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THE EXTENT INDIVIDUALS ARE WILLING TO UNDERTAKE ENERGY EFFICIENCY MEASURES: EVIDENCE FROM BOSNIA AND HERZEGOVINA

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Abstract

This paper studies the extent individuals are willing to undertake energy efficiency measures, with evidence coming from a developing country (Bosnia and Herzegovina). The goal of this paper is to analyze energy-savings behaviors, aiming to understand what is typically meant under the term energy efficiency, who is more likely to know the meaning, and the extent individuals are willing to undertake some energy efficiency measures. The sample size used in this paper is a random stratified sample of 1,415 individuals coming from various backgrounds. Our logistic regression models found no statistically significant predictor across all ten measures used in the study. However, past experience, age, and being married are relatively common across these ten energy-saving behaviors. These results might be beneficial in defining policies in order to promote energy-saving behaviors.

Keywords: *energy-savings behavior, energy efficiency measures, energy crisis, micro data, Bosnia and Herzegovina*

JEL classification: *D90; O13; Q41*

1. Introduction

The more efficient use of energy can be achieved by changing the behavior of many actors, including employers, employees, governments, and individuals. At the micro level of analysis, individuals can take meaningful actions at home and in their working environment, which should not be ignored. For example, some estimations in Bangkok identified opportunities to save energy between 7 and 15%, i.e. 484.2 - 1037.6 kWh/year/household (Jareemit and Limmeechokchai 2019). Energy-saving behaviors are widely promoted as a solution to growing energy-related problems (Suntornsan, Chudech, and Janmaimool 2022). However, as concluded by Sony and Mekoth (2018), electricity-saving behavior "represents a significant untapped potential". Within the organizational context, Glavas (2012) pointed out that the majority of studies

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in the field of employee engagement and sustainability have been focusing on macro issues; the knowledge about organization-wide implementation is scarce; and we are just at the beginning of understating how to engage employees in sustainability. Glavas (2012) summarized the conclusions of several studies to identify variables that sustainability has a positive impact on, including performance, engagement, retention, creative involvement, commitment, attractiveness to prospective employees, identification with the organization, organization citizenship behaviors, and employee relationships.

This paper studies the extent individuals are willing to undertake energy efficiency measures, with evidence coming from a developing country (Bosnia and Herzegovina). The goal of this paper is to analyze energy-saving behaviors, starting with the meaning of the term energy efficiency, i.e., how individuals from Bosnia and Herzegovina typically understand the term. As not all respondents are willing to engage in energy-saving behaviors, the following question emerged: Who is more likely to know the meaning of energy efficiency? Finally, the paper identifies the extent individuals are willing to undertake some energy efficiency measures and what factors are important predictors of energy-saving behavior. However, existing literature typically examines one type of energy-saving behavior. Our data contain questions related to the willingness to accept energy-saving behavior in 10 specific domains, with the aim of discovering common predictors across domains.

The contribution of this paper lies in the application of logistic regression on ten observed energy-saving practices and testing which socio-demographic characteristics could predict this behavior, in order to test whether it is possible to find consistent predictors across ten different energy-saving measures. Such results can be used in shaping better policy-decision measures to increase individual's energy efficiency.

2. Literature Review

In this section, we start with the theory of planned behavior as a theoretical background of the paper. Then, a discussion about psychological and socio-demographic predictors is presented.

2.1. Theory of planned behavior as a theoretical background of the paper

An energy-saving behavior can be defined as "an individual action that aims to reduce energy consumption and the negative environmental impacts of energy consumption and production" (Sony and Mekoth 2018 as cited in Suntornsan, Chudech, and Janmaimool 2022). The theory of Planned Behavior (TPB) might be used as a good theoretical background to understand what factors can explain an individual's decision to engage in a certain behavior, including energy-saving behaviors in a very particular category - students with physical impairments (Suntornsan, Chudech, and Janmaimool 2022). TPB is widely used to explain the association between intention and behavior in the general domain, as well as in the environmental and specific energy-related domain (Carrus et al. 2022). The theory postulates that the intention of an individual is an important predictor of actual behavior, while attitude towards the behavior, subjective norms, and perceived behavioral control are important predictors of an individual's intention to engage in that behavior. Attitude towards the behavior represents the belief of an individual about the observed behavior, which could be positive/favorable or negative. Subjective norms explain how social pressure influences intention to engage in certain behavior, while perceived behavioral control (PBC) is best explained by an individual's perception that sufficient resources, opportunities, and capabilities are available to perform a certain action, i.e., it explains how easy or difficult to participate in behavior that is the subject of research. The theoretical background of this paper is drawn from TBP.

2.2. Psychological predictors of energy-saving behavior

Carrus et al. (2022) concluded that "understanding how psychological processes drive human energy choices is urgent, and yet relatively under-investigated, need for contemporary society." By applying a meta-analytical procedure, the moderate association between attitudes, intentions, values, awareness, and emotions, on one side, and energy-saving behavioral intentions (self-reported) and behaviors (actual), on the other side, are found to be positive and moderate in size. While five psychological factors are considered to be statistically and positively related to energy-saving intentions and behaviors, emotions have been identified to have more explanatory power than others, like values or beliefs, by meta-analysis of Carrus et al. (2022). An explanation provided by the authors is that emotions associated with a particular course of action are probably more directly associated with real-life choices.

Using a nationally representative probability sample of US adults, Gustafson et al. (2020) also showed that psychological factors are important considerations in supporting energy-saving behaviors. Particularly, Republicans and Democrats differ in their stated motivation for supporting a transition to renewable energy, i.e. the main motivator of Republicans is economic benefits consideration and Democrats are more concerned about global warming.

As noted by Gustafson et al. (2020), the perception of benefits and the reduction in environmental harms were perceived to motivate individuals to increase their support for renewable energy trends. However, in the qualitative study in Western India, Sony and Mekoth (2018) identified seven master themes related to the question of why consumers do not care about electricity energy-saving behavior, including the lack of reward and motivation, lack of environmental concern, lack of information, lack of communication, lack of policy and legislation, lack of social norms and lack of user-friendly technology.

2.3. Socio-demographic predictors of energy-saving behavior

On a sample from Bosnia and Herzegovina, Radoš et al. (2020) showed that socio-demographic variables are important predictors of an individual's support for projects related to renewable energy sources, including age, gender, income, satisfaction with the standard of living, religiousness, living in a male-dominated household, and ethnicity. For example, socio-demographic predictors, such as education level and household income, are found to play an important role in adopting biogas technologies in Ethiopia (Shallo, Ayele, and Sime 2020). However, regarding age, the results are not found to be consistently significant. The studies conducted on the data from multiple European countries[1] (Mills and Schleich 2012), Portugal (Paço and Varejao 2010), Austria (Getzner and Grabner-Kräuter 2004), and Canada (Kinnera et al. 1974) found that younger individuals are more likely to use renewable energy sources, while other studies (such as Radoš et al. 2020, the study from Bosnia and Herzegovina; and Roberts 1996, the study from the US) showed the opposite, i.e. older people show a higher level of support for renewable energy, compared to younger individuals. Similar contradictory results are found for gender. The studies from the UK (Devine-Wright 2010), a large North-American city (Laroche et al. 2001), and the US (Mainieri and Barnett 1997; Black et al. 1985) found women are more likely to support renewable energy and adopt environmentally friendly behavior, while other studies from Bosnia and Herzegovina (Radoš et al. 2020) and the US (MacDonald and Hara 1994) show men are more likely to support these projects, and two US studies found no statistically significant differences (Groth and Vogt 2004; Samdahl and Robertson 1989). Age and gender are also used as moderator variables. By applying a meta-analytic approach, Carrus et al. (2022) also found that age and gender are significant moderators in explaining pro-environmental values and emotions with energy-saving intentions.

Marital status is also found to increase or decrease the odds of engaging in energy-saving behaviors. Radoš et al. (2020) found that "that married individuals or individuals in a cohabiting partnership will support projects related to renewable energy sources are 24% lower than for single, divorced, or widowed ones". On the other side, using a sample of more than 12 000 respondents from various countries (Australia, Canada, Chile, France, Israel, Japan, Korea, the Netherlands, Spain, Sweden, and Switzerland), Ameli and Brandt (2015) found that individuals in multi-member households demonstrate energy-friendly behavior with a higher probability than single individuals. Existing literature also identifies income as an important predictor, as income can increase the likelihood of energy-friendly behavior (Rados et al. 2020; Ameli and Brandt 2015; Paço and Varejao 2010; Getzner and Grabner-Kräuter 2004). Similar results are found regarding education. More educated individuals are more likely to engage in energy-saving behaviors, as found by two studies from the US (Roberts 1996; Zimmer, Stafford, and Stafford 1994).

Based on the previous discussion, this paper aims to analyze these predictors' consistency concerning specific energy-saving behavior. The main research question is related to discovering common predictors across ten different energy-saving practices.

3. Data and Methods

Data used in this project are collected for the purpose of the Social Monitoring and Evaluation project, which was implemented in Bosnia and Herzegovina in order to monitor and evaluate energy efficiency improvements of selected buildings. In addition to the data collected for the employees and users of the building involved in the energy efficiency project, the survey for social monitoring was designed in a way to

collect data about the level of awareness of energy efficiency and related issues raised, and the level of subjective attitudes toward positive changes in behavioral pattern change. Population data for Bosnia and Herzegovina was used to make initial strata.

Table 1 presents sample characteristics. A total of 1,415 responses were collected. Male respondents represent 44.81% of the sample. The majority of surveyed respondents are from rural areas (54.98%). Regarding age, the most represented age group is 55-75, accounting for 36.89% of the total sample, followed by the 36-55 age group (33.43%). The largest proportion of respondents graduated at least from high school (56.04%). In terms of personal income, the data collected are distributed equally across observed categories up to BAM 900, i.e. 23.32% of individuals with no income, 25.23% of individuals with income up to BAM 500, and 23.39% of individuals with income between BAM 501 and BAM 900. Respondents with income higher than BAM 2000 are the least represented, accounting for 2.61%. Most respondents are married (61.63%).

The data in the study are analyzed using descriptive statistics and logistic regression. Logistic regression is commonly used to generate models from which predictions can be made about the likelihood of an individual supporting energy efficiency measures. Due to its more intuitive interpretation, the study reports the odds ratio Exp(B) to show the change in odds that results from a unit change in the variable of interest. The first logistic regression model was constructed to test which personal characteristics could increase the odds of belonging to the group that self-reported the lack of knowledge regarding the meaning of energy efficiency. The independent variables include gender, type of settlement, age, education level, marital status, and personal income. Afterward, we constructed ten logistic regression models. Dependent variables of these models measure respondents' willingness to undertake specific energy measures, while independent variables include proxies for attitude towards the behavior, past experience, perceived behavioral control, and subjective norms, as well as socio-demographic variables (gender, type of settlement, age, education,

Table 1. Sample characteristics

		Frequency	Percentage (% of total)
Total	Total sample size	1,415	100%
Gender	Male	634	44.81%
	Female	781	55.19%
Type of settlement	Rural	778	54.98%
	Urban	637	45.02%
Age	18-35	336	23.75%
	36-55	473	33.43%
	55-75	522	36.89%
	76+	84	5.94%
Education	No education	30	2.12%
	Elementary school	218	15.41%
	High school	793	56.04%
	College or university	363	25.65%
	Missing	11	0.78%
Marital status	Single	380	26.86%
	Married	872	61.63%
	Divorced	150	10.60%
	Missing	13	0.92%
Personal income	No income	330	23.32%
	1-500	357	25.23%
	501-900	331	23.39%
	901-2000	196	13.85%
	More than 2000	37	2.61%
	Missing	164	11.59%

marital status, and income). Attitude towards the behavior is measured by the question "According to your observations, what is the impact of energy efficiency on the quality of life and living standards of ordinary citizens?", on the scale from extremely unfavorable/negative (1) to extremely favorable (5). In order to simplify the interpretation of the regression results, it was recoded into a dummy variable where 1 represents the case when respondents consider the impact of energy efficiency to be mostly favorable or extremely favorable. Past experience is measured by the number of energy-efficiency measures implemented in the past. Perceived behavioral control (PBC) typically represents a belief that an individual has sufficient capability, resources, and opportunities to perform a given behavior (Suntornsan, Chudech, and Janmaimool 2022). The individuals were asked to report the extent that environmental problems, such as water or air pollution, and climate change, affect their bodies and their health, with answers ranging from absolutely not (1) to a lot (5). This question represents a proxy dummy variable for PBC, assuming that if individuals believe that these environmental concerns cause potential harm, they might be motivated to increase or improve capabilities, and resources and search for opportunities to engage in energy-saving behaviors.

4. Results and Discussion

In this section, we present the main results. First, the meaning of the term energy efficiency is presented, followed by the logistic regression to identify specific socio-demographic characteristics of those individuals with no understanding of the term energy efficiency. The third part reports the results of descriptive statistics and logistic regression in an attempt to analyze the extent individuals are willing to undertake some energy efficiency measures.

4.1. The meaning of the term energy efficiency

The first question was open-ended, i.e., respondents could express the meaning energy efficiency has for themselves. Responses were analyzed following typical qualitative data techniques, i.e. summarizing data, categorizing data, and structuring data. The most common response was related to energy savings, such as financial viability, energy-saving devices, rational consumption, use of cheap tariffs, etc. This response was identified as the meaning behind the term energy efficiency by 39.7% of the respondents. The second most frequent meaning was heating of the house (thermal energy, insulation, facade, etc.), which was identified by 19.2% of all respondents. Interestingly, 17.2% of respondents stated that they do not know the meaning behind the term energy efficiency.

4.2. Who is more likely not to know the meaning behind energy efficiency?

Since 17.2% of respondents reported that they do not know the meaning of energy efficiency, we constructed the logistic regression model to test which

Table 2. In your opinion, what is meant by term energy efficiency?

The meaning	Frequency	Percentage (% of total)
Energy savings (financial viability, energy saving devices, rational consumption, use of cheap tariffs, …)	562	39.7%
Heating of the house (thermal energy, insulation, facade)	271	19.2%
I don't know	243	17.2%
Something about electricity	161	11.4%
Other	101	7.1%
Renewable energy sources (hydropower, wind, solar)	93	6.6%
Utilizing energy in the best way (efficient work, quality energy)	80	5.7%
Pollution reduction (coal, fuel, wood)	66	4.7%
Energy consumption in general	41	2.9%
Human health, body and life energy	19	1.3%
Nothing	14	1.0%
Energy production	10	0.7%

Table 3. Logistic regression results

Variable	Odds ratio	Standard Error	z	P>|z|
Gender (male as a reference group)				
Female	1.31	0.23	1.52	0.13
Type of settlement (rural as a reference group)				
Urban	1.01	0.17	0.03	0.975
Age (18-35 as a reference group)				
36-55	0.81	0.19	-0.85	0.397
55-75	0.57	0.15	-2.15	0.031**
76+	0.92	0.35	-0.21	0.834
Education (No education as a reference group)				
Elementary school	0.48	0.20	-1.77	0.077*
High school	0.16	0.07	-4.43	0.000***
College or university	0.06	0.03	-5.80	0.000***
Marital status (Single as a reference group)				
Married	1.15	0.25	0.65	0.52
Divorced	1.17	0.37	0.51	0.61
Personal income (No income as a reference group)				
1-500	1.24	0.27	1.02	0.398
501-900	1.28	0.29	1.12	0.264
901-2000	0.62	0.21	-1.39	0.165
More than 2000	0.27	0.28	-1.26	0.208
Const	1.09	0.52	0.18	0.854

Number of observations = 1,236; Pseudo R^2 = 10.03%

personal characteristics could increase the odds of belonging to that group. The results are presented in Table 3. Our results indicated that education level plays an important role in predicting whether an individual would report a lack of knowledge about the meaning of energy efficiency. The odds for individuals with elementary education are about 52% lower than those with no education, and with an increase in education levels, the odds ratio is decreasing. The odds for individuals with a high school degree are about 84% lower than those with no education, and with a college or university education, the odds are 94% lower. Other variables are mostly insignificant, except the age group 55-75. The odds that an individual in this age group will not understand the meaning of energy efficiency are 43% lower than in a reference group (18-35 age group).

4.3. The extent individuals are willing to undertake some energy efficiency measures

Typical activities individuals are willing to undertake energy efficiency measures analyzed in this paper includes heating-related measures, the use of electricity, and overall investing in house unit (quality windows, exterior insulation, alternative energy sources, new heating systems) and home appliances. The most common measure that is typically undertaken by almost everyone is turning off the light source in rooms that are rarely used or not used (91.31%), followed by the use of so-called energy-saving light bulbs (84.82%) and turning off radiators and heating sources in rooms that are rarely used (84.03). The measures that are considered to be the least prevailing among respondents are the investment in alternative energy sources (45.58%) and choosing a lower temperature level when heating housing units. The extent individuals are willing to undertake some energy efficiency measures are shown in Table 4.

Table 4. The extent individuals are willing to undertake some energy efficiency measures

To what extent are you personally willing to undertake some of these typical activities?	Frequency	Percentage	Rank
A. Heat your housing unit during the winter heating season to a level of 18 degrees Celsius.	699	49.40%	9
B. Replace all classic light bulbs in the housing unit with so-called energy-saving light bulbs.	1,196	84.82%	2
C. Use large electricity consumers (washing machine, dishwasher, water heater, electric heaters) only at night	954	67.42%	6
D. Invest in quality carpentry – windows (PVC / ALU)	1,075	75.97%	4
E. Turn off radiators and heating sources in rooms that are rarely used	1,189	84.03%	3
F. Turn off the light source in rooms that are less or not used	1,292	91.31%	1
G. Invest in home appliances (dishwashers, stoves, refrigerators, water heaters) that have energy efficiency certificates	922	65.16%	7
H. Invest in better exterior insulation of the walls of a residential unit / building	1,016	71.80%	5
J. Invest in new / modern heaters with lower energy consumption	829	58.59%	8
K. Invest in alternative energy sources (solar panels on the roof of the building; biomass heaters...)	645	45.58%	10

Respondents believe that improving the quality of insulation of the external walls of the building is the measure with the most impact on reducing energy consumption, i.e. a total of 40% of the respondent ranked this measure as the first or the second in terms of their impact. The second measure, identified by 35.2% of respondents, is the utilization of solar power or solar panels, followed by the installation of modern/quality carpentry.

Table 5. The most efficient measures in terms of their impact

The energy-efficiency measure	1st rank	2nd rank	1st and 2nd rank combined	%
Improving the quality of insulation of the external walls of the building (modern insulation)	276	290	566	40.0%
Utilization of solar power / solar panels	351	147	498	35.2%
Installation of modern / quality carpentry (windows and doors)	183	286	469	33.1%
Usage of energy-saving bulbs	209	192	401	28.3%
Use of large consumers of electricity (washing machines, water heaters, radiators) mostly at night (at a lower rate)	125	132	257	18.2%
Removing coal and wood as heat sources energy	83	76	159	11.2%
Usage of energy efficient home appliances	59	92	151	10.7%
Using natural gas for space heating and cooking	47	78	125	8.8%
Switching off light and heat sources in rooms that are less frequently used	51	62	113	8.0%
I don't know	31	29	60	4.2%

4.4. Who is more likely to undertake some typical energy-efficiency measures?

In this section, we present the results of several logistic regression models with dependent variables representing the willingness of respondents to undertake certain policy measures. First, we present results and discuss the role of socio-demographic variables, followed by three components of TPB.

Gender plays a significant role in predicting the wiliness of individuals to adjust the heating temperature of the housing unit in the winter season at 18 degrees Celsius (Model 1). In particular, the odds for women to adjust heating temperatures to 18 degrees are about 20% lower than the odds for men. This might be because female participants might experience different levels of thermal dissatisfaction because of behavioral and physiological reasons (Wang et al. 2018). Physiological reasons are related to metabolic rate in cold exposure, stroke volumes, and blood circulation to the extremities in cold exposures (Wang et al. 2018). Other models show no statistically significant relationships between gender and the willingness to undertake some policy measures, but the coefficients (odds) of the four models are below 1, which might be indicating that women are less likely to undertake some policy measures than men. These models are typically associated with the use of more energy-efficient bulbs, turning off the light sources in rooms that are rarely used, and investing in better exterior insulation of a building. While the results are insignificant ($p>0.1$), the odds in the remaining models (6 out of these 10 models) might indicate that men are slightly more likely to implement energy efficiency measures (1-12% higher odds).

The type of settlement is significant only in two models (models 3 and 10). In comparison to rural respondents, the odds for urban respondents are 39% higher in the case of using large electricity consumers only at night, but 22% lower in the case of investing in alternative energy sources. This might be explained by the different lifestyles of urban and rural respondents. For example, Kohatsu et al. (2009) found an association between short sleep duration and higher BMI in the rural population, while the results of Yang et al. (2009) show that the average sleep time in urban children was shorter than in the children from rural areas. On the other hand, the higher probability of the rural respondent investing in alternative energy sources might come from ownership of larger properties and the type of activities involved in the rural lifestyle, which might require higher energy consumption. Other models show no statistically significant relationships between the type of settlement and the willingness to undertake some policy measures. However, the coefficients for eight out of 10 models are higher than 1, which might indicate that urban respondents are more willing to undertake energy-efficiency policy measures compared to rural respondents. Urban respondents, due to their exposure to various campaigns on different media, might be more aware of energy efficiency measures.

The age of respondents is the variable that is found to influence individuals' willingness to undertake policy measures in almost all models. In seven out of 10 models, age has a statistically significant influence on the individuals' willingness to undertake policy measures. However, there is no consistent direction of the coefficient. With a one-year increase in age, we expect to see about a 1% decrease in the odds of being willing to undertake energy-efficiency measures in the following cases: investing in quality windows (model 4), investing in home appliances that have energy efficiency certificates (model 7), investing in better exterior insulation of the walls of a residential unit/building (model 8); invest in new/modern heaters with lower energy consumption (model 9); and investing in alternative energy sources (model 10). We argue that these types of investments are typically implemented at the younger period of life as individuals are in the process of purchasing housing units, and as they age, their intention to invest more money is reduced. As such, these results might be as expected because as people age, their comfort with what they own increases, making it harder to pursue these investments. On the other hand, our results indicate that with a one-year increase in age, we expect to see about a 1% increase in the odds of being willing to undertake energy-efficiency measures such as setting up the room temperatures to 18 degrees, turning off radiators and heating sources in rooms that are rarely used. Again, the possible explanation might be that individuals taking care of such behaviors can make some differences as their lives become more stable over years, and as they become more aware of the potential of energy-saving opportunities in their everyday life.

In term of education, the more educated an individual is, it seems the odds of engaging in various energy efficiency measures increases. However, results are significant only for two models: with a one-year increase in education, we expect to see about a 1% increase in the odds of being willing to invest in quality carpentry – windows; and 7% in home appliances that have energy efficiency certificates. A possible explanation might involve a better understanding of the potential cost savings made by these two investments.

For other models, the results are insignificant but the value of coefficients in seven out of 10 models might be a good indication that spending more time in formal education can result in higher chances of accepting more energy-efficient behaviors.

Being married is found to increase the willingness for energy efficiency measures in five models. In four models, the odds for married persons are between 34 and 39% higher than the odds of single persons in case of their engagement in some sort of investment, such as new windows (model 4), home appliances with energy-efficient certificates (model 7), better exterior insulation of the walls (model 8), and alternative energy sources (model 10). Overall, being married is associated with higher chances of increasing the odds of engaging in energy-efficient practices in seven out of 10 models, but not all results are statistically significant. On the other hand, the odds for divorced persons to engage in such behavior are typically lower than for single persons, but the results are significant only for three models. We argue that married persons might engage in this type of behavior due to joint decision-making and improvement of living conditions for their family. However, the odds for married persons are 34% lower than the odds for single persons in the context of their willingness to change the room temperature to 18 degrees Celsius, significant at 5%. A possible explanation might include care for the family and kids and, consequently, increasing the temperature to make their family members more comfortable.

Personal income is found to increase the willingness to implement energy efficiency measures in five models, but not all observed income levels are found to be statistically significant. The overall conclusion is that the odds for individuals with higher income to engage in energy-efficiency measures are higher than for those without income. This is a logical conclusion since we expected that individuals with higher incomes are more prone to engage in energy efficiency measures due to better financial situations. While the results are statistically insignificant, the only case where the odds are decreasing with income increase is in model 3 (the use of large electricity consumers at night). As electricity prices are typically lower in Bosnia and Herzegovina, the effort to save energy by using this energy efficiency measure is not motivating enough due to relatively lower savings compared to their income. However, as the informal economy in Bosnia and Herzegovina is relatively large, with an average value of 34% of GDP for 1998-2015 (Pasovic and Efencic 2018), the problem of undeclared work and personal earnings related to it should be noted. The survey used in the research required respondents to report their income, which might vary based on whether respondents included undeclared work in their responses.

Attitude towards the behavior is measured by the question "According to your observations, what is the impact of energy efficiency on the quality of life and living standards of ordinary citizens?" on the scale from extremely unfavorable/negative (1) to extremely favorable (5). The variable is statistically significant in the second model, indicating that the odds for those who have a positive attitude are 35% higher than for those without such an attitude. While the results are statistically insignificant in other models, the odds for individuals with a positive attitude to engage in energy-efficiency measures are higher compared to the reference group in eight out of 10 models.

Past experience is measured by the number of energy-efficiency measures implemented in the past. Our results indicated that past experience is the single most important predictor of intention, i.e. in most cases, it shows that with a one-unit increase in the number of implemented measures, we expect to see between 18-68% increase in the odds of being willing to undertake energy-efficiency measures. The non-significant results are only found in model 1 (setting the temperature at 18 degrees Celsius) and in model 10 (investing in alternative energy sources).

Perceived behavioral control (PBC) typically represents a belief that an individual has sufficient capability, resources, and opportunities to perform a given behavior (Suntornsan, Chudech, and Janmaimool 2022). Our results indicate that the odds for those individuals with greater PBC are between 48% and 102% higher than for those with the opposite PBC, in five out of ten models. In the remaining models, the PBC has no statistically significant impact, but the coefficients are mostly in favor of a higher probability of being willing to undertake energy-efficiency measures.

Subjective norms are significant in only two models, most coefficients are higher than 1, potentially indicating that subjective norms can increase the odds of being willing to undertake energy-efficiency measures.

Table 6. The results of logistic regression models, dependent variable willingness of respondents to undertake certain policy measures

Variable	M1 (TEMP)	M2 (EE_BL)	M3 (EL_N)	M4 (WIN)	M5 (HEAT)	M6 (LIGHT)	M7 (I_HA)	M8 (I_IW)	M9 (I_H)	M10 (I_AES)
Female	**0.8 (0.1*)**	0.81 (0.15)	1.17 (0.16)	1.02 (0.16)	1.01 (0.18)	0.96 (0.23)	1.18 (0.17)	0.94 (0.14)	1.13 (0.15)	1 (0.13)
Urban settlement	1.19 (0.15)	1.03 (0.18)	**1.39 (0.19**)**	1.15 (0.17)	1.23 (0.22)	1.08 (0.25)	1.19 (0.16)	0.93 (0.13)	1.03 (0.13)	**0.78 (0.1**)**
Age	**1.01 (0*)**	0.99 (0.01)	0.99 (0)	**0.99 (0.01*)**	**1.02 (0.01**)**	1.01 (0.01)	**0.99 (0**)**	**0.99 (0**)**	**0.98 (0***)**	**0.99 (0**)**
Years of education	0.96 (0.03)	0.96 (0.04)	1.02 (0.03)	**1.1 (0.03**)**	1.00 (0.04)	0.97 (0.05)	**1.07 (0.03**)**	1.02 (0.03)	1.02 (0.03)	1.04 (0.03)
Married	**0.66 (0.11**)**	1.01 (0.23)	1.12 (0.19)	**1.41 (0.27*)**	0.95 (0.21)	0.87 (0.24)	**1.49 (0.26**)**	**1.47 (0.26**)**	1.02 (0.17)	**1.34 (0.21*)**
Divorced	0.67 (0.17)	**0.56 (0.19*)**	0.82 (0.22)	0.99 (0.29)	0.86 (0.32)	2.01 (1.22)	**0.62 (0.17*)**	0.95 (0.26)	**0.64 (0.17*)**	0.81 (0.22)
Income										
1-500	1.08 (0.19)	1.24 (0.31)	1.21 (0.24)	0.97 (0.2)	1 (0.25)	0.98 (0.32)	1.09 (0.21)	1.02 (0.2)	1.09 (0.2)	1.06 (0.19)
501-900	**1.39 (0.25*)**	1.1 (0.27)	1.15 (0.22)	1.15 (0.24)	1.18 (0.29)	1.06 (0.33)	1.27 (0.24)	1.23 (0.24)	**1.50 (0.28**)**	1.27 (0.23)
901-2000	1.24 (0.25)	1.38 (0.42)	0.92 (0.2)	1.42 (0.38)	1.30 (0.39)	1.40 (0.56)	**2.12 (0.51**)**	**1.88 (0.47**)**	**1.79 (0.39**)**	1.39 (0.29)
More than 2000	1.61 (0.63)	1.56 (1.02)	0.67 (0.27)	1.77 (1.01)	1.24 (0.72)	0.75 (0.51)	**3.58 (2.03**)**	**2.70 (1.52*)**	**2.52 (1.16**)**	**2.85 (1.17**)**
Attitude (proxy)	0.99 (0.13)	**1.35 (0.24*)**	1.1 (0.15)	1.04 (0.16)	0.98 (0.18)	1.41 (0.32)	1.11 (0.16)	0.99 (0.14)	**1.09 (0.15)**	1.11 (0.15)
PBC (proxy)	0.91 (0.13)	**1.85 (0.35***)**	1.32 (0.2*)	**1.48 (0.24**)**	1.23 (0.24)	**2.02 (0.47**)**	**1.46 (0.22**)**	0.96 (0.16)	**1.45 (0.22**)**	1.21 (0.17)
Subjective norms (proxy)	1.1 (0.21)	1.08 (0.29)	1.16 (0.24)	1.25 (0.29)	**0.58 (0.14**)**	1.04 (0.36)	**1.75 (0.38**)**	1.08 (0.23)	**1.44 (0.29*)**	1.35 (0.25)
Past experiences	1.01 (0.04)	**1.39 (0.08***)**	**1.27 (0.06***)**	**1.25 (0.06***)**	**1.33 (0.08***)**	**1.68 (0.14***)**	**1.18 (0.05***)**	**1.2 (0.06***)**	**1.19 (0.05***)**	1.05 (0.04)
Constant	1.47 (0.65)	2.32 (1.45)	0.53 (0.25)	**0.38 (0.2*)**	0.79 (0.49)	0.88 (0.7)	**0.32 (0.16**)**	1.42 (0.7)	0.87 (0.4)	0.55 (0.25)
Pseudo R^2	0.02	0.06	0.04	0.06	0.05	0.10	0.08	0.04	0.06	0.03

The dependent variable in each model measures the willingness of respondents to **M1**. Heat your housing unit during the winter heating season to a level of 18 degrees Celsius; **M2**. Replace all classic light bulbs in the housing unit with so-called energy-saving light bulbs; **M3**. Use large electricity consumers (washing machine, dishwasher, water heater, electric heaters) only at night; **M4**. Invest in quality carpentry – windows (PVC / ALU); **M5**. Turn off radiators and heating sources in rooms that are rarely used; **M6**. Turn off the light source in rooms that are less or not used; **M7**. Invest in home appliances (dishwashers, stoves, refrigerators, water heaters) that have energy efficiency certificates; **M8**. Invest in better exterior insulation of the walls of a residential unit / building; **M9**. Invest in new / modern heaters with lower energy consumption; **M10**. Invest in alternative energy sources (solar panels on the roof of the building; biomass heaters...)

***Significant at 0.01 level. **Significant at 0.05 level. *Significant at 0.10 level.

5. Conclusions

This paper focuses on the analysis of the extent individuals are willing to undertake energy efficiency measures, with the main focus on the sample from a developing country. More precisely, the study analyses the willingness of individuals to support ten different energy efficiency measures at home. Understanding how individuals differ in terms of their support for these measures might help us better shape policy toward a more sustainable future.

5.1. Main findings

Individuals from Bosnia and Herzegovina associate energy efficiency with energy savings from electricity and heating of the housing unit. Interestingly, 17.2% of respondents stated that they do not know the meaning of energy efficiency. The typical person with no idea about energy efficiency is one with a lower education level and probably a younger individual. Individuals are willing to undertake many measures to become energy efficient, but the most common are the ones that are the least mentally demanding, such as turning off the light bulbs, using energy-saving bulbs, and not heating rarely-used rooms. Investment in alternative energy sources and heating the room at lower temperatures are among the least popular measures. However, individuals believe that these are not the most efficient measures in terms of their impact, i.e., improving the quality of insulation of the external walls and utilization of solar panels, and installation of modern windows and doors are perceived to be the measures with the most impact on reducing energy consumption. Nevertheless, our logistic regression models found no statistically significant predictor across all ten measures used in the study. Our regression models aimed to test whether individuals' characteristics can contribute to the explanation of variability in individuals' willingness to support ten energy-related measures. Our results indicated that past experience is the single most important predictor of intention to implement energy-efficiency measures, i.e., in most cases, it shows that with a one-unit increase in the number of implemented measures, we expect to see between 18-68% increase in the odds of being willing to undertake energy-efficiency measures. The second most common predictor is age, found to be statistically significant in seven models. Interestingly, our results indicate that age can both increase and decrease odds for certain energy-saving behaviors. Being married is also found to be an important predictor, in most cases increasing the odds for energy-saving types of behaviors. The proxy we used to measure perceived behavioral control is found in the majority of models to be an important predictor. Other variables were only found to play a statistically significant role in some models.

5.2. Policy implications

These results might be beneficial in defining policies in order to promote energy-saving behaviors. For the purpose of informing policy-decision makers, Table 7 provides the overview of the most common predictors across models with their indicative direction of the effect.

Our first policy recommendation concerns the role of an individual's previous experience in energy-saving measures. As individuals with more past experience are more likely to engage in energy-saving behaviors, providing suitable examples in the form of possible savings or providing financial and non-financial support to implement some measures might be a good starting point to increase energy savings initiatives further. In order to gain the first experience, financial incentives for the replacement of old appliances are found relevant in the existing literature, including various incentives (De Almeida, Fonseca, Schlomann, and Feilberg 2011): reducing VAT on highly energy-efficient products, rebates, and subsidies, demand side management programs, tax credits given to manufacturers and white certificates. Other methods to gain first experience could also come by utilizing existing policy recommendations in the literature (De Almeida, Fonseca, Schlomann, and Feilberg 2011): raising awareness about labeling schemes and expanding the energy label to include more products and increasing minimum standards. From the perspective of employers, mirror flourishing and personal/individual approaches (Glavas, 2012) can be used to engage employees for higher sustainability practices in the organization. Similarly to the practices within the organization, these practices might be used broadly, i.e., being applied to the overall population. Mirror flourishing, a practice being used in the organizational context, is defined as "the consonant flourishing or growing together that happens naturally and reciprocally to us when we actively engage in or witness the acts that help nature flourish, others flourish, or the world as a whole to flourish." (Cooperrider and Fry 2012, p.24). Jointly with the action of raising awareness, managers and key staff could demonstrate energy-efficient behavioral patterns in order to experience the effects of mirror flourishing. As such, new policies should ensure the first experience in applying

Table 7. The most common predictors across models with their indicative direction of the effect

Independent variable	Frequency*	%	The indicative direction of the effect
Past experience	8	80%	Individuals with past experience are more inclined to implement energy-saving measures.
Age	7	70%	Older individuals might be less inclined to implement energy-saving measures.
Marital status	7	70%	Being married is associated with higher chances of increasing the odds of engaging in energy-efficient practices.
Perceived behavioral control (PBC)	5	50%	Individuals with greater PBC might be more inclined to implement energy-saving measures.
Income	5	50%	Individuals with higher incomes might be more inclined to implement energy-saving measures.
Subjective norms	3	30%	Individuals with higher subjective norms might be more inclined to implement energy-saving measures.
Type of settlement	2	20%	Urban individuals might be more inclined to implement energy-saving measures.
Years of education	2	20%	More educated individuals might be more inclined to implement energy-saving measures.
Gender	1	10%	Inconclusive
Attitude toward the behavior	1	10%	Individuals with a positive attitude might be more inclined to implement energy-saving measures.

* Note: Frequency refers to the number of times the predictor has a statistically significant influence on dependent variables across ten models.

any energy-efficiency practice, to promote behavioral changes further.

In addition to these policy recommendations, individuals of different ages and marital statuses process information and make decisions differently. Some investments are typically implemented early in life when individuals or married couples invest in purchasing housing units. However, their intention to replace or change these products is reduced as they age, making investing in more energy-efficient solutions harder. However, aging also brings wisdom and awareness of the potential of energy-saving opportunities. Policy measures should promote behavioral changes at the earliest age, starting with the formal educational system. However, awareness-raising campaigns should consider different factors that influence every stage of an adult's life and the potential for savings in these stages, considering the different needs of married couples, single individuals, and individuals of different ages. Awareness-raising campaigns should consider who the decision-maker is, i.e., if the decision is made by an individual or jointly. The existing literature notes that cross-cultural variations significantly influence consumer behavior, with some products being adopted regardless of cultural differences (Timokhina, Urkmez, and Wagner 2018).

If an individual does not have the capability, resources, and opportunities to perform a given behavior, it is not rational to expect changes in behavior. In that regard, decision-makers should identify and then remove or reduce obstacles that are found to influence perceived behavioral control. Promoting the reduction of the heating temperature in the largest canton in Bosnia and Herzegovina (Canton Sarajevo) without being able to experience the benefits of such behavior is rather a waste of public money. For example, the price for the consumption of the central heating system, used by 34% of households in Canton Sarajevo (as noted by Midžić Kurtagić, Arnaut, and Mahmutović 2019), is calculated solely based on the square meters, which does not account for energy-efficiency measure implemented in the building or how individuals behave.

5.3. Limitations

The paper has several shortcomings. As we used data already collected to draw some useful conclusions, our model did not include some useful psychological variables. This is a shortcoming that might be addressed by future papers. We also used proxy variables for PBC and subjective norms, which might limit the interpretation of our results.

Endnotes

1 Belgium, Bulgaria, Czech, Denmark, France, Germany, Greece, Hungary, Norway, Portugal, and Romania

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