

# The influence of subjective norms on the use of heat pumps in achieving sustainable development

Утицај субјективних норми на коришћење топлотне пумпе у постизању одрживог развоја

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**Abstract:** Sustainable development, use of renewable energy sources and energy efficiency have been the focus of interest of the scientific and professional public in recent decades. The aim of the research is to investigate the influence of subjective norms on the use of heat pumps within the framework of behavior in the function of energy efficiency. In addition, the profile of consumers is investigated in the context of their sociodemographic characteristics. Marketing research was conducted on a convenience sample of 208 respondents on the territory of Serbia, in August 2019. The measurement of subjective norms according to the heat pump was performed on the basis of a Likert scale, while the analysis of the sociodemographic characteristics of the respondents was performed using the SPSS program package. Based on the results of the research, it was concluded that the influence of subjective norms on the introduction of the use of heat pumps is closest to the score 3, which is neutral on a five-point Likert scale, as well as that subjective norms can be statistically significantly explained by income and the number of children under the age of 18 as sociodemographic characteristics of the respondent.

**Keywords:** renewable energy sources, subjective norms, heat pumps, socio-demographic characteristics of consumers.

**JEL classification:** M31

**Сажетак:** Одрживи развој, коришћење обновљивих извора енергије и енергетска ефикасност су последњих деценија стављене у фокус интересовања научно-стручне јавности. Циљ рада је да се у оквиру понашања у функцији енергетске ефикасности истражује утицај субјективних норми на коришћење топлотне пумпе. Поред тога истражује се профил потрошача у контексту њихових социодемографских карактеристика. Маркетинг истраживање је спроведено на пригодном узорку од 208 испитаника на територији Србије, у августу 2019. године. Мерење субјективних норми према топлотној пумпи је извршено на основу Ликертове скале, док је анализа социодемографских карактеристика испитаника извршена коришћењем SPSS програмског пакета. На основу резултата истраживања изведена су закључна разматрања да је утицај субјективних норми на увођење коришћења топлотне пумпе најближи оцени 3 која је неутрална на петостепеној Ликертовој скали, као и да се субјективне норме могу статистички значајно објаснити приходом и бројем деце млађе од 18 година као социодемографским карактеристикама испитаника.

**Кључне речи:** обновљиви извори енергије, субјективне норме, топлотне пумпе, социодемографске карактеристике потрошача.

## Introduction

The concept of sustainable development in contemporary living conditions is one of the current and inexhaustible research topic. The transition trend towards reducing the use of fossil fuels in the member states of the European Union, as well as in the Republic of Serbia, defines a series of measures that motivate and encourage more intensive use of renewable energy sources. Munitlak-Ivanovic (2008) states that, while taking into account the pollution tolerance threshold, the environment can be viewed as a resource for carrying out economic activities, but also as a waste recipient.

Rašić-Jelavić & Pajdaković-Vulić (2021) consider that there are several objectives of environmental protection, starting with reducing air and water pollution, reducing waste, more efficient consumption of resources, increasing the use of renewable energy sources, improving energy efficiency, improving recycling and reuse of products, etc.

Boskovic, Djuric & Turanjanin (2017) point out that for sustainable development, the existence of environmentally conscious consumers is necessary along with a continuous change in consumer behavior towards energy-saving behavior.

The focus on the importance of using renewable energy sources, on the one hand, and relatively few researches on this topic in the Republic of Serbia, on the other hand, determined the author to choose the research of subjective norms for the heat pump, as a product that uses renewable energy sources - hydro and geothermal energy.

Karic, Blagojevic & Skundric (2010) point out in their work that geothermal energy is a renewable energy source and that geothermal heating represents an environmentally acceptable type of heating. In this context, the authors state that heat pumps extract low-temperature energy from the environment and increase it in order to heat the space without combustion, the emission of harmful gases and without environmental pollution. As the main advantage of the heat pump, the authors cite efficiency, i.e. low level of electricity consumption compared to standard heating systems, which is an extremely important fact at the time of the current energy crisis. At the same time, heat pumps can also be used for space cooling, with affordable maintenance of the system, according to Karic et al. (2010).

The first part of the paper presents an overview of the scientific and professional literature and previous research on the influence of subjective norms, energy efficient behavior, and environmental protection. The second part of the paper gives an overview of the empirical research results on the influence of subjective norms regarding the use of heat pumps in the Republic of Serbia in the context of the sociodemographic characteristics of the respondents. At the same time, consumer profiling using sociodemographic characteristics can have significant repercussions on the creation of marketing strategies.

In order to achieve the aim of the paper, a primary marketing survey was conducted on the territory of the Republic of Serbia in July 2019, which included 208 respondents. The prerequisite for someone to be a respondent is that they are the decision maker regarding the purchase of the researched product and that there are (or will be in the future) technical grounds for installing and using a heat pump in the household.

## 1. Investments in energy efficiency

Energy efficiency is an important segment of environmental efficiency within the framework of sustainable development in business operations (Rakić, Krstić & Rađenović, 2021). The authors suggest in their research that energy efficiency is different in different industries because they involve different products and processes.

People's daily behavior increases household energy consumption, which affects the uncertainty of the efficiency of household energy saving policies much more than in other sectors, according to Zhang, Yu, Wang & Wei (2018), who conclude that it is necessary to analyze consumer behavior for sustainable household energy consumption.

Barr, Gilg & Ford (2005) and Zhang et al. (2018) point out that energy-saving behavior is behavior by which consumers try to reduce their overall energy use. In this context, Zhang et al. (2018) believe that energy saving implies efficient use of energy aimed at reducing energy consumption.

The European Union has ambitious energy efficiency targets related to household behaviors in terms of energy efficiency with a focus on a low-carbon society (Bye, Fæhn & Rosnes, 2018), while Niamir, Ivanova, Filatova, Voinov & Bressers (2020) point out that households are directly and indirectly responsible for 70% of CO<sub>2</sub> emissions.

Considering the process of industrialization and urbanization in China, Aboltins & Blumberga (2018) suggest that it is important to promote proper consumption patterns, motivate the population to adopt energy-saving lifestyles and reduce CO<sub>2</sub> emissions, and conclude that improving energy efficiency technology is the best way to promoting the reduction of CO<sub>2</sub> emissions in households.

Ouyang, Long & Hokao (2010) also emphasize that it is necessary to promote consumer behaviors in the context of time-saving, energy-efficient technology or a comfortable environment and conclude that when the alignment of lifestyle trends, energy-efficient technologies and behaviors is achieved, changes in behavior towards energy-saving behavior occur spontaneously.

In research conducted in the capital city of Shandong Province in China Zhang et al. (2018) consider three main factors that define energy efficient behavior in households: individual subjective and objective factors (e.g. gender, age, occupation, degree of concern, sense of responsibility, values), factors of external influence (e.g. quality of energy-saving products, social norms, public and education) and intentions to save energy (including usual behaviors - habits and behaviors in the function of purchasing energy-efficient products).

Based on the obtained results, Zhang et al. (2018) conclude that there is a need for state support and stimulation of companies for the production of high-quality energy-efficient products, in order to encourage the motivation of energy-saving behavior in households.

There is an interest of the respondents in the use and saving of energy in the household, but access to information on the most effective activities for saving is necessary in order to make a decision on the implementation of energy-saving behavior observed by Ouyang et al. (2010) and Jareemit & Limmeechokchai (2017).

In their research, Niamir et al. (2020) presented a dynamic process of changing household behavior that takes place in several stages. In doing so, the authors analyze three determinants of energy behavior in the Netherlands and Spain:

1. investments in house insulation, solar panels and/or energy-efficient devices,
2. saving energy by changing energy usage habits such as turning off unused devices or adjusting the temperature in the house and
3. transition to green sources of electricity.

The results show that in the period from 2006 to 2016, compared to households in Spain, households in the Netherlands were more active in energy-efficient investments, specifically in house insulation activities 6% more, in installing solar panels 12.6% more, Niamir et al. (2020) say.

Rankings of energy-saving household activities show that Bangkok citizens use energy-efficient air conditioners the most, as well as household appliances with a higher energy efficiency rating. When making a decision to buy a household appliance, they emphasize durability in the first place, followed by energy efficiency and the price of the product, with 2-4 years as the expected investment return period (Jareemit & Limmeechokchai, 2017).

When looking at investments in energy efficiency, it is relevant for Bangkok citizens to consider investment costs that affect perception significantly, which is in line with the results showing that most respondents applied activities with lower investments (painting the outer wall of the house in a light color, planting trees to increase amounts of shade). The greatest interest in future activities is for the upgrade of canopies, roof insulation and the installation of insulated glass windows (Jareemit & Limmeechokchai, 2017).

Aboltins & Blumberga (2018) state that energy prices have an impact on households in Latvia, but to a lesser extent, primarily due to stable energy consumption habits, relatively cheap energy and low energy consumption per capita, in contrast to more economically developed countries, where energy consumption increases with the growth of well-being.

The Norwegian government introduced economic support for alternative heating systems (pellet and heat pump) in 2003 due to the high dependence on electric heating combined with the high price of electricity. The financial support of the state led to the rapid growth of the heat pump market, while in the case of pellets the result was not achieved as

expected. In the paper, the authors study the factors that influence the choice of household heating systems in Norway (Sopha, Klöckner, Skjevraak & Hertwich, 2010). The conclusion of the research is that the state should implement special strategies for different groups of households. For example, households where younger people dominate, should promote heating systems based on new technologies. Also, ensuring a stable fuel supply and low operating costs appear as two relevant factors when making a decision on choosing a sustainable heating system in Norway, which the state must pay attention to when creating a marketing strategy.

## 2. Subjective norms and energy efficient behavior

Subjective norms represent an important psychological variable that influences the energy-efficient behavior of consumers. Many academics confirm the significant influence of subjective norms on consumer behavior (Sun, Liu & Zhao (2018); Wang, Zhang & Li (2014); Gadenne, Sharma, Kerr & Smith (2011); Thøgersen & Grønhøj (2010); Nakamura (2016); Inhoffen, Siemroth & Zahn (2018)).

Nikolic-Ristic & Djokic (2021) based on Gadenna et al. (2011) conclude that the influence of environmental pressures (subjective norms) is very significant for the acceptance of environmental protection behavior with a pronounced impact on the development of people's values. A sense of belonging arises when people accept behaviors that are considered the norm in the group.

Thøgersen & Grønhøj (2010) emphasize the importance of perception of how much other household members care about energy saving and communication between family members about energy saving efforts and the influence of social norms. In their research, they conclude that subjective norms influence an individual's electricity saving goals directly and indirectly, that is, that men put more pressure on women to save energy.

Analyzing one of the largest subsidized renewable energy support programs in the European Union for the installation of photovoltaic systems in Germany, Inhoffen et al. (2018) state that in municipalities with more solar radiation and less unemployment, social interaction has a stronger effect, which affects the probability of increasing the number of new installation up to 50%. On the other hand, in the northern areas of the country, with minimal solar potential, the positive influence of environmental pressure was confirmed.

Also, Wang et al. (2014) state the great influence of national culture in China, the importance of relationships with family members, close friends and colleagues, and conclude that subjective norms represent the most important factor in household behavior regarding energy saving in Beijing.

Gaspar & Antunes (2011) suggest that shopping together with family members or friends affects a greater tendency to consider the relationship between cost and quality, water and energy consumption, in contrast to the situation of respondents who were alone while shopping.

In his research, Nakamura (2016) shows that households are motivated to replace appliances more because of the social pressure they feel, than because of the willingness to save energy.

Although somewhat weaker, the influence of subjective norms (friends, family and media) on the online purchase of tourist services is also very important, which especially applies to younger respondents and can partly be interpreted as their consumer socialization, according to Djokic & Milicevic (2017).

On the contrary, the results of the research by Li, Li, Jin & Wang (2019) show that there is no statistically significant influence of subjective norms on the intention to purchase energy-efficient appliances.

### 3. Research design

#### 3.1. A sample

Field marketing research was conducted using a structured personal survey on a purposive and convenience sample of 208 respondents in August 2019 on the territory of the Republic of Serbia. The average level of total income in the respondent's household was 93,075 dinars.

Sociodemographic characteristics of the respondents are shown in Table 1.

Table 1: Sociodemographic characteristics of respondents

Characteristic		Percentage	Characteristic	Percentage	Standard deviation
<b>Gender</b>	Male	52.9%	<b>Age</b>	43.4	11.96
	Female	47.1%			
<b>Marital status</b>	Married	76%	<b>Years of education</b>	14.5	2.4
	Single	24%			
<b>Work status</b>	Employed	83.2%	<b>Number of children in the household</b>	0.7	0.9
	The others	16.8%			
<b>Total income</b>	Up to 100.000 RSD	67.3%	<b>Income rating</b>	0.7	1.03
	From 100-450.000 RSD	32.7%			

Source: the authors' research

Through the descriptive analysis of the respondents, it can be concluded that the

majority of the respondents were male, with an average age of 43, college or university education, predominantly married and employed, with less than one child under the age of 18 in the household, the majority with a relatively low income rating and low income up to 100,000 dinars.

### 3.2. Questionnaire

The questionnaire was designed in two parts, where the first part of the questionnaire referred to the socio-demographic characteristics of the respondents. Thereby, gender, age, years of education, marital status (married, not married), number of children under the age of 18 in the household, work status (employed, unemployed, pensioners, students), self-assessed household income (from 1 to 5 – 1 the lowest, 5 the highest rating) and total income in the household were investigated.

The second part of the questionnaire was related to the research of subjective norms towards the use of heat pumps in the household. Subjective norms were measured using six statements:

1. People whose opinion we value support the use of heat pumps.
2. People we care about encourage the use of heat pumps.
3. We feel pressure from society to start using a heat pump.
4. People close to us would approve of using a heat pump.
5. Most households similar to ours will start using heat pumps.
6. Most people who are important to us will use heat pumps.

In doing so, respondents expressed subjective norms using a five-point Likert scale (from "I do not agree at all" to "I completely agree"). The questions in the questionnaire about subjective norms were adapted from the research conducted by Ajzen, Joyce, Sheikh & Gilbert (2011).

### 3.3. Procedures

Subjective norms of the respondents regarding the use of heat pumps in the household are expressed by the average rating of the answers to the 6 described questions. The T test of independent samples was used to compare respondents of different gender, marital and work status. Pearson's correlation was used to determine the existence of a correlation between age, education and the number of children under 18 in the household, income and household income with the subjective norms of the respondents according to the heat pump used in the household.

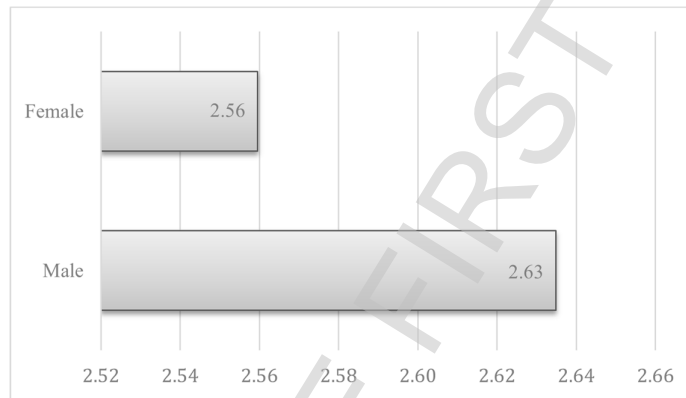
## 4. Research results

The average rating of the respondents' subjective norms according to the use of heat pumps

in the household is 2.60 (standard deviation 0.74). At the same time, the respondents mostly agree with the statement that people whose opinion they value support the use of a heat pump, while they disagree, i.e. they gave the lowest average rating that they feel pressure from society in this sense.

Graph 1 presents the average rating of respondents of different genders.

Chart 1: Subjective norms of respondents of different genders towards the heat pump

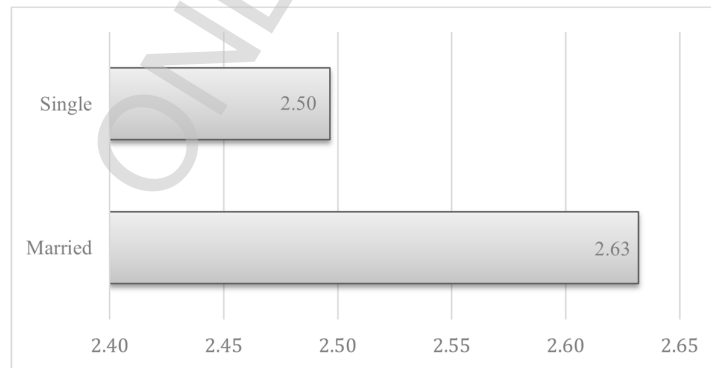


Source: the authors' research

Results of the T test:  $t(206) = 0.737$ ;  $p=0.462 > 0.05$  show that men and women do not statistically significantly differ in subjective norms according to the use of heat pumps.

Graph 2 shows the average rating of respondents of different marital status.

Chart 2: Subjective norms of subjects of different marital status according to the heat pump



Source: the authors' research



Results of the T test:  $t(206) = 1.134$ ;  $p = 0.258 > 0.05$  show that respondents who are married and respondents who are not married statistically do not differ significantly in subjective norms according to the use of heat pumps.

Results of the T test:  $t(184) = 0.188$ ;  $p = 0.851 > 0.05$  show that respondents who are employed and respondents who are not employed (unemployed, retired, students) do not statistically significantly differ in terms of subjective norms regarding the use of heat pumps.

Pearson's correlation results:  $r = -0.100$ ;  $p = 0.151 > 0.05$  show that there is no correlation between the age of the respondents and the subjective norms according to the use of the heat pump in the household.

The average education of the respondents in relation to the introduction of the use of the heat pump is at the level of college/university degree. Pearson's correlation results:  $r = -0.031$ ;  $p = 0.656 > 0.05$  show that there is no correlation between the respondents' years of education and subjective norms regarding the use of heat pumps in the household.

Pearson's correlation results:  $r = 0.200$ ;  $p = 0.004 < 0.05$  show that there is a positive and statistically significant correlation between the number of children under the age of 18 in the respondent's household and subjective norms regarding the use of a heat pump in the household.

The results of the Pearson correlation in relation to the subjective norms according to the use of the heat pump are for income rating  $r = 0.150$ ;  $p = 0.031 < 0.05$  and for total income  $r = 0.127$ ;  $p = 0.068 > 0.05$ . The above results show that there is no correlation of total household income with subjective norms according to the use of a heat pump in the household, while when it comes to self-assessed household income there is a weak, positive and statistically significant correlation with subjective norms.

In general, the Pearson's correlation results show that there is a positive and statistically significant correlation between the number of children under the age of 18 in the respondent's household and subjective norms, as well as a positive, weak and statistically significant correlation between the respondent's self-assessed income and subjective norms regarding the use of heat pumps in the household. On the other hand, the influence of subjective norms on the use of the heat pump cannot be statistically significantly explained by the sociodemographic characteristics of the respondents such as gender, age and education, marital and work status and total household income.

The results obtained based on the respondents' ratings indicate that the influence of subjective norms on the introduction of the use of the heat pump is neutral (closest to rating 3 on a five-point Likert scale). This is partially in line with Irfan, Elavarasan, Hao, Feng & Sailan (2021), who state that it is noticeable that environmental pressure has an insignificant effect on the intention to use solar energy. In contrast, the obtained results are not in agreement with the researches of Li et al. (2019) who indicate that the influence of subjective norms on the intention to purchase energy-efficient devices is not significant, and Lundheim, Vesely, Nayum, & Klöckner (2020) that subjective norms do not have a significant influence

on the use of solar panels, nor with the aforementioned researches which confirm the importance of subjective norms (Sun et al. (2018); Wang et al. (2014); Gadenne et al. (2011); Thøgersen & Grønhøj (2010); Nakamura (2016); Inhoffen et al. (2018)).

When looking at the context of the sociodemographic characteristics, the results are consistent with the results of Wang et al. (2014) who conclude that the age of the respondents is not a significant variable influencing energy-saving behavior. Sopha et al. (2010) confirm our results and state that household education does not show a significant effect when it comes to the use of a heat pump for heating, as well as Wang et al. (2014) who point out that education does not significantly affect the intention to adopt energy-saving behaviors. Dieu-Hang, Grafton, Martínez-Espiñeira & Garcia-Valiñas (2017) confirm that income as a socio-demographic characteristic of the household has a positive effect on the probability of investing in energy-efficient water devices, while Sopha et al. (2010) state that income has a marginally significant effect on the probability of pellet heating. Also, the obtained results are partially in accordance with Djokic & Milicevic (2016), who state that one of the aims of the work is to investigate the profile of organic food consumers in the context of their sociodemographic characteristics and conclude that actual and potential consumers of organic food can be linked to higher incomes, and especially with a higher level of education, and the results of Niamir et al. (2020) who emphasize economic comfort as a factor influencing household behavior in the sense that economically vulnerable households are more motivated to save energy.

On the contrary, the obtained results are not in accordance with the research results of Sun et al. (2018) who states that income has no significant direct or indirect impact on green consumption, while Niamir et al. (2020) and Jareemit & Limmeechokchai (2017) indicate the importance of gender on energy-saving behavior and confirm that women have a greater tendency towards energy-saving than men. When looking at the probability of making a decision on energy-efficient investments in households, Niamir et al. (2020) as key determinants they state the level of education of the citizens (95%), personal norms (90-99%), type (99%) and size of the apartment (90-95%), noting that a higher level of personal norms also increases the probability of investment in energy efficiency, energy conservation and transition to green suppliers. The results of Sopha et al. (2010) showed that the age variable is statistically significant for the choice of electric heating, heat pump and pellets and that education has a marginally significant effect on the probability of pellet heating.

## Conclusion

The results of the research conducted in the Republic of Serbia in this paper showed that the influence of subjective norms on the use of heat pumps is neutral, and when the mentioned question is observed by segments, it can be concluded that subjective norms can be statistically significantly explained by self-assessed household income and the number of children under the age of 18 as sociodemographic characteristics.

Also, the impression of the research is the low standard of living of the respondents,

which is reflected in the low income rating and low average incomes at the level of the entire household of the respondents. The fact that the influence of subjective norms, in addition to the variable of the number of children under the age of 18, can be statistically significantly explained and the income refers to the importance of the respondent's income for making a decision on the introduction of the use of a heat pump and the possibility of financing the purchase. On the other hand, it is necessary to mention that there is still not enough information among citizens about the advantages of using a heat pump, and therefore the environmental pressure, i.e. the influence of subjective norms, is very low.

The obtained results of this research can be useful to the state in order to improve the information and education of the population regarding the use of renewable energy sources, as well as the use of the heat pump as a product in the function of energy efficiency. If we look back at the current energy situation in our country and the world, which was caused by the crisis in Ukraine, the focus on promoting products that use renewable energy sources comes to the fore. In this way, the state can achieve a reduction in energy consumption from traditional (fossil) sources and increase the use of renewable energy sources, and citizens can reduce their bills for consumed energy and thereby make their contribution to sustainable development.

Future researches should include new bases, larger and more representative samples, as well as a larger number of products in terms of energy efficiency.

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