The effect of awareness and responsibility regarding energy consumption on the purchase of energy efficient household devices: mediation and moderation effects

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Abstract: Energy consumption sustainability can be ensured by reducing unnecessary energy consumption in households. Achieving this depends on increasing awareness levels of individuals about energy consumption and attitudes/behaviors that exhibit environmental responsibility. There are several indicators that show individuals are energy consumption responsible. One of the ways is the purchase of energy efficient household appliances (EEHA) in residential buildings. In this study, the attitudes and purchase intentions of households towards the choice of EEHA were investigated with a proposed structural model. In the model, it is assumed that energy information, which is defined as an exogenous latent variable, affects environmental concern and energy consumption responsibility, and that these two endogenous mediating latent variables affect the attitude towards EEHA and purchase intention. The analysis of the effects of the model and the importance performance map on the effect of latent variables on the intention to purchase EEHA was performed using Partial Least Squares Structural Equation Modelling (PLS-SEM). At the end of the study, it was determined that the proposed model has an acceptable fit and that energy information affects the intention to purchase EEHA through environmental concern and energy consumption responsibility.

1. Introduction

It is apparent that coal, natural gas and oil, which are used as energy sources, are exhaustible energy sources. Although these energy sources are limited, individuals still use these energy sources irresponsibly instead of being more frugal and responsible regarding the use of energy resources. Therefore, energy consumption has increased day by day and continues to increase rapidly. In line with this, the harmful effects of the waste of fossil energy sources on human health and the natural environment are constantly increasing and threatening the existence of all living things.

Growing world population, rapid increase in energy consumption, irresponsible energy consumption problems, high level of carbon dioxide emission etc. have led to great destruction on nature such as global warming and climate change. Many countries and scientists have accelerated their efforts to find a solution to the global climate change crisis and the energy crisis that has emerged recently. There are several measures such as finding new energy sources (renewable energy sources) and reducing the consumption of the fossil fuels. However, among the solutions, energy saving is the
most important solution. It has been agreed that energy saving can be achieved with technical measures on the one hand and the attitudes and behaviours of individuals on the other, and thus, unnecessary energy consumption at home can be reduced (Koçak, 2020; Wang et al., 2018; Tan et al., 2017; Prete et al, 2017).

Recently, the understanding of environmentalism has differentiated to include new problems such as climate change, overpopulation and genetic engineering (Tan et al., 2017). Ek and Soderholm (2010) pointed out that the energy-related activities of household members are important in the policies. Akyıldız and Koçoğlu (2022) showed the relation among attitude toward reducing the use of plastic bags, environmental manner and environmental behaviour. Tehci (2022) studied concerns, knowledge, attitudes, and behaviours of individuals towards marine pollution. They proposed sustainable environment. Energy and water saving, purchasing green products, preference for renewable energy, and recycling behaviours can be given as examples to these activities.

The preference of EEHA that consume less energy in houses provides an opportunity to create more sustainable environment and cities by reducing the energy consumption in households (Prete et al, 2017). In addition, energy efficiency targets can be achieved more easily through the faster dissemination of EEHA in residences. Consequently, the widespread use of EEHA can be considered as an important option for lower fossil fuel and carbon emissions (Tan et al., 2017; Prete et al, 2017; Ek and Soderholm, 2010; Mills and Schleich, 2013).

Despite the great developments in industry and technology in recent years, natural energy resources are rapidly depleting. For this reason, it is necessary to use energy effectively both to prevent waste and to reduce energy costs. In other words, before it can lead to a decrease in the quality of life, it is necessary to reduce energy consumption, that is, to increase efficiency in energy. In order to ensure the continuity of this increase, it is essential to make energy efficiency measurements at regular intervals. These measurements should be evaluated continuously and new investments and adjustments should be made if necessary. To summarize, energy efficiency refers to the highest efficiency evaluation of energy resources at all stages from production to consumption.

Compared to fossil-based energy sources, renewable energy sources such as solar, wind, hydroelectric, hydrogen, geothermal, biomass, marine-based energies have great advantages such as renewing themselves, being environmentally friendly, increasing the savings of countries, and having the opportunity to invest at lower costs. Turkey is richer than many developed countries in terms of renewable energy resources thanks to its geography. However, due to the delay in the necessary legislations, bureaucratic steps, insufficient incentives for the adoption of renewable energies, lack of correct planning, and insufficient awareness of the citizens about renewable energy, Turkey’s energy resources are dependent on foreign sources at the rate of 75%. In addition, long-term fossil fuel agreements with foreign countries such as Russia seem to be obstacles for Turkey (Yılmaz and Hotunoğlu, 2015).

Due to the energy supply problem in recent years and the economic crisis experienced by countries, the prices of electricity used at homes have increased dramatically. It should not be forgotten that in addition to the benefits of energy efficient devices, it will contribute to the budget of the household by reducing the energy consumption in the houses. In order to exhibit environmentalist attitudes and behaviours listed on the subject of energy, people must first have energy knowledge and a high awareness of the environmental effects of unnecessary energy use. This study focused on the importance of households, energy knowledge and attitudes towards responsible energy consumption and the effects of these attitudes on energy saving. In the study, the effect of energy knowledge on environmental concern and energy consumption responsibility and the effect of these two factors on the intention to purchase EEHA by affecting the attitude towards EEHA as intermediary endogenous variables were investigated.
Although it is realized that there are many studies on energy efficiency and energy saving in the literature, only a few of them focus on the determinants of purchasing attitude and the behaviour of energy consumption responsibility for energy efficient appliances. Therefore, in this study, consumers’ attitudes towards energy-saving home appliances and their purchasing intentions were investigated with a proposed structural model. For this purpose, environmental information is considered as an exogenous latent variable in the proposed model. In the model, it is assumed that environmental information will affect environmental concern and responsibility for energy consumption, and these two factors, as intermediary endogenous variables, can affect the attitude towards EEHA and describe the intention to purchase energy-saving home appliances. The fit of the model, the test of hypotheses and the importance performance map of the effect of hidden variables on the intention to purchase EEHA were carried out using PLS-SEM.

2. Literature review

2.1. Theoretical foundation

Energy efficiency plays a crucial role in reducing energy demand. Using energy efficiently is the fastest and lowest-cost solution to reduce greenhouse gas emissions. Especially considering the rapidly increasing world population, it can be better understood how important energy efficiency is in meeting the increasing demand.

With the increase in the variety and number of digital devices in recent years, the number of electrical devices used in residences has increased, and there has been a rapid increase in energy consumption. It is estimated that the use of primary energy resources worldwide will have increased by about one third until 2035. Furthermore, it is stated that the regions with the largest share in this increase will be in China, India and the Middle East (International Energy Agency IEA, 2014).

Turkey adopted the energy efficiency labelling program in 2001 in accordance with the European Union Directives. The EU labelling program is in place for most household electrical appliances sold in Turkey, and there are plans to expand the labelling program to new product types such as refrigerator, washing machine, dishwasher, dryer, etc. Following the process of labelling of devices, a regulation on the labelling of all energy-using products, including household air conditioners and lighting products is put into practice. Many consumers do not want to replace their household appliances with energy-efficient ones due to high purchasing costs. According to a study conducted in Turkey, it has been determined that there is an awareness on the use of energy efficient products. In spite of this awareness that individuals have, users do not have enough information about the content of the energy label and the creation processes of the energy labels (Pala and Esen, 2018).

When the literature is examined, it is possible to come across studies that reveal the intentions and behaviours related to energy and environment-oriented studies. For example, intention to adopt electrical energy efficiency measures (Prete et al., 2017), intention to purchase EEHA (Tan et al., 2017), electricity saving behaviour (Wang et al., 2011; Wang et al., 2017; Zhang et al., 2018). TPB was applied as a research model in studies such as energy saving behaviour (Wang et al., 2015). In addition, TPB was used as the basic model in environmental attitude and behaviour and energy saving studies (Tan et al., 2017).

In some previous studies, it was realized that new variables were added to the TPB to explain the factors affecting behavioural intention and the relationship among these factors (Tan et al., 2017; Prete et al, 2017). For example, Tan et al. (2017) added the variable of environmental concern and moral values to the TPB while investigating consumers’ intention to purchase EEHA. Chen and Tung (2014) tried to increase the explanatory power of the model by adding environmental concern and perceived moral
responsibility to the TPB model in order to reveal the behaviour of consumers visiting green hotels.

Ajzen (1991) stated that moral norms should be added to increase the explanatory power of TPB. In studies on environment and green purchasing, it has been determined that the explanatory power of behavioural intention increases with the addition of moral norms to TPB (Kaiser, 2006; Kaiser et al., 1999). Prete et al. (2017) applied an expanded form of TPB, including attitude, subjective norms, perceived behavioural control, and environmental concern, to investigate the antecedents of households’ intention to adopt electrical energy efficiency measures and their willingness to pay.

Improving environmental sustainability significantly and reducing unnecessary energy consumption in residences depend on the responsibility, attitudes and behaviours of households. Individually, this energy consumption responsibility can be transformed into attitudes and reflected in behaviours by purchasing EEHA in residences. In the light of all this information, it has become important to investigate the factors affecting users’ attitudes and preferences about energy efficient devices. It is thought that the factors affecting the use of EEHA will also be important for policy makers and manufacturers and marketers of such household appliances (Pelenur, 2018; Never et al., 2022; Yue et al., 2020). In this study, the effects of consumers' energy knowledge, environmental concerns and energy consumption responsibility on their attitudes towards EEHA and their intention to purchase these appliances were investigated.

2.2. Hypotheses development

2.2.1. Energy information, responsibility for energy consumption, environmental concern

De Groot and Steg (2007) explained that individuals obtain information through news such as social media, radio/TV, magazines, books, etc., which associate global climate changes and the deterioration of natural balance with the energy crises experienced. It has also been stated that their sense of responsibility for the environment will increase and their attitudes will tend to protect the environment by increasing their environmental concerns with the effects of their discomfort on the environment. Responsibility refers to the perceived moral feelings for doing or not doing a certain behaviour (Kaiser, 2006). Chen and Tung (2014) on the other hand, defined the sense of responsibility as the perceived obligations to act by considering moral elements. Chen (2016) associated the basic framework of TPB with additional factors related to one's moral responsibility with the model. Tan et al. (2017) tried to increase the explanatory power of the model by adding the moral responsibility variable to the TPB while investigating consumers' intention to purchase EEHA.

In studies on green purchasing, recycling and energy saving, the responsibility variable was added to the model and the relationships among environmental information, environmental concern and purchase intention were investigated (Chen and Tung, 2014; Chan and Bishop, 2013; Harland et al., 1999).

The harm caused by energy information and unnecessary energy consumption to the environment affects pro-environmental attitudes and behaviours. In the literature, it is considered that environmental information, concern and awareness are the basic antecedents of environmental attitude. It is also referred that individuals with high environmental information are more willing to exhibit environmental behaviour (Chen and Tung, 2014; Chan et al., 2014).

There are also studies highlighting the importance of information in environmental problems and energy saving behaviours. Frick et al. (2004) investigated energy saving behaviour and determined that environmental information has a vital role in affecting behaviour. Chan et al. (2014) stated that environmental information affects green purchasing intention, while Zografakis et al. (2010) put that people with a higher level of knowledge about energy use and conservation are more likely to pay more for
renewable energy use. Wang et al. (2011) claimed that as the level of knowledge about efficient energy use and saving increases, the behaviour of electricity saving also increases. Lau and Hashim (2020) evaluated that environmental information and attitudes towards unnecessary energy consumption responsibilities can trigger environmental concerns and affect environmental protection and environmental attitudes. del Mar Sola´ et al. (2023) investigated the impact of energy labels on the adoption of energy efficient products. He also analysed how monetary information about the cost of energy affects the purchase of energy-efficient appliances. The authors evaluated the importance of energy labels in promoting energy-efficient appliances.

The following hypotheses were designed to test the effects of energy information on energy consumption responsibility, environmental concern, attitude towards energy efficient devices and purchase intention:

H1: Energy information has a positive and significant impact on energy consumption responsibility (H1: A→B).

H2: Energy information has a positive and significant impact on environmental concern.

H3: Energy information has a positive and significant impact on attitude towards EEHA (H3: A→D).

H4: Energy information has a positive and significant impact on intention to purchase energy-efficient appliances (H4: A→E).

2.2.2 The impact of environmental concern on attitude towards EEHA and intention to purchase

Environmental concern is defined as people's beliefs, effects, and intentions about environmental activities or behaviours. In addition, in studies investigating the attitudes and behaviours of individuals on energy saving, environmental concern has been described as the responsibility that individuals perceive in their behaviour (Chan et al., 2014; Song et al., 2019). Studies evaluating environmental concern as an attitude are also available in the literature (Bamberg, 2003).

While examining environmental behaviours in many studies, the environmental concern variable is also discussed. Ajzen (2015) stated that environmental concern can affect the behavioural belief that nature and all living things in nature are at risk. So, it is of great importance to take action to protect nature from these risks. It has been evaluated that individuals with a high level of environmental concerns are also more frequently involved in environmental behaviours. In some studies, the relationship between environmental concern and attitude has been examined and it has been determined that there is a positive relationship in most of them (Tan et al., 2017; Song et al., 2019). According to Albayrak et al. (2013) individuals who tend to participate in environmentally friendly purchasing behaviour are affected by increasing environmental concern. Zhang et al. (2018) evaluated that the increasing environmental concerns of people can shape environmentally friendly attitudes. When the attitudes towards EEHA are evaluated within the scope of environmental attitudes, the following hypotheses can be written:

H5: Environmental concern affects the responsibility for energy consumption positively and significantly (H5: C→B).

H6: Environmental concern affects Attitude towards EEHA positively and significantly (H6: C→D).

H7: Environmental concern affects intention to purchase energy-efficient appliances positively and significantly (H7: C→E)

2.2.3. Attitude and intention to purchase towards EEHA

Greaves et al. (2013) stated that the attitude towards the behaviour affects the intention of the person that the behaviour will lead to the desired results. For example,
a consumer may find it more sensible to buy a cheap refrigerator and therefore have a positive attitude towards the refrigerator. However, when comparing different refrigerator alternatives, the consumer may decide to purchase a more costly and more energy efficient refrigerator.

Koçak (2020) investigated the factors affecting the household energy saving behaviour of consumers and revealed that environmental attitudes affected the energy saving intention behaviour positively. When the environmental studies in the literature are examined, it is realized that the intention for the behaviour is important before, for example, buying green products and energy saving behaviours (Wang et al., 2018; Prete et al., 2017; Zhang et al., 2018). Zhang et al. (2018) claimed that energy saving intention affects energy saving behaviour positively. Studies on energy conservation and environmental behaviour have confirmed that intention is an important determinant (Prete et al., 2017; Wang et al., 2015; Alam et al., 2014).

In order to investigate the relationships between responsiveness for energy consumption, attitude towards energy efficient devices and purchase intention, the following hypotheses were designed:

H8: Responsibility for energy consumption affects intention to purchase energy-efficient appliances positively and significantly (H8: B→E).

H9: Responsibility for energy consumption affects attitude towards EEHA positively and significantly (H9: B→D).

H10: Attitude towards energy-efficient appliances affects purchase intention positively and significantly (H10: D→E).

2.2.4 Hypotheses about the mediation and moderation effect

Ibrahim et al. (2021) stated that environmental concern affects certain behaviours through attitudes and certain beliefs. Suárez-Perales et al. (2018) stated that increases in environmental knowledge increases environmental concerns. Furthermore, the authors evaluated that the increase in environmental anxiety has a positive effect on the increase of environmentally friendly behaviours. Ahmed et al. (2020) claimed that those working on the environment are concerned about the damage to nature and can try to obtain relevant environmental information to reduce the destruction of nature effectively. In this study, however, perhaps slightly different from Ahmed's study, which assumed that information, concerns and attitudes about the environment and energy would affect them, it was evaluated that energy information could have a significant effect as a mediator variable.

Thanks to environmental awareness trainings on unnecessary energy use, individuals can be made aware of environmental problems that may be caused by unnecessary energy use. By learning about energy problems, households can improve their energy consumption responsibilities and gain a sense of responsibility for the environment. It is considered that the effect of energy information and environmental concern is important in displaying environmental energy consumption behaviours in residences. In this respect, it is thought that increasing the level of responsibility of individuals regarding environmental problems that may be caused by unnecessary energy use is one of the prerequisites of coping with environmental problems (Güven and Aydoğdu, 2012).

Masud et al. (2015) revealed the effect of information and awareness about the global climate crisis on environmental behaviours and that responsibility plays a mediating role on these effects. Testing of the hypotheses developed using the literature information was carried out with the help of the theoretical framework in Figure 1.

H11: Energy information increases the relationship between responsibility for energy consumption and Intention to purchase energy efficient appliances such that the relationship is stronger when energy information is high (AXB→E).
H12: Energy information increases the relationship between environmental concern and Intention to purchase energy efficient appliances such that the relationship is stronger when energy information is high (AxC→E)

H13a: The mediating effect of energy consumption responsibility is significant in the relationship between environmental concern and the intention to purchase EEHA.

H13b: The mediating effect of the attitude towards EEHA is significant in the relationship between environmental concern and the intention to purchase EEHA.

H14a: The mediating effect of energy consumption responsibility in the relationship between energy knowledge and EEHA purchase intention is significant.

H14b: The mediating effect of environmental concern is significant in the relationship between energy knowledge and the intention to purchase EEHA.

H14c: The mediating effect of the attitude towards EEHA is significant in the relationship between energy knowledge and EEHA purchase intention.

In the model in Figure 1, it is basically assumed that as the level of information and awareness of households about the negative effects of excessive and unnecessary energy use on nature and people increases, people's concerns about the environment increase. As a result, their energy consumption responsibilities develop. It has been evaluated that the aforementioned feelings of concern and responsibility will create a positive attitude towards EEHA and their intention to purchase EEHA. In addition, hypotheses have been proposed to reveal whether the level of information about energy affects the intention to be assumed directly or through concern and responsibility. The model describing the aforementioned relations and hypotheses are given in Figure 1. In the model, the level of concern about energy is defined as exogenous, responsibility and concern is defined as mediating endogenous, and attitude and intention are defined as endogenous latent variables.

![Figure 1. Theoretical framework](image)

A: Energy information, B: Responsibility for energy consumption, C: Environmental concern, D: Attitude towards EEHA, E: Intention to purchase energy-efficient appliances

3. Methodology

3.1. Measurement

The data used in the study were compiled through the online form in June 2021. The questionnaires were filled by 350 voluntary participants who had digital access to the data collection tools. When the data were analysed, it was determined that the answers
of 56 questionnaires were not consistent and the analyses were made with the data obtained from 294 participants. In the first part of the questionnaire, there are 6 questions to measure demographic characteristics, and in the second part, there are 20 items of 11-point Likert scale referring to "0-totally disagree, 10-totally agree" to measure attitudes. As a result of the exploratory factor analysis, 8 items were excluded from the analysis because the factor load was less than 0.50. The Cronbach's Alpha was calculated as 0.889 and evaluated as highly reliable. While designing the questionnaire, items number 7, 12, 13, 16, 20, 26 were adapted from Tan et al. (2017). Similarly, Item 8 was adapted from Koçak (2020). Items 11, 19, 2 were from Wang et al. (2018). Finally, Items 22 and 23 were written by the researchers. While the prices of high EEHA should be low in countries dependent on energy from abroad, unfortunately the prices are quite high in Turkey. In addition, energy prices are at a high level compared to personal income. For this reason, c22 was added to the data collection tool to measure attitudes towards the adoption of EEHA in order to protect the environment, despite the high prices. c23, on the other hand, is designed to measure information about the results of high energy consuming devices that affect the environment negatively, such as global warming.

3.2. Participants

Characteristics of the participants are given in Table 1. According to the table, 44.6% of the participants are women and 55.4% are women. The online survey was conducted in the most populous cities of the country. 27.2% of the participants are from İstanbul, 10.0% from Eskişehir, 22.4% from Ankara, 13.6% from İzmir, 8.5% form Bursa and 13.3% from other cities.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td>Male</td>
<td>163</td>
<td>55.4</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>131</td>
<td>44.6</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td>Married</td>
<td>85</td>
<td>28.9</td>
</tr>
<tr>
<td></td>
<td>Single</td>
<td>209</td>
<td>71.1</td>
</tr>
<tr>
<td><strong>City</strong></td>
<td>İstanbul</td>
<td>80</td>
<td>27.2</td>
</tr>
<tr>
<td></td>
<td>Eskişehir</td>
<td>44</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>Ankara</td>
<td>66</td>
<td>22.4</td>
</tr>
<tr>
<td></td>
<td>İzmir</td>
<td>40</td>
<td>13.6</td>
</tr>
<tr>
<td></td>
<td>Bursa</td>
<td>25</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>39</td>
<td>13.3</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>18-22</td>
<td>85</td>
<td>28.9</td>
</tr>
<tr>
<td></td>
<td>23-27</td>
<td>86</td>
<td>29.3</td>
</tr>
<tr>
<td></td>
<td>28-33</td>
<td>49</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>34-40</td>
<td>29</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>41-48</td>
<td>19</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>49-56</td>
<td>23</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>57-69</td>
<td>12</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Education status</strong></td>
<td>Primary school</td>
<td>4</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Middle school</td>
<td>7</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>High school</td>
<td>62</td>
<td>21.0</td>
</tr>
<tr>
<td></td>
<td>Vocational school</td>
<td>26</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>University</td>
<td>141</td>
<td>48.0</td>
</tr>
<tr>
<td></td>
<td>Graduate</td>
<td>27</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>College student</td>
<td>27</td>
<td>9.2</td>
</tr>
</tbody>
</table>
4. Results and discussion

4.1. Measurement model

The following criteria are required for the convergent validity and reliability of the measurement model; (a) standardized factor load > 0.50 and it is statistically significant, (b) Composite Reliability (CR) > 0.70, (c) Average Variance Extracted (AVE) > 0.50 (Fornell and Larcker, 1981; Hair et al., 2014). Eight items were excluded from the analysis because the factor load was less than 0.70. Subsequent analyses were made with 12 items. The results in Table 2 show that the measurement model has a convergent validity.

Table 2. Standardized factor loads, CR and AVE

<table>
<thead>
<tr>
<th>Item</th>
<th>Factors</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>a8: Fossil fuels, which consume high energy, increase the amount of carbon dioxide (CO2) in the atmosphere and pose a risk to natural life.</td>
<td>A: information</td>
<td>0.788</td>
</tr>
<tr>
<td>a16: Toxic releases from high energy consuming devices pose a health risk by being included in the food chain via groundwater.</td>
<td></td>
<td>0.785</td>
</tr>
<tr>
<td>a23: Low-energy devices help prevent global warming.</td>
<td></td>
<td>0.881</td>
</tr>
<tr>
<td>b13: It is my individual responsibility to consume less energy to conserve and develop natural resources.</td>
<td>B: Responsibility</td>
<td>0.938</td>
</tr>
<tr>
<td>b21: Reducing my unnecessary energy consumption is my moral obligation to other people and nature.</td>
<td></td>
<td>0.940</td>
</tr>
<tr>
<td>c12: Recent air pollution has been worrying me.</td>
<td>C: Concern</td>
<td>0.831</td>
</tr>
<tr>
<td>c20: The consequences of climate change make me worry about the future.</td>
<td></td>
<td>0.833</td>
</tr>
<tr>
<td>c26: Pollution in clean water sources worries me.</td>
<td></td>
<td>0.812</td>
</tr>
<tr>
<td>c7: In my decision to purchase electrical appliances, whether the appliance is energy efficient or not is the reason for preference for me.</td>
<td>D: Attitude</td>
<td>0.878</td>
</tr>
<tr>
<td>c22: Although the price is high, I prefer home appliances with high energy saving level.</td>
<td></td>
<td>0.809</td>
</tr>
<tr>
<td>c11: It is very likely that I will purchase energy-saving devices in my upcoming purchases.</td>
<td>E: Intention</td>
<td>0.841</td>
</tr>
<tr>
<td>c19: I intend to purchase EEHA in the near future.</td>
<td></td>
<td>0.847</td>
</tr>
</tbody>
</table>

Table 3 presents the discriminant validity matrix proposed by Fornell and Larcker (1981). When Table 3 is examined, it can be seen that the measurement model has a discriminant validity.

Table 3. Discriminant Validity

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.816</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0.761</td>
<td>0.939</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.677</td>
<td>0.728</td>
<td>0.825</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>0.653</td>
<td>0.653</td>
<td>0.604</td>
<td>0.844</td>
</tr>
<tr>
<td>E</td>
<td>0.531</td>
<td>0.529</td>
<td>0.467</td>
<td>0.679</td>
</tr>
</tbody>
</table>
4.2. Structural model

The structural model usually evaluates with the criteria of $R^2$, $f^2$, $Q^2$ and GoF. In addition, it is recommended to fill SRMR and NFI for model fit (Chin, 1998). $R^2$ values are the values written inside the ellipses in figure 2 (B=0.663, C=0.458 D=0.500, E=0.477).

In addition, the effect measure $f^2$ was calculated in the study (Cohen, 1988). $f^2$ values are given in Table 4. When Table 4 is examined, it can be observed that the effects of $A \rightarrow B$ and $A \rightarrow C$ are 0.845 and 0.392, respectively. From this result, it can be said that especially energy information affects energy consumption responsibility at a high level.

Collinearity Statistics (VIF) of model variables is $1.220<\text{Outer VIF Values}<2.396$ and $1.845<\text{Inner VIF Values}<2.396$. It was calculated as GoF=0.625 for the model and the model fit was high (Wetzels et al., 2009). Model fit values are SRMR=0.078 and NFI= 0.762. From these values, it can be stated that the model has an acceptable fit.

Table 4 shows the $R^2$ and the predictive relevance ($Q^2$) values of the exogenous structures on the respective internal structures. In this study, $Q^2$ was used by Geisser (1974) to analyse the prediction accuracy. It was calculated in $Q^2$, which gives an idea about the accuracy of the predictions in the study (Hair et al., 2014). $Q^2$ values are given in Table 4.

### Table 4. $R^2$, predictive accuracy-$Q^2$, and prediction output

<table>
<thead>
<tr>
<th>Path</th>
<th>PLS predict RMSE</th>
<th>$Q^2$</th>
<th>LM RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>d7</td>
<td>1.971</td>
<td>0.221</td>
<td>1.956</td>
</tr>
<tr>
<td>d22</td>
<td>1.560</td>
<td>0.357</td>
<td>1.522</td>
</tr>
<tr>
<td>e19</td>
<td>2.182</td>
<td>0.207</td>
<td>2.165</td>
</tr>
<tr>
<td>e11</td>
<td>1.949</td>
<td>0.167</td>
<td>1.957</td>
</tr>
</tbody>
</table>

$R^2$

| B    | 0.663 | 0.573 |
| C    | 0.458 | 0.447 |
| D    | 0.500 | 0.413 |
| E    | 0.477 | 0.261 |

4.3 Test of Hypothesis

Except for three of the 10 hypotheses put forward for direct effects in the model, the others were supported. The results of the hypothesis test for direct effects are given in Table 5.

### Table 5. Hypothesis testing results

<table>
<thead>
<tr>
<th>Path</th>
<th>$t$-values</th>
<th>$p$-values</th>
<th>Decision</th>
<th>$f^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: A→B</td>
<td>0.494</td>
<td>8.313</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H2: A→C</td>
<td>0.677</td>
<td>13.611</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H3: A→D</td>
<td>0.315</td>
<td>3.535</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H4: A→E</td>
<td>0.101</td>
<td>1.148</td>
<td>0.252</td>
<td>NS</td>
</tr>
<tr>
<td>H5: C→B</td>
<td>0.394</td>
<td>5.626</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H6: C→D</td>
<td>0.190</td>
<td>3.064</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H7: C→E</td>
<td>-0.003</td>
<td>0.043</td>
<td>0.966</td>
<td>NS</td>
</tr>
<tr>
<td>H8: B→D</td>
<td>0.275</td>
<td>3.500</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
<tr>
<td>H9: B→E</td>
<td>0.093</td>
<td>1.122</td>
<td>0.262</td>
<td>NS</td>
</tr>
<tr>
<td>H10: D→E</td>
<td>0.554</td>
<td>5.996</td>
<td>P&lt;0.01</td>
<td>Supported</td>
</tr>
</tbody>
</table>

NS: Not Supported
When Figure 2 and Table 5 are examined, the biggest effects are $A \rightarrow C$, $D \rightarrow E$ and $A \rightarrow B$ respectively. If the positively estimated parameters are interpreted, it is determined that a one-unit increase in energy information will cause an increase of 0.677 units in environmental concern, a one-unit increase in the attitude towards EEHA will cause an increase of 0.554 units in the intention to purchase EEHA, and a one-unit increase in energy information will cause an increase of 0.494 units in responsibility for energy consumption. It has also been revealed that a one-unit increase in environmental concern will result in an increase of 0.394 unit in responsibility for energy consumption. Considering that the level of energy information affects environmental concern and responsibility for energy consumption to a high degree, the importance of including the energy information variable in the model as the only exogenous latent variable becomes apparent. As it can be seen in Figure 2, the percentage of responsibility for energy consumption and environmental concern explained by the energy information level is 0.66 and 0.46, respectively. These disclosure rates for a single variable are considered to be a remarkable result.

![Figure 2. Empirical structural equation modelling](image)

Variance accounted for (VAF) was used to test the hypotheses regarding the mediation effect given in H13 and H14. As VAF value is 1.01; which is higher than 0.80 for H13a and VAF value is 1.04; which is higher than 0.80 for H13b, it is stated that there is full mediation and both hypotheses are supported. Furthermore, because VAF value is 0.31 which is in the range of [0.20, 0.80] for H14a and VAF value is 0.63 which is in the range of [0.20, 0.80] for H14c, partial mediation and hypotheses were confirmed. Finally, for H14b, as VAF value is found to be 0.02; which is lower than 0.20, it can be interpreted that there is no mediation. Therefore, the hypothesis is not supported.

The obtained results have been compared to some other similar studies in the literature. Wang et al. (2011) supposed that there is a potential positive correlation among household electricity conservation behaviour and factors such as economic benefits, policy and societal norms, and past experiences. The findings suggested that there is significant potential to decrease unnecessary household electricity consumption. Prete et al. (2017) demonstrated that attitude plays a central role in shaping households' intentions to embrace and their willingness to invest in Energy Efficiency Measures. Nevertheless, subjective norms, perceived behavioural control, and environmental concern also exert positive influences, and these effects vary depending on the income.
level, education, and age of different household subgroups. Tan et al. (2017) indicated that consumers’ more positive attitudes towards energy-efficient household appliances and their perception of having control over their behaviour significantly impact their intention to purchase such products. When the results are examined in this context, it is observed that the findings are consistent with previous studies in the literature.

5. Conclusion

One of the ways in which the feelings of responsibility for energy consumption in households are transformed into attitudes and reflected in behaviour can be the purchase of EEHA in the houses. In this study, the attitudes and purchasing intentions of households towards energy-saving appliances were investigated with a proposed structural model. In the model, it is assumed that energy information, which is defined as an exogenous latent variable, will affect environmental concern and responsibility for energy consumption, and these two internal intermediary latent variables will also affect the attitude towards EEHA and intention to purchase. The test of the effects in the model and the importance-performance map of the effect of latent variables on the intention to purchase EEHA were made using Partial Least Squares Structural Equation Modelling.

At the end of the study, it was determined that the proposed model had an acceptable fit. In the hypothesis test, energy information→ intention to consumption energy efficient home appliances (A→E), responsibility for energy consumption → intention to purchase energy efficient home appliances (B→E), Environmental concern→ intention to purchase instruments (C→E) was not found to be significant and related hypotheses were not supported. In addition, it was determined that the mediating role of energy information, B→E and C→E relations was positive and significant.

As a result of supporting moderating effects, it can be said that energy information will increase the relationship between the responsibility for energy consumption and the intention to purchase energy efficient devices. In addition, according to another moderating effect, it was concluded that when the energy information the household is high, the responsibility of energy consumption will increase the intention to purchase EEHA. AxB→E=0.097 (t=2.045, p<0.05). Furthermore, it can be seen from Figure 3 that energy information increases the relationship between environmental concern and intention to purchase energy efficient devices. Finally, it was revealed that when the energy information in the household is high, the intention to purchase EEHA increases as the environmental concern increases (Figure 4). AxC→E=0.077 (t=1.772, p<0.10).

![Figure 3. AxB→E moderation effect](image3.png)

![Figure 4. AxC→E moderation effect](image4.png)
It is a remarkable result that energy information is both a mediator and a moderator in the relationships between responsibility for energy consumption and environmental concern's purchase intention. This result shows the importance of A, B and C variables and the relationships among these variables in predicting the intention to purchase energy efficient home appliances.

In the study, Importance-performance map analysis (IPMA) analysis of exogenous latent variables on E: Intention to purchase energy-efficient appliances was performed. The IPMA graphically combines the total effects (significance) on the x-axis with latent variable performance scores scaled on the y-axis in the range of 0 to 100. To interpret the results, focus is placed on the structures in the lower right area of the importance-performance map. These builds are of high importance to the target build but perform below average (Ringle and Sarstedt, 2016). As a result, it is evaluated that there is a particularly high potential to improve the performance of structures located in this area.

As can be seen in Figure 6, A: Energy information and D: Attitude towards EEHA variables are potential factors to be considered to improve the performance of E: Intention to purchase energy-efficient appliances.

In recent years, the shortage of energy supplies and the rise in energy prices all over the world have become challenges for the economic structures of many countries. Due to the very large increases in energy prices, households have taken the path of taking energy saving measures. Electrical appliances are responsible for most of the energy consumption in residential buildings. Establishing high efficiency standards for electrical appliances can greatly control the demand for electricity. For this reason, energy information labels and standards can be seen as complementary tools for consumers to purchase energy-efficient home appliances. Labelling can serve as an incentive for manufacturers to offer more efficient products in the Sunday, unlike competitors, while creating a demand for their economical ones.

Educators and managers can work together in various activities to increase the public's knowledge and awareness about energy. As a result, it might be possible to reduce unnecessary energy consumption, especially in residential buildings. It can make individuals who are responsible for energy consumption feel obliged to use energy-efficient devices. Consequently, the behaviours of consumers in purchasing EEHA, reducing the energy bill will bring positive benefits to the family budgets. In addition to all these, perhaps most importantly, reducing carbon emissions will have important
effects on improving the environment for a more liveable world and better living conditions.

As it can be understood from the results of the study, it has been revealed that energy knowledge and energy consumption responsibility are the key variables in the household's environmental priority behaviour. In countries where households with low purchasing levels live, it is necessary for decision makers to direct the production of electrical appliances in such a way that the energy consumption, efficiency and prices of the appliances are optimal. In addition to these, it is considered that it may be important to plan informative and educational activities on the negative effects of unnecessary energy consumption on nature and life urgently, and to explain "energy consumption information and our responsibilities" in some lessons in schools.

Limitations of the study

Due to the limitations of the pandemic, a face-to-face survey could not be conducted in the study. Considering the low response rates in online surveys, the number of questions has been kept low in order to avoid biased and inconsistent answers. In the study, the purchasing behaviour of consumers for EEHA and the use of these household appliances in residences could not be examined in detail. By adding the behaviour variable to the model, the effects of the variables on behaviour can be investigated. In future studies, more detailed information about the psychological states of consumers can be obtained and the results can be enriched by using qualitative methods.

References


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