhovskiy (2014) Nguyen et al. (2021) | TH1 |
| 5.2 | I am ready to install a rooftop solar power system if the government comes up with a policy to encourage the entire population to use solar power | | TH2 |
| 5.3 | I am ready to install a rooftop solar power system if the government has the policy to support me to connect to the grid and sell unused electricity | | TH3 |
| 5.4 | I am willing to install a rooftop solar power system if the government has the policy to support the exchange of old damaged panels | | TH4 |

| No | Scale | | Code |
|---|---|---|---|
| 6 | *Demand and motivation* | | NC |
| 6.1 | The need to use clean energy affects investment decisions | Akil et al. (2021) | NC1 |
| 6.2 | The need to expand electricity use affects investment decisions | | NC2 |
| 6.3 | Business demand for more electricity affects investment decisions | | NC3 |
| 6.4 | The need to increase safety for electricity use affects investment decisions | | NC4 |
| 6.5 | The need to demonstrate an understanding of trends that influence investment decisions | | NC5 |
| 7 | *Product characteristics* | | DT |
| 7.1 | Characteristics of panels affect investment decisions | Đinh et al. (2021)<br>Schelly (2014)<br>(Ngo et al., 2021) | DT1 |
| 7.2 | Housing characteristics affect investment decisions | | DT2 |
| 7.3 | Characteristics of natural conditions affecting investment decisions | | DT3 |
| 7.4 | Features of the product's usefulness affect investment decisions | | DT4 |
| 7.5 | Features of accessories and interchangeability affect investment decisions | | DT5 |
| 7.6 | Safety characteristics affect investment decisions | | DT6 |
| 7.7 | Features of comfort, ease of use influence investment decisions | | DT7 |
| 7.8 | The use of new technology affects investment decisions | | DT8 |
| 7.9 | Warranty and after-sales of goods affect investment decisions | | DT9 |
| 8 | *Economical* | | KT |
| 8.1 | The price of the rooftop solar power system affects investment decisions | Jackson and Mushi (2020)<br>Ondraczek (2013)<br>Đinh et al. (2021) | KT1 |
| 8.2 | Household income affects investment decisions | | KT2 |
| 8.3 | Promotional programs of firms influence investment decisions | | KT3 |
| 8.4 | The extra income from selling excess electricity to the grid affects investment decisions | | KT3 |
| 8.5 | Repair costs affect investment decisions | | KT5 |
| 8.6 | The difference in benefits between using rooftop solar power and grid electricity affects investment decisions | | KT6 |
| | **Dependent Variable** | | |
| 9 | *Investment decision in rooftop solar power* | | *QD* |
| 9.1 | I have to consider a lot in deciding to invest in rooftop solar power | Malik and Ayop (2020) | QD1 |
| 9.2 | I want to invest in rooftop solar power | | QD2 |
| 9.3 | I encourage everyone to invest in rooftop solar power | | QD3 |

# 4. Results

## 4.1. Descriptive Statistics

The survey with the number of questionnaires was 280, distributed in 3 inner districts of Hanoi City, with 47% in Long Bien district, 26% in Hoang Mai district, and 27% in Hai Ba Trung district (Table 1). The proportions of men and women are 46.1% and 53.9%, respectively. The age of the mean sample was 49.5 years old (standard deviation = 13.1 years). 56.2% of respondents have a bachelor's degree or higher. When asked about homeownership, 70% of respondents ($n$ = 280) own a home they live in. Homeownership is often likely to influence perceived behavioral control related to solar installations, as non-homeowners are less inclined to install. However, the $t$-test showed no statistically significant difference in perceived behavioral control between homeowners and renters, $p$ = 0.61. The average total residential usable area was 86.2 square meters (median = 78.3 square meters), and the house value of the respondents was 2,136 billion VND. The average household income of the respondents is between 150 and 250 million VND/year.

## 4.2. The Reliability of the Scale

It is necessary to evaluate the reliability of the scales through Cronbach's Alpha coefficient of the questionnaire to build an appropriate official scale. Testing the reliability coefficient of the scale plays a very important role in the accuracy and relevance of the research results. On the one hand, it helps to eliminate the observed variables that are not reliable enough. On the other hand, it helps to study the adjustment and develop the official scale. The scale is accepted when the Cronbach's Alpha reliability coefficient is from 0.5 or higher and will exclude those variables with a total variable correlation coefficient lower than 0.3, making the Cronbach's Alpha coefficient unsatisfactory. The results presented in Table 2 show that: all scales have Cronbach's alpha coefficient greater than 0.8 > 0.6, so it can be concluded that the scales are built quite well. These scales will bring reliability to the model and help the influence model to be accurately determined.

## 4.3. Exploratory Factor Analysis

After checking the reliability of the scale, an exploratory factor analysis was conducted. The extraction method selected for factor analysis is the principal components method with varimax rotation (Table 3). Components of factors affecting investment decisions on rooftop solar systems are measured by 27 observed variables. According to the components, all variables meet the requirements and are included in the EFA exploratory factor analysis to determine the degree of convergence.

Conducting exploratory factor analysis, EFA gave the following results:

The exploratory factor analysis for the independent variables shows that the *p*-value = 0.000 of Bartlett's test allows us to safely reject the null hypothesis H0 (H0: Factor analysis does not fit the data). KMO index equal to 0.847 shows that the model's relevance is high. Besides, the results of 5 factors extracted at Eigenvalue = 1.218 with total variance extracted is 65.015% > 50%. Therefore, factor analysis is appropriate. Thus, the exploratory factor analysis results show five groups of factors extracted from the data to ensure eligibility for factor analysis. These factors will act as independent variables in the study's research model.

The dependent variable scale of 3 observed variables with Cronbach's alpha reliability was included in the exploratory factor analysis. The results of the exploratory factor analysis for the dependent variable are as follows:

The KMO coefficient is 0.745 > 0.5, and the significance level is 0.000 < 0.05; Therefore, the observed variables are correlated with each other in general. Three observed variables of the dependent factor were extracted to the same factor at Eigenvalue = 2.453 > 1, and the variance extracted was 61.338% > 50%, proving that the extracted factor explained 61.338% of the variation of the data.

**Table 3:** KMO Coefficient and Bartlett's Test for Independent Factors

| **KMO (for Independent)** | | 0.846 |
|---|---|---|
| **Bartlett** | Chi-square | 9,841.297 |
| | Df | 253 |
| | Sig. | 0.000 |
| **KMO (for Dependent)** | | 0.715 |
| **Bartlett** | Chi-square | 460.705 |
| | Df | 3 |
| | Sig. | 0.000 |

**Table 2:** Cronbach's Alpha Coefficient of the Observed Variables

| Variable Name | The Scale | Number of Observed Variables | Cronbach's Alpha Coefficient | Responsive |
|---|---|---|---|---|
| RR | Risk level | 4 | 0.896 | yes |
| TN | Environmental protection point of view | 3 | 0.878 | yes |
| XH | Social consumption trends | 3 | 0.898 | Yes |
| TK | Reference group | 4 | 0.859 | Yes |
| TH | Government policies | 4 | 0,814 | Yes |
| NC | Consumer demand and motivation | 5 | 0,875 | Yes |
| DT | Product characteristics | 9 | 0.900 | Yes |
| KT | Economical | 6 | 0.881 | Yes |
| QD | Investment decision for rooftop solar power | 3 | 0.808 | Yes |

**Table 4:** Rotation Matrix Table for Independent Variables

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| DT9 | 0.826 | | | | | | | |
| DT2 | 0.767 | | | | | | | |
| DT5 | 0.737 | | | | | | | |
| DT8 | 0.718 | | | | | | | |
| DT1 | 0.713 | | | | | | | |
| DT6 | 0.698 | | | | | | | |
| DT7 | 0.641 | | | | | | | |
| DT3 | 0.640 | | | | | | | |
| DT4 | 0.631 | | | | | | | |
| KT5 | | 0.914 | | | | | | |
| KT1 | | 0.815 | | | | | | |
| KT6 | | 0.772 | | | | | | |
| KT2 | | 0.737 | | | | | | |
| KT3 | | 0.601 | | | | | | |
| KT4 | | 0.595 | | | | | | |
| NC4 | | | 0.846 | | | | | |
| NC3 | | | 0.757 | | | | | |
| NC2 | | | 0.751 | | | | | |
| NC5 | | | 0.739 | | | | | |
| NC1 | | | 0.712 | | | | | |
| RR2 | | | | 0.903 | | | | |
| RR5 | | | | 0.845 | | | | |
| RR1 | | | | 0.796 | | | | |
| RR4 | | | | 0.774 | | | | |
| TK1 | | | | | 0.886 | | | |
| TK3 | | | | | 0.802 | | | |
| TK2 | | | | | 0.733 | | | |
| TK4 | | | | | 0.695 | | | |
| TH4 | | | | | | 0.780 | | |
| TH2 | | | | | | 0.768 | | |
| TH3 | | | | | | 0.709 | | |
| TH1 | | | | | | 0.658 | | |
| XH1 | | | | | | | 0.971 | |
| XH2 | | | | | | | 0.839 | |
| XH3 | | | | | | | 0.782 | |
| TN1 | | | | | | | | 0.852 |
| TN2 | | | | | | | | 0.825 |
| TN3 | | | | | | | | 0.797 |

All observed variables have loading coefficients greater than 0.5, so all observed variables meet the requirements, and no variables are excluded.

Table 4 shows the factors made based on recognizing observed variables with large transmission coefficients in the same factor. The results of the EFA analysis are shown in the factor matrix after rotation. All factors are greater than 0.5, so the variables are preserved, not removed. In particular, no element is uploaded twice.

## 4.4. Results of Structural Equation Model (SEM)

The SEM model is formed with 8 independent variables affecting the dependent variable after converting 2-dimensional arrows into 1-dimensional according to the research model proposed. Model testing has affirmative value for the research model (Figure 1 and Table 5).

Accordingly, the decision to invest in a rooftop solar system is correlated with five factors. The test results show that the "correlation coefficient" between the dependent variable and the factors is 0.650 (for the Subjective Standard variable), and the lowest is 0.345 (for the variable Concern about the environment). These relationships are significant when sig < 0.05. The independent variables can be included in the model to explain the dependent variable. In addition, the correlation coefficient between the independent variables, although it exists, is at a low level. So it can be predicted that the possibility of multicollinearity between the independent variables above is unlikely. In summary, the data is perfectly suitable for inclusion in regression analysis (Table 5).

The author performed a weighted regression analysis, all P values are less than 0.05, showing that the relationship between the factors in the model is statistically significant (Table 5).

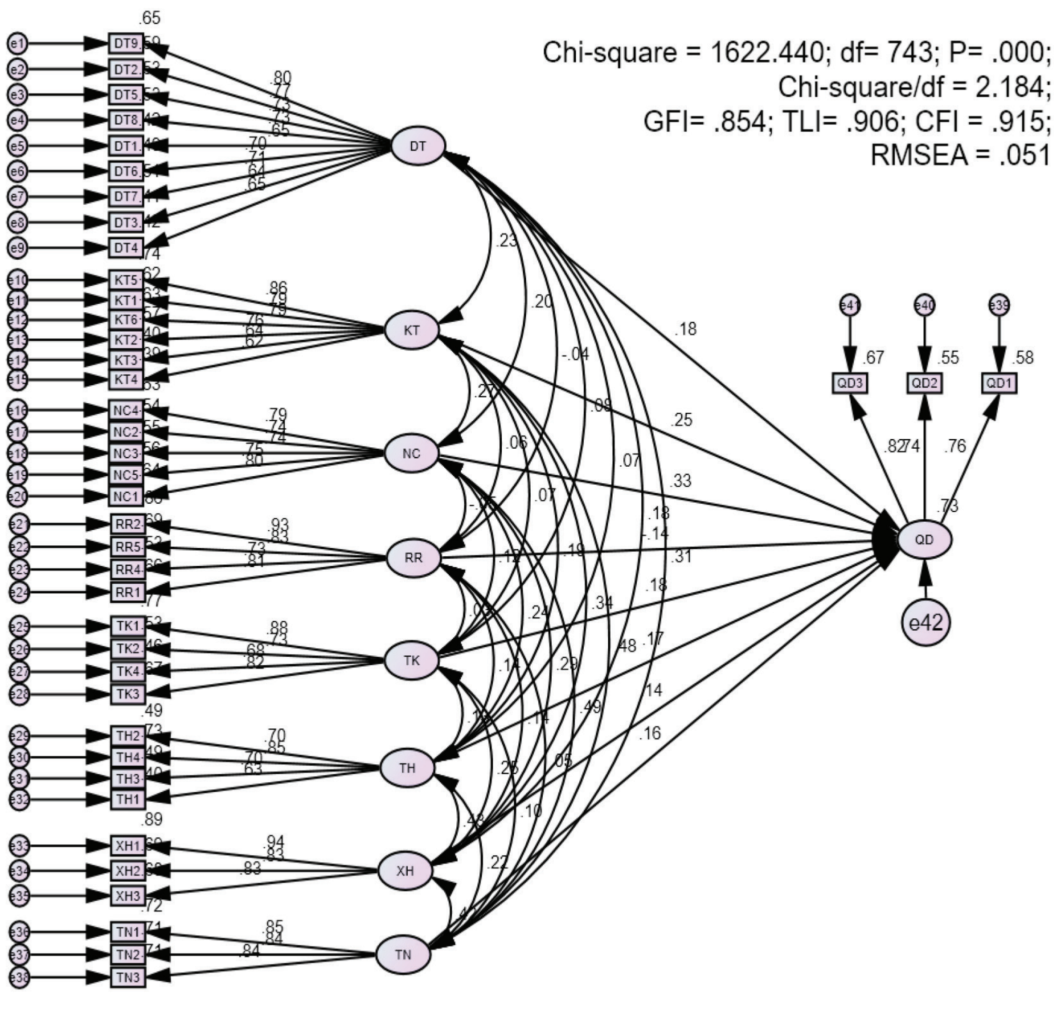


**Figure 1:** SEM Model

**Table 5:** Table of Regression Weights (Unnormalized) in the SEM Model

| | | | Estimate | S.E. | C.R. | *P* |
|---|---|---|---|---|---|---|
| QD | ← | DT | 0.194 | 0.042 | 4.583 | *** |
| QD | ← | KT | 0.204 | 0.037 | 5.444 | *** |
| QD | ← | NC | 0.263 | 0.038 | 6.851 | *** |
| QD | ← | RR | –0.096 | 0.026 | –3.685 | *** |
| QD | ← | TK | 0.153 | 0.033 | 4.611 | *** |
| QD | ← | TH | 0.228 | 0.058 | 3.903 | *** |
| QD | ← | XH | 0.102 | 0.035 | 2.940 | 0.003 |
| QD | ← | TN | 0.113 | 0.036 | 3.128 | 0.002 |
| DT9 | ← | DT | 1.000 | | | |
| DT2 | ← | DT | 0.945 | 0.053 | 17.804 | *** |
| DT5 | ← | DT | 0.876 | 0.053 | 16.517 | *** |
| DT8 | ← | DT | 0.947 | 0.057 | 16.619 | *** |
| DT1 | ← | DT | 0.825 | 0.058 | 14.306 | *** |
| DT6 | ← | DT | 0.887 | 0.056 | 15.717 | *** |
| DT7 | ← | DT | 0.889 | 0.055 | 16.067 | *** |
| DT3 | ← | DT | 0.858 | 0.061 | 14.110 | *** |
| DT4 | ← | DT | 0.810 | 0.057 | 14.274 | *** |
| KT5 | ← | KT | 1.000 | | | |
| KT1 | ← | KT | 0.896 | 0.046 | 19.626 | *** |
| KT6 | ← | KT | 0.979 | 0.049 | 19.870 | *** |
| KT2 | ← | KT | 0.937 | 0.051 | 18.521 | *** |
| KT3 | ← | KT | 0.701 | 0.048 | 14.604 | *** |
| KT4 | ← | KT | 0.700 | 0.049 | 14.211 | *** |
| NC4 | ← | NC | 1.000 | | | |
| NC2 | ← | NC | 0.843 | 0.052 | 16.168 | *** |
| NC3 | ← | NC | 0.883 | 0.054 | 16.391 | *** |
| NC5 | ← | NC | 0.822 | 0.050 | 16.509 | *** |
| NC1 | ← | NC | 0.841 | 0.047 | 17.888 | *** |
| RR2 | ← | RR | 1.000 | | | |
| RR5 | ← | RR | 0.816 | 0.034 | 23.949 | *** |
| RR4 | ← | RR | 0.632 | 0.033 | 19.045 | *** |
| RR1 | ← | RR | 0.847 | 0.037 | 22.888 | *** |
| TK1 | ← | TK | 1.000 | | | |
| TK2 | ← | TK | 0.755 | 0.044 | 17.168 | *** |
| TK4 | ← | TK | 0.671 | 0.043 | 15.587 | *** |
| TK3 | ← | TK | 0.905 | 0.046 | 19.763 | *** |
| TH2 | ← | TH | 1.000 | | | |
| TH4 | ← | TH | 1.414 | 0.096 | 14.684 | *** |
| TH3 | ← | TH | 1.105 | 0.085 | 12.998 | *** |
| TH1 | ← | TH | 0.942 | 0.079 | 11.870 | *** |
| XH1 | ← | XH | 1.000 | | | |
| XH2 | ← | XH | 0.859 | 0.035 | 24.342 | *** |
| XH3 | ← | XH | 0.953 | 0.040 | 24.005 | *** |
| TN1 | ← | TN | 1.000 | | | |
| TN2 | ← | TN | 0.962 | 0.046 | 20.756 | *** |
| TN3 | ← | TN | 0.802 | 0.039 | 20.679 | *** |
| QD1 | ← | QD | 1.000 | | | |
| QD2 | ← | QD | 1.184 | 0.078 | 15.210 | *** |
| QD3 | ← | QD | 1.054 | 0.063 | 16.780 | *** |

Consider the normalized regression weight table to determine the degree of influence between the independent and dependent variables. The research results show that the factors in the model all affect the investment decision of households in the field of rooftop solar power. Therefore, the model's hypotheses are accepted.

The degree of influence of the variables is arranged in the following order: Research > KT > DT > TK > TH > TN > XH > RR. In which, the strongest influence is the variable "need and motivation to use" and the weakest level of influence is "social consumption trend". Particularly, the risk variable has a negative value, showing the opposite effect on the dependent variable. The results show that to promote investment decisions in the field of rooftop solar power, businesses, as well as the government, need to have appropriate strategies to influence each factor. High correlation factors have a strong impact, while low correlation factors may not require much adjustment.

## 5. Conclusion

In the context that the power system is under a lot of pressure to ensure electricity supply, the development of solar energy projects, including rooftop solar power, is considered one of the solutions to reduce pressure on the electricity industry. The Vietnamese Government has also introduced incentive mechanisms and policies suitable to development practices for each period and in the direction of fairness and transparency, creating conditions for all economic sectors to participate in development to exploit full advantage and potential of renewable energy resources in Vietnam to serve sustainable socio-economic development.

The study has evaluated 8 factors affecting rooftop solar power investment; most of the factors have a positive impact on the decision to install rooftop solar power in households. Therefore, based on the research results, the author wants to make some policy suggestions to increase investment in rooftop voltage in Vietnam.

*First*, the Vietnamese Government needs to come up with policies to promote the investment needs of households. Even households in big cities have not yet identified their need to invest in rooftop solar power. They have the habit of using traditional electricity from the power grid and feel that installing a power generation system for their own family is complicated, facing many risks. The government, EVN, or businesses providing rooftop solar power systems are forced to pay attention to the needs of households, produce and supply suitable goods and even create motivational needs for their investment decisions.

*Second*, rooftop solar power systems show clear economic benefits to households when making investment decisions. Economics is related to initial investment costs, costs incurred in the process of use (replacement, repair, additional loads, etc.), and return value (difference between the cost of installing rooftop solar PV) houses with grid electricity, income increases when selling surplus electricity to the grid, etc.). Investment in rooftop solar power is also a form of long-term investment for households and they also have to face financial risks. Therefore, when the perception of risk is reduced when installing rooftop solar power systems, households will increase their investment decisions.

For rooftop solar power systems, product quality is one of the most important factors that directly affect households' investment decisions. Because they have to spend a huge amount of money to use the product and they need to be used for a long enough time to be able to replace it with another product. Even a small technical problem can directly affect the investment money, the daily life of households as well as the national electricity grid.

*Third*, product characteristics are related to the use-value of a commodity. When deciding to invest in a rooftop solar power system, households always compare the use-value with the investment cost. Therefore, the rooftop solar power system provides good photovoltaic absorption efficiency, low load, safety, meeting as many needs as possible for domestic electricity consumption as well as easy connection.

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