



Applying the Theory of Planned Behavior to Analyze Household Energy-Saving Behavior

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ABSTRACT

Energy consumption in residential areas is increasing which leads to greenhouse gas emissions and environmental pollution. Household energy-saving behavioral intentions are diverse and influenced by many different factors. This study approaches the theory of planned behavior (TPB) with an integrated perspective (economic-oriented, technology-oriented, and behavior-oriented perspective) to demonstrate affecting factors to the energy-saving intention of households in Vietnam. Applying the structural equation modeling (SEM), the study has pointed out the above affecting factors include subjective norms, perceived behavioral control, perceived benefits, attitude, product quality, and energy policies. In which, the “perceived benefits” factor has the most impact on the energy-saving intention of households.

Keywords: Theory of Planned Behavior, Behavioral Intention, Energy Saving, Household

JEL Classifications: C52, C78, M59

1. INTRODUCTION

Recently, the proportion of residential energy consumption in total energy consumption has increased significantly (Nie et al., 2019; Irfan et al., 2021; Zhang et al., 2021). Energy-saving behavior is one of the most important factors, which greatly affects the energy consumption of residential areas and is easily affected by energy policies (Abrahamse and Steg, 2009, Manjunath et al., 2014). According to Yeboah and Kaplowitz (2016), efficient use of energy contributes to changing user behavior, thereby improving energy-saving practices. Changes in individual behavior in terms of energy consumption can bring great benefits and reduces greenhouse gas emissions and negative consequences for the environment (Lokhorst et al., 2015).

The topic of household energy-saving behavioral intentions has received the attention of researchers around the world (Hori et al., 2013; Yue et al., 2013; Chen et al., 2017; Trotta, 2018; Wang et al., 2018a; Ding et al., 2019; Mansor and Sheau-Tingi, 2019; Nie et al., 2019; Ahmad et al., 2022). Household energy-saving

behavioral intentions are proven to be diverse and influenced by many different factors. Studies on household energy-saving behavioral intentions mainly focus on three research directions, including (i) economic-oriented perspective, (ii) technology-oriented perspective, and (iii) behavior-oriented perspective (Zhou and Yang, 2016; Arawomo, 2017; da Silva and Cerqueira, 2017). There are few studies on household energy-saving behavioral intentions approaching from an aggregate point of view. Therefore, this study approaches the theory of planned behavior (TPB) with an integrated view to figure out factors affecting the energy-saving intention of Vietnamese households (Figure 1).

2. THEORETICAL BASIS AND RESEARCH HOSPHONES

2.1. Theoretical Basis

The theory of Planned Behavior (TPB) has been widely used in recent studies to explain how a person develops behavioral

Figure 1: Proposed research model

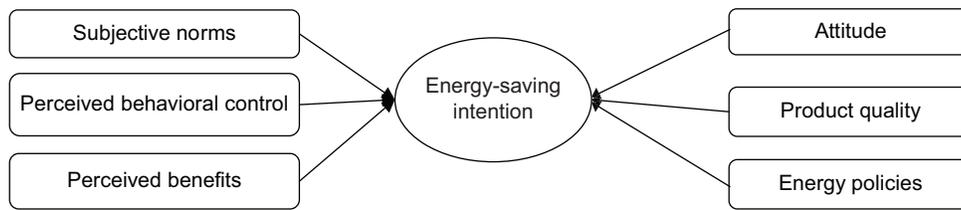


Table 1: Interpretation of observed variables in the research model

Factor	Observable variables	Scale
SN	SN1: I save electricity because my neighbors do the same SN2: My family members encourage me to save electricity SN3: My friends encourage me to save electricity SN4: Energy saving is a matter of social concern References: Tan et al. (2017), Wang et al. (2018a)	Likert 1–5 Likert 1–5 Likert 1–5 Likert 1–5
PBC	PBC1: I know what I should do to save electricity PBC2: I think it is not too difficult to reduce electricity usage PBC3: I know how to use electricity efficiently PBC4: I can save electricity easily References: Abrahamse and Steg (2009), Wang et al. (2018a)	Likert 1–5 Likert 1–5 Likert 1–5 Likert 1–5
PB	PB1: Saving electricity helps reduce costs for the household PB2: Saving electricity is beneficial for the household PB3: Saving electricity makes family life better PB4: Saving electricity helps protect the ecological environment References: Zhang et al. (2014), Hien and Chi (2020)	Likert 1–5 Likert 1–5 Likert 1–5 Likert 1–5
ATT	ATT1: Saving electricity at home is necessary ATT2: Saving home electricity helps improve the air environment ATT3: Saving home electricity is important to reduce CO ₂ emissions ATT4: The quality of family life is still high when saving electricity References: Abrahamse and Steg (2009), Wang et al. (2018a)	Likert 1–5 Likert 1–5 Likert 1–5 Likert 1–5
PQ	PQ1: Prioritize buying products with energy-saving labels PQ2: Pay more attention to products that apply scientific and technological advances to save energy PQ3: Customer feedback on energy-saving features is an important factor in purchasing decisions References: Zhang et al. (2018), Thanh Nguyen et al. (2021)	Likert 1–5 Likert 1–5 Likert 1–5
EP	EP1: Policies and regulations play essential roles in promoting and encouraging me to save electricity EP2: I save electricity because of policies and regulations related to electricity saving EP3: I save electricity because I am affected by electricity usage policies and regulations EP4: I save electricity because I was guided on how to use electricity efficiently References: Zhang et al. (2018), Thanh Nguyen et al. (2021)	Likert 1–5 Likert 1–5 Likert 1–5 Likert 1–5
ESI	ESI1: I intend to save home electricity in the future ESI2: I will make a plan to save electricity in my house in the future ESI3: I will try to save electricity in my house in the future ESI4: I will use energy-efficient appliances to save electricity in the future References: Wang et al. (2018a), Hien and Chi (2020)	Likert 1–5 Likert 1–5 Likert 1–5 Likert 1–5

SN: Subjective norms, PBC: Perceived behavioral control, PB: Perceived benefits, ATT: Attitude, PQ: Product quality, EP: Energy policies, ESI: Energy-saving intention

intention (Han et al., 2017; Ye et al., 2017). The TPB is the most widely used among the various models and theories to demonstrate energy-saving behavioral intentions (Rivis et al., 2009).

The TPB of Ajzen (1991) was extended from the theory of Reasoned Action - TRA (Fishbein and Ajzen, 1975). It was developed due to the limitation of the previous theory on the assumption that human behavior is based on mind control. Similar to the TRA, the central factor in the TPB is the individual intention to perform a certain behavior. In this theory, the author believes that the intention to perform the behavior is influenced by three factors such as attitude towards the behavior, subjective norms, and perceived behavioral control.

According to Fishbein and Ajzen (1975), behavioral intention reflects the strength of an individual’s intention to perform a

specified behavior. Intentions are signs that a person is willing and try to make an effort to perform a behavior; or it is a state of readiness to perform a certain behavior and is considered a precondition before performing a behavior (Ajzen, 1991; Armitage and Conner, 2001; Conner and Sparks, 2005). The intention is an individual’s process of action to achieve future behavior (Mowen and Minor, 2001; Zhao and Othman, 2010). According to Bosnjak et al. (2020), the intention is an antecedent of behavior, an important factor to lead to behavior.

2.2. Research Hypotheses

2.2.1. Relationship between subjective norms and the intention to save energy

Subjective norms are defined as an individual’s perception with that individual’s key references considering whether should or should not perform a certain behavior (Fishbein and Ajzen, 1975;

Ajzen, 1991). Subjective norm is defined as the perceived external social pressure or expectation of a particular group of people or society to perform certain behaviors (Fishbein and Ajzen, 1975; Ajzen, 1991; Ajzen and Fishbein, 2000). Subjective norms are the best predictor of a person's behavior (Caputo, 2020; La Barbera and Ajzen, 2020). Several studies have demonstrated a positive relationship between subjective norms and household energy-saving intention (Hori et al., 2013; Chen et al., 2017; Wang et al., 2018a; Ding et al., 2019; Mansor and Sheau-Tingi, 2019; Nie et al., 2019; Hien and Chi, 2020). Thus, the research hypothesis H1 is proposed as follows: Subjective norms positively affect the intention to save energy in households.

2.2.2. Relationship between perceived behavioral control and the intention to save energy

Perceived behavioral control is understood as the perception of the difficulty of enacting a behavior (Ajzen, 1991; Fornara et al., 2016; Sembada and Koay, 2021). Perceived behavioral control is a very essential factor in predicting an individual's future behavior (Klößner, 2013; Ajzen, 2019; La Barbera and Ajzen, 2020). As presented by Bosnjak et al. (2020), the greater the perceived behavioral control, the stronger the intention to perform that behavior. Perceived behavioral control has a positive relationship with family energy-saving intention (Chen et al., 2017; Zhang et al., 2014; Wang et al., 2018a; Mansor and Sheau-Tingi, 2019; Nie et al., 2019; Fu et al., 2021; Ahmad et al., 2022). Therefore, the research hypothesis H2 is suggested as follows: Perceived behavioral control positively influences the intention to save energy in households.

2.2.3. Relationship between perceived benefits and the intention to save energy

The perceived benefit is a type of emotional perception that positively influences an individual's behavior (Tsujikawa et al., 2016). Perceived economic benefits and environmental benefits have a positive influence on the behavioral intention to save energy (Wang et al., 2011; Zhang et al., 2014). Studies related to energy-saving behavioral intention topics have shown that perceived benefits have a positive effect on household energy-saving intentions (Banfi et al., 2008; Dianshu et al., 2010; Wang et al., 2011; Zhang et al., 2014; Steinhorst et al., 2015; Zhou and Yang, 2016; Hien and Chi, 2020; Fu et al., 2021; Ahmad et al., 2022). Then, the research hypothesis H3 is proposed as follows: Perceived benefits positively impact the intention to save energy in households.

2.2.4. Relationship between attitude and the intention to save energy

According to the TPB, attitude is considered a significant factor in determining behavioral intention. The more positive person's attitude towards a behavior, the more likely that person intends to perform a behavior (Ajzen, 1991). Attitude is a significant factor related to an individual's intention to perform a behavior (Verplanken and Orbell, 2003; Bosnjak et al., 2020; Caputo, 2020). Recent studies have shown that an energy-saving attitude positively affects household energy-saving intention (Zhang et al., 2014; Chen et al., 2017; Wang et al., 2018a; Ding et al., 2019; Mansor and Sheau-Tingi, 2019; Nie et al., 2019; Hien and Chi, 2020). Therefore, the research hypothesis H4 is proposed as

follows: Attitude positively affects the intention to save energy in households.

2.2.5. Relationship between product quality and the intention to save energy

Residential areas can contribute significantly to environmental conservation and sustainable development by using energy-efficient products (Ali et al., 2019). According to some studies, the purchase and use of energy-saving appliances help reduce household energy consumption (Ali et al., 2019, Sukarno et al., 2015; Hua and Wang, 2019). Recent studies have demonstrated the influence of energy-saving product quality on household energy-saving behavioral intentions (Yue et al., 2013; Trotta, 2018; Zhang et al., 2018; Thanh Nguyen et al., 2021). The research hypothesis H5 is proposed as follows: Product quality positively affects household energy-saving intention.

2.2.6. The relationship between energy policies and energy-saving intention

Energy policy is an important tool to reduce the intensity of energy use (Yuan et al., 2009), contributing to improving energy efficiency (Dos Santos et al., 2013). Social policies and regulations have an impact on the formation and change of family energy-saving behavioral intentions (Wang et al., 2011). Researchers have demonstrated a positive relationship between energy policies and household energy-saving intentions (Abrahamse and Steg, 2009; Mizobuchi and Takeuchi, 2012; Manjunath et al., 2014; Wang et al., 2018b; Zhang et al., 2020; Hien and Chi, 2020; Yue et al., 2020; Thanh Nguyen et al., 2021; Fu et al., 2021). Therefore, hypothesis H6 is proposed as follows: Energy policies positively affect the intention to save energy in households.

Based on the above literature review and research hypotheses, the study uses the group discussion method (qualitative research) with 8 households living in Ho Chi Minh City which has the largest population in Vietnam. The results of the group discussion help identify appropriate scales for the research model (Table 1). The proposed research model is as below.

3. RESEARCH METHODOLOGY

3.1. Analytical Methods

The study uses quantitative analyzes in the following order. Step 1: Test the reliability of scales by Cronbach's Alpha to eliminate observed variables with low reliability; Step 2: Exploratory factor analysis (EFA) to evaluate the convergent and discriminant validity; Step 3: Confirmatory factor analysis (CFA) to test the appropriateness of the research data; Step 4: Structural equation modeling (SEM) to test the research hypotheses.

3.2. Data Collection Method

According to Tho (2011), the sample size for the study depends on many factors such as the analytical method and the required reliability. To ensure the reliability of the SEM, the sample size needs to be large because it is based on the theory of sample distribution (Raykov and Widaman, 1995). To ensure reliability in testing the suitability of the SEM model, a sample size from 100 to 200 is acceptable (Hoyle, 1995). Reasonable sample size must achieve

a minimum of 200 observations for the SEM test (Hoelter, 1983, Kline, 2011). So this study aims to collect at least 200 observations.

The study surveyed three cities in Vietnam (Ho Chi Minh City, Da Nang City, and Can Tho City). These are 3 cities directly under the Central Government, of which Ho Chi Minh City has the largest population in Vietnam. The survey period was from March to April 2022. The study used quota sampling to collect data. The survey criteria are household size, occupation, and location of residence. In the context of the Covid-19 epidemic, the online interviews via google forms were used to collect detailed information from the respondents. To increase the enthusiasm of the respondents, they will receive a souvenir gift after completing the survey. After eliminating unsuitable questionnaires, a total of 306 valid questionnaires were included in the tests.

Table 2 shows that the demographic characteristics of respondents are diverse, fully reflecting the representative standards of the survey subjects. The proportion of males and females is almost equal (52.61% of males and 47.39% of women). Most respondents are in the group of 36-50 years old, accounting for the highest proportion (47.39%). In terms of education, the majority of respondents have college degrees (22.22%) and university degrees (36.60%). The most common family structure is the 2-generation family (42.16%). The occupation of respondents is diverse, the most common are office workers, small businesses, and engineers.

Table 2: Structure of the study sample (n=306)

Category	Frequency (%)
Gender	
Male	161 (52.61)
Female	145 (47.39)
Age	
20–35	68 (22.22)
36–50	145 (47.39)
51–65	93 (30.39)
Family structure	
Single	34 (11.11)
1 generation	88 (28.76)
2 generations	129 (42.16)
3 generations	55 (17.97)
Monthly income (VND)	
Under 10 million	48 (15.68)
10–20 million	138 (45.10)
20–30 million	73 (23.86)
Over 30 million	47 (15.36)
Education level	
Junior high school	25 (8.17)
High school	57 (18.63)
Intermediate	26 (8.50)
College	68 (22.22)
University	112 (36.60)
Post-graduate	18 (5.88)
Occupation	
Office staff	55 (17.97)
Small business	44 (14.38)
Engineer	45 (14.70)
Doctor	26 (8.50)
Manager	39 (12.75)
Worker	36 (11.76)
Teacher	35 (11.44)
Retired	12 (3.92)
Others	14 (4.58)

Regarding monthly income, respondents with an income from 10 to 20 million VND account for the highest proportion (45.10%).

4. RESEARCH RESULTS AND DISCUSSION

4.1. Evaluate the Reliability of the Scales

To test the reliability of the scales, the study uses Cronbach’s Alpha reliability coefficient to test the internal correlation between observed variables. According to the test results in Table 3, all scales have Cronbach’s Alpha values greater than 0.8. The corrected item-total correlation of all observed variables is greater than 0.3 (Nunnally and Bernstein, 1994), so no variable is excluded from the research model (Nunnally, 1978; Peterson, 1994; Slater, 1995). Therefore, all observations are satisfactory and suitable for the EFA.

According to the EFA result (Table 3), the statistical values of convergent and discriminant validity of the research scales are guaranteed: (1) Factor loading values are all > 0.5 (Hair et al., 1998; Hair et al., 2010); (2) Testing the appropriateness of the model with KMO = 0.912 (Hair et al., 1998; Kline, 2011); (3) Bartlett’s test on the correlation of observed variables meets the requirements with the Sig. = 0.000 (Hair et al., 1998; Kline, 2011).

Table 3: Scale reliability test result

Observed variable	Mean	SD	Factor loading	Cronbach’s alpha
SN				0.890
SN1	3.395	0.990	0.864	
SN2	3.395	0.978	0.767	
SN3	3.470	0.978	0.776	
SN4	3.307	0.942	0.829	
PBC				0.900
PBC1	3.558	0.980	0.789	
PBC2	3.483	0.902	0.884	
PBC3	3.483	0.948	0.781	
PBC4	3.519	0.909	0.843	
PB				0.872
PB1	3.643	1.021	0.674	
PB2	3.725	0.999	0.887	
PB3	3.709	1.029	0.813	
PB4	3.601	1.013	0.744	
ATT				0.896
ATT1	3.209	0.927	0.877	
ATT2	3.202	0.943	0.778	
ATT3	3.022	0.892	0.795	
ATT4	3.300	0.876	0.822	
PQ				0.824
PQ1	3.653	1.013	0.868	
PQ2	3.673	1.007	0.732	
PQ3	3.692	1.013	0.691	
EP				0.847
EP1	3.640	0.794	0.726	
EP2	3.630	0.840	0.758	
EP3	3.669	0.856	0.733	
EP4	3.571	0.815	0.804	
ESI				0.870
ESI1	3.630	1.00698	0.731	
ESI2	3.588	0.99526	0.787	
ESI3	3.568	0.96676	0.811	
ESI4	3.558	1.04872	0.670	

SD: Standard deviation, SN: Subjective norms, PBC: Perceived behavioral control, PB: Perceived benefits, ATT: Attitude, PQ: Product quality, EP: Energy policies, ESI: Energy-saving intention

The cumulative variance test reaches 74.59% higher than 50% (Anderson and Gerbing, 1988). Therefore, 7 factors are created from 27 observed variables and are consistent with the scales.

Based on Table 4, statistical indicator values are guaranteed as follows: Chi-square/df = 1.564 < 2; The TLI and CFI reach values of 0.960 and 0.966 and higher than 0.9; RMSEA = 0.043 < 0.08 (Anderson and Gerbing, 1988; Hair et al., 2014). This proves that the model fits the market data. The standardized regression weights of scales are greater than 0.5 and the unstandardized regression weights are statistically significant, so the model reaches convergent validity. Besides, the correlation coefficients among factors are all <1 and the standard deviation is <0.05. Therefore, the research model achieves discriminant validity (Hair et al., 2014). In addition to this, the composite reliability (Pc) and average variance extracted (Pvc) all satisfy the conditions. The minimum value of Pc = 0.80 and Pvc = 0.50 all meet the requirement for statistical validity (Fornell and Larcker, 1981). To conclude, all scales in the model meet the requirements in terms of value and reliability, so they are suitable for the next SEM test.

4.2. Research Hypothesis Test

Structural equation modeling (SEM) is used to test the research hypotheses. The analytical result is in table. Based on Table 5, all research hypotheses are accepted with a 99% significance level. The relationships between factors are explained in detail below.

Hypothesis H1: Subjective norms positively affect household energy-saving intention. According to the estimation result, subjective norms and the household's energy-saving intention have a positive relationship, with a standardized estimated value of 0.182. This shows that, if the family is under social pressure (community, friends, colleagues, neighbors, influencers), they tend to save energy. This result confirms that subjective norms play an essential role in energy-saving intention. The study result is consistent with studies proposed by Hori et al. (2013), Chen et al. (2017), Wang et al. (2018a), Ding et al. (2019), Mansor and Sheau-Tingi (2019), Nie et al. (2019), Hien and Chi (2020).

Table 4: Confirmatory factor analysis test result

Indicator	CFA value	Comparative index	Reference resources
χ^2/df	1.564	≤ 2	Anderson and Gerbing (1988),
TLI	0.960	≥ 0.9	Hair et al. (2014)
CFI	0.966	≥ 0.9	
RMSEA	0.043	≤ 0.08	

CFA: Confirmatory factor analysis, RMSEA: Root mean square error of approximation, CFI: Comparative fit index, TLI: Tucker-Lewis index

Table 5: Research hypothesis test

Relationship	Unstandardized			Standardized estimated value	Significance	Hypothesis
	Estimated value	SE	CR			
ESI ← SN	0.173	0.054	3.188	0.182	***	H1: Accepted
ESI ← PBC	0.163	0.061	2.683	0.169	***	H2: Accepted
ESI ← PB	0.181	0.056	3.242	0.211	***	H3: Accepted
ESI ← ATT	0.165	0.060	2.760	0.177	***	H4: Accepted
ESI ← PQ	0.170	0.064	2.659	0.177	***	H5: Accepted
ESI ← EP	0.227	0.067	3.397	0.195	***	H6: Accepted

SE: Standard error, CR: Critical ratio, SN: Subjective norms, PBC: Perceived behavioral control, PB: Perceived benefits, ATT: Attitude, PQ: Product quality, EP: Energy policies, ESI: Energy-saving intention, *** shows 1% significance level

Hypothesis H2: Perceived behavioral control positively affects household energy-saving intention. This hypothesis is accepted with a statistical significance of $p = 0.000$ and the standardized estimated value of 0.169. This shows a positive correlation between perceived behavioral control and household energy-saving intention. The study result is consistent with some studies proposed by Chen et al. (2017), Zhang et al. (2014), Wang et al. (2018a), Mansor and Sheau-Tingi (2019), Nie et al. (2019), Fu et al. (2021), Ahmad et al. (2022). This concludes that perceived behavioral control is an important factor that positively affects the intention to save energy in families.

Hypothesis H3: Perceived benefits positively impact the intention to save energy in households. According to the test results in Table 5, perceived benefits are positively correlated with energy-saving intention, with the standardized estimated value reaching 0.211 and statistical significance $p = 0.000$. This is the factor that has the most impact on household energy-saving behavioral intention. This finding confirms that the perception of economic benefits and environmental benefits positively influence behavioral intention to save energy (Wang et al., 2011; Zhang et al., 2014). The research result is similar to studies proposed by Banfi et al. (2008), Dianshu et al. (2010), Steinhorst et al. (2015), Zhou and Yang (2016), Hien and Chi (2020), Fu et al. (2021), Ahmad et al. (2022).

Hypothesis H4: Attitude positively affects the intention to save energy in households. This hypothesis is accepted with a statistical significance of $p = 0.000$ and a standardized estimated value of 0.177. This shows that there is a positive correlation between energy-saving attitude and energy-saving intention. Attitude is one of the best predictors of the intention to perform an individual behavior (Caputo, 2020). The research result is consistent with studies proposed by Zhang et al. (2014), Chen et al. (2017), Wang et al. (2018a), Ding et al. (2019), Mansor and Sheau-Tingi (2019), Nie et al. (2019), Hien and Chi, (2020).

Hypothesis H5: Product quality beneficially impacts household energy-saving intention. According to the estimation result, product quality and energy-saving intention have a positive correlation, with a standardized estimated value of 0.177 and a statistical significance of $p = 0.000$. If energy-saving products are high-quality, easy to identify, and accessible, the household's intention to save energy will be higher. The research result is similar to studies by Yue et al. (2013), Trotta (2018), Zhang et al. (2018), and Thanh Nguyen et al. (2021).

Hypothesis H6: Energy policies positively affect household energy-saving intention. This hypothesis is accepted after considering the standardized estimated value of 0.195 and the statistical significance of $p = 0.010$. This shows a beneficial correlation between energy policies and household energy-saving intention. This confirms that energy policies are an important tool to reduce the intensity of household energy use, contributing to improving energy efficiency. The finding is consistent with studies proposed by Abrahamse and Steg (2009), Mizobuchi and Takeuchi (2012), Manjunath et al. (2014), Wang et al. (2018b), Zhang et al. (2020), Hien and Chi (2020), Yue et al. (2020); Thanh Nguyen et al. (2021), Fu et al. (2021).

5. CONCLUSION

The study focuses on proving the factors affecting the intention to save energy of households from an integrated point of view (economy-oriented, technology-oriented, and behavior-oriented perspective). The study has developed a model applying the theory of planned behavior (TPB) to demonstrate the factors affecting the energy-saving intention in Vietnam. Research data were collected from households in 3 cities (Ho Chi Minh, Da Nang, and Can Tho). Applying the structural equation modeling (SEM), six research hypotheses are accepted. Factors that positively affect the intention to save energy include subjective norms, perceived behavioral control, perceived benefits, attitude, product quality, and energy policies. In which, the “perceived benefits” factor has the strongest impact on the intention to save energy. The study provides a useful scientific basis for building policies to control household energy consumption behavior, as well as opens up new research directions on energy-saving behavioral intentions.

REFERENCES

Abrahamse, W., Steg, L. (2009), How do socio-demographic and psychological factors relate to households' direct and indirect energy use and savings? *Journal of Economic Psychology*, 30(5), 711-720.

Ahmad, B., Irfan, M., Salem, S., Asif, M.H. (2022), Energy efficiency in the post-COVID-19 era: Exploring the determinants of energy-saving intentions and behaviors. *Frontiers in Energy Research*, 9(824318), 1-11.

Ajzen, I. (1991), The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.

Ajzen, I. (2019), TPB Questionnaire Construction. United States: The University of Massachusetts Amherst. Available from: <https://people.umass.edu/ajzen/pdf/tpb.measurement.pdf>

Ajzen, I., Fishbein, M. (2000), Attitudes and the attitude-behavior relation: Reasoned and automatic processes. *European Review of Social Psychology*, 11(1), 1-33.

Ali, S., Ullah, H., Akbar, M., Akhtar, W., Zahid, H. (2019), Determinants of consumer intentions to purchase energy-saving household products in Pakistan. *Sustainability*, 11(5), 1462-1482.

Anderson, J.C., Gerbing, D.W. (1988), Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, 103(3), 411-423.

Arawomo, D.F. (2017), Electricity billing systems and household electricity use behavior in Ibadan, Nigeria. *Energy for Sustainable Development*, 40, 77-84.

Armitage, C.J., Conner, M. (2001), Efficacy of the theory of planned behavior: A meta-analytic review. *British Journal of Social Psychology*, 40(4), 471-499.

Banfi, S., Farsi, M., Filippini, M., Jakob, M. (2008), Willingness to pay for energy-saving measures in residential buildings. *Energy Economics*, 30(2), 503-516.

Bosnjak, M., Ajzen, I., Schmidt, P. (2020), The theory of planned behavior: Selected recent advances and applications. *Europe's Journal of Psychology*, 16(3), 352-356.

Caputo, A. (2020), Comparing theoretical models for the understanding of health-risk behavior: Towards an integrative model of adolescent alcohol consumption. *Europe's Journal of Psychology*, 16(3), 418-436.

Chen, C.F., Xu, X., Day, J.K. (2017), Thermal comfort or money-saving? Exploring intentions to conserve energy among low-income households in the United States. *Energy Research and Social Science*, 26, 61-71.

Conner, M., Sparks, P. (2005), Theory of planned behavior and health behavior. In: *Predicting Health Behavior*. New York: McGraw-Hill Education. p121-162.

Da Silva, P.P., Cerqueira, P.A. (2017), Assessing the determinants of household electricity prices in the EU: A system-GMM panel data approach. *Renewable and Sustainable Energy Reviews*, 73, 1131-1137.

Dianshu, F., Sovacool, B.K., Vu, K.M. (2010), The barriers to energy efficiency in Liaoning Province. *Energy Policy*, 38(2), 1202-1209.

Ding, Z.H., Li, Y.Q., Zhao, C., Liu, Y., Li, R. (2019), Factors affecting heating energy-saving behavior of residents in hot summer and cold winter regions. *Natural Hazards*, 95(2), 193-206.

Dos Santos, A.H.C., Fagá, M.T.W., Dos Santos, E.M. (2013), The risks of an energy efficiency policy for buildings based solely on the consumption evaluation of final energy. *International Journal of Electrical Power and Energy Systems*, 44(1), 70-77.

Fishbein, M., Ajzen, I. (1975), *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Boston: Reading, MA: Addison-Wesley.

Fornara, F., Pattitoni, P., Mura, M., Strazzer, E. (2016), Predicting intention to improve household energy efficiency: The role of value-belief-norm theory, normative and informational influence, and specific attitude. *Journal of Environmental Psychology*, 45, 1-10.

Fornell, C., Larcker, D.F. (1981), Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50.

Fu, W., Zhou, Y., Li, L., Yang, R. (2021), Understanding household electricity-saving behavior: Exploring the effects of perception and cognition factors. *Sustainable Production and Consumption*, 28, 116-128.

Hair, J.F. Jr., Anderson, R.E., Tatham, R.L., Black W.C. (1998), *Multivariate Data Analysis with Readings*. 5th ed. Englewood Cliffs, NJ: Prentice-Hall.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. (2010), *Multivariate Data Analysis: A Global Perspective*. 7th ed. Upper Saddle River: Pearson Education.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., Tatham, R.L. (2006), *Multivariate Data Analysis*. Upper Saddle River: Person Prentice Hall.

Hair, J.F., Gabriel, M., Patel, V. (2014), AMOS covariance-based structural equation modeling (CB-SEM): Guidelines on its application as a marketing research tool. *Brazilian Journal of Marketing*, 13(2), 44-55.

Han, H., Meng, B., Kim, W. (2017), Emerging bicycle tourism and the theory of planned behavior. *Journal of Sustainable Tourism*, 25(2), 292-309.

Hien, N.N., Chi, P.H. (2020), The factors affecting household electricity saving behavior: A study in Vietnam. *International Journal of Sustainable Development and Planning*, 15(8), 1241-1250.

Hoelter, J.W. (1983), The analysis of covariance structures: Goodness-of-fit indices. *Sociological Methods and Research*, 11(3), 325-344.

Hori, S., Kondo, K., Nogata, D., Ben, H. (2013), The determinants of household energy-saving behavior: Survey and comparison in five

- major Asian cities. *Energy Policy*, 52, 354-362.
- Hoyle, R.H. (1995), *Structural Equation Modeling: Concepts, Issues, and Applications*. Thousand Oaks, CA: Sage Publications.
- Hua, L., Wang, S. (2019), Antecedents of consumers' intention to purchase energy-efficient appliances: An empirical study based on the technology acceptance model and theory of planned behavior. *Sustainability*, 11(10), 2994.
- Irfan, M., Ikram, M., Ahmad, M., Wu, H., Hao, Y. (2021), Does temperature matter for COVID-19 transmissibility? Evidence across Pakistani provinces. *Environmental Science and Pollution Research*, 28(42), 59705-59719.
- Kline, R.B. (2011), *Principles and Practice of Structural Equation Modeling (3 Baski)*. New York: Guilford, 14, 1497-1513.
- Klößner, C.A. (2013), A comprehensive model of the psychology of environmental behavior a meta-analysis. *Global Environmental Change*, 23(5), 1028-1138.
- La Barbera, F., Ajzen, I. (2020), Control interactions in the theory of planned behavior: Rethinking the role of the subjective norm. *Europe's Journal of Psychology*, 16(3), 401-417.
- Lokhorst, A.M., Staats, H., Van Iterson, J. (2015), Energy saving in office buildings: Are feedback and commitment-making useful instruments to trigger change? *Human Ecology Interdisciplinary Journal* 43(5), 759-768.
- Manjunath, M., Singh, P., Mandal, A., Parihar, G.S. (2014), Consumer behaviour towards electricity-a field study. *Energy Procedia*, 54, 541-548.
- Mansor, R., Sheau-Tingi, L. (2019), The psychological determinants of energy-saving behavior. In: *IOP Conference Series: Materials Science and Engineering*, 620(1), 012006.
- Mizobuchi, K., Takeuchi, K. (2012), Using economic incentives to reduce electricity consumption: A field experiment in Matsuyama, Japan. *International Journal of Energy Economics and Policy*, 2(4), 318-332.
- Mowen, J.C., Michael, S. (2001), *Minor. Consumer Behavior: A Framework*. Hoboken: Prentice Hall; Available from: https://www.amazon.com/gp/reader/0130169722/ref=sib_int_redir/104-1145649
- Nguyen, T.T., Duong, K.T., Anh Do, T. (2021), Situational factors affecting energy-saving behavior in direct approaches in Hanoi City. The role of socio-demographics. *Cogent Psychology*, 8(1), 1978634.
- Nie, H., Vasseur, V., Fan, Y., Xu, J. (2019), Exploring reasons behind careful use, energy-saving behaviors in residential sector based on the theory of planned behavior: Evidence from Changchun, China. *Journal of Cleaner Production*, 230, 29-37.
- Nunnally, J. (1978), *Psychometric Theory*. New York: McGraw-Hill.
- Nunnally, J.C., Bernstein, I.H. (1994), *Psychometric Theory*. 3rd ed. New York: McGraw-Hill.
- Peterson, R.A. (1994), A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research*, 21(2), 381-391.
- Raykov, T., Widaman, K.F. (1995), Issues in applied structural equation modeling research. *Structural Equation Modeling A Multidisciplinary Journal*, 2(4), 289-318.
- Ravis, A., Sheeran, P., Armitage, C.J. (2009), Expanding the affective and normative components of the theory of planned behavior: A meta-analysis of anticipated affect and moral norms. *Journal of Applied Social Psychology*, 39(12), 2985-3019.
- Sembada, A.Y., Koay, K.Y. (2021), How perceived behavioral control affects trust to purchase in social media stores. *Journal of Business Research*, 130, 574-582.
- Slater, S.F. (1995), Issues in conducting marketing strategy research. *Journal of Strategic Marketing*, 3(4), 257-270.
- Steinhorst, J., Klößner, C.A., Matthies, E. (2015), Saving electricity-for the money or the environment? Risks of limiting pro-environmental spillover when using monetary framing. *Journal of Environmental Psychology*, 43, 125-135.
- Sukarno, I., Matsumoto, H., Susanti, L., Kimura, R. (2015), Urban energy consumption in a city of Indonesia: General overview. *International Journal of Energy Economics and Policy*, 5(1), 360-373.
- Tan, C.S., Ooi, H.Y., Goh, Y.N. (2017), A moral extension of the theory of planned behavior to predict consumers' purchase intention for energy-efficient household appliances in Malaysia. *Energy Policy*, 107, 459-471.
- Tho, N.D. (2012), *Scientific Research Methods in Business*. Hanoi, Vietnam: Social Labor Publishing House.
- Trotta, G. (2018), Factors affecting energy-saving behaviors and energy efficiency investments in British households. *Energy Policy*, 114, 529-539.
- Tsujikawa, N., Tsuchida, S., Shiotani, T. (2016), Changes in the factors influencing public acceptance of nuclear power generation in Japan since the 2011 Fukushima Daiichi nuclear disaster. *Risk Analysis*, 36(1), 98-113.
- Verplanken, B., Orbell, S. (2003), Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, 33(6), 1313-1330.
- Wang, B., Wang, X., Guo, D., Zhang, B., Wang, Z. (2018b), Analysis of factors influencing residents' habitual energy-saving behavior based on NAM and TPB models: Egoism or altruism? *Energy Policy*, 116, 68-77.
- Wang, S., Lin, S., Li, J. (2018a), Exploring the effects of non-cognitive and emotional factors on household electricity saving behavior. *Energy Policy*, 115, 171-180.
- Wang, Z., Zhang, B., Yin, J., Zhang, Y. (2011), Determinants and policy implications for household electricity-saving behavior: Evidence from Beijing, China. *Energy Policy*, 39(6), 3550-3557.
- Ye, S., Soutar, G.N., Sneddon, J.N., Lee, J.A. (2017), Personal values and the theory of planned behavior: A study of values and holiday trade-offs in young adults. *Tourism Management*, 62, 107-109.
- Yeboah, F.K., Kaplowitz, M.D. (2016), Explaining energy conservation and environmental citizenship behaviors using the value-belief-norm framework. *Human Ecology Review*, 22(2), 137-159.
- Yuan, C., Liu, S., Fang, Z., Wu, J. (2009), Research on the energy-saving effect of energy policies in China: 1982-2006. *Energy Policy*, 37(7), 2475-2480.
- Yue, T., Long, R., Chen, H. (2013), Factors influencing energy-saving behavior of Urban households in Jiangsu Province. *Energy Policy*, 62, 665-675.
- Yue, T., Long, R., Chen, H., Liu, J., Liu, H., Gu, Y. (2020), Energy-saving behavior of Urban residents in China: A multi-agent simulation. *Journal of Cleaner Production*, 252, 119623.
- Zhang, C.Y., Yu, B., Wang, J.W., Wei, Y.M. (2018), Impact factors of household energy-saving behavior: An empirical study of Shandong Province in China. *Journal of Cleaner Production*, 185, 285-298.
- Zhang, J., Zhang, W., Song, Q., Li, X., Ye, X., Liu, Y., Xue, Y. (2020), Can energy saving policies drive firm innovation behaviors?-Evidence from China. *Technological Forecasting and Social Change*, 154, 119953.
- Zhang, S., Ma, X., Cui, Q. (2021), Assessing the impact of the digital economy on green total factor energy efficiency in the post-COVID-19 Era. *Frontiers in Energy Research*, 9, 9-18.
- Zhang, Y., Wang, Z., Zhou, G. (2014), Determinants of employee electricity saving: The role of social benefits, personal benefits and organizational electricity saving climate. *Journal of Cleaner Production*, 66, 280-287.
- Zhao, W., Othman, M.N. (2010), Predicting and explaining complaint intention and behavior of Malaysian consumers: An application of the planned behavior theory. *Advances in International Marketing*, 9(1), 229-252.
- Zhou, K., Yang, S. (2016), Understanding household energy consumption behavior: The contribution of energy big data analytics. *Renewable and Sustainable Energy Reviews*, 56, 810-819.