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ENERGY LITERACY IN POLAND

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ABSTRACT: The aim of the study is to assess energy literacy in households in Poland. Energy literacy influences decisions related to electricity consumption. Low energy literacy contributes to the energy efficiency gap, and therefore it is important to examine its level, understand the determinants, and look for solutions that can increase literacy. Based on previous research, we designed the energy literacy questionnaire. Knowledge of energy prices, costs of using selected electrical appliances, beliefs about the impact of electricity consumption on the environment, and awareness of the consequences of climate change were taken into account. We analysed data from the computer-assisted web interviews conducted in December 2018. The quota sample of 1,000 respondents was representative of the Polish population with respect to location, education, age, and sex. Correlation analysis showed the relation between energy literacy and norms associated with the use of energy. To date, no such relationships have been analysed in Poland.

KEY WORDS: electricity consumption, energy efficiency, energy literacy, households

Introduction

World electric power production is mainly based on the use of fossil fuels (coal, crude oil, gas) whose combustion is one of the main causes of climate change (IEA, 2019). Mitigating climate change and reducing the use of fossil fuels are among the most pressing challenges facing humanity (IPCC, 2018). Climate change leading to ecosystem imbalances, along with growing energy needs, induces the search for new opportunities to improve energy efficiency.

The electric power market in Poland is changing dynamically – demand is rising, the share of renewable energy sources (RES) in the energy mix is increasing, more and more investments in micro-installations are appearing, and smart meters are planned to be introduced.

The development of the electricity market, technology, and renewable energy sources require the activation of a consumer side as part of modern intelligent power networks (ISE).

According to the "Polish energy policy until 2040" (Ministry of Energy, 2019), increasing the activity of end-users is of great importance. The document highlights:

- Broadening of information policy. The consumer should be able to compare offers available on the market, and the information attached to the invoice should be broader, however, presented in a clear manner.
- Equipping 80% of households with smart meters by 2028. They are a key element enabling both access to data and information as well as conscious energy consumption. Their installation is correlated with the construction of an intelligent network. It means enabling customers to take an active role in all markets, i.e. to generate energy electricity in their homes, selling this energy or sharing it within an energy community, providing DSR services (demand-side response), electricity storage. There are already on the market prosperous renewable energy prosumers who take active roles.

Improving energy efficiency indicators in the household sector is a huge challenge due to the number – over 13 million final recipients (Fortuński, 2016). Low energy literacy may be an obstacle to consumer activation. Therefore, it is crucial to study the energy literacy and its determinants.

Researchers assess energy literacy using questionnaires. They take into account knowledge of energy costs, the energy consumption of electrical appliances, understanding of the structure of energy bills, knowledge of possible ways to save energy, understanding of the energy-related concepts, knowledge of the functioning of the electric power system, and other aspects related to the consumption of electric power, such as awareness of the amount of own electricity consumption, understanding the relationship

between energy production and the state of the environment, habits associated with the use of energy. Energy literacy can be based on consumers' answers to knowledge questions – revealed literacy or self-reported measures – stated literacy.

According to European research, the level of energy literacy in households is low. For example, in the Netherlands, only 56% of consumers know their monthly electricity costs (Brounen et al., 2013), in another survey conducted among the consumers of Italy, Switzerland, and the Netherlands, only 27% of the consumers were able to determine the average price for electricity, 48% knew the total cost of using electrical appliances (Blasch et al., 2018). Some analyses for Poland indicate that customers do not know some of the services available on the energy market, they have problems understanding the concepts needed to make decisions, they do not know the electricity tariffs or the aspects on which the prices depend (for example Bator, Kukuła, 2016). The findings are bothering because energy literacy has an impact on consumption decisions (Craig and Allen, 2015).

The article aims to assess the energy literacy (including awareness of the effects of climate change) of households in Poland. The empirical part of the paper is the results of the questionnaire on energy literacy and knowledge about the effects of climate change carried out on a representative group of Polish residents. We designed a questionnaire based on research conducted abroad to determine the level of energy literacy of the Poles (Blasch et al., 2017; Blasch et al., 2019). The study takes into account knowledge of energy costs, beliefs about the positive effects of conscious electricity consumption, and also awareness of climate change. So far, no research has been conducted in Poland combining these aspects, testing knowledge and beliefs that make up energy literacy.

Higher consumer energy literacy and understanding of the relationship between energy consumption and climate change contribute to improving energy efficiency at the household level (Dwyer, 2011; Demeo et al., 2013; Blasch et al., 2017; Blasch et al., 2019). Projects to improve energy efficiency are part of the sustainable development policy, and it is worth conducting further research on the factors that contribute to its improvement.

Energy literacy

Energy literacy means knowing the costs of purchasing energy, knowing the energy consumption of appliances, and being aware of the impact of energy consumption on the environment. Energy literacy is considered as one of the main factors of sustainable electricity consumption (Lee et al.,

2019; Blasch et al., 2017). Raising consumer energy literacy may be key to ensuring sustainable development in the coming years, so it is important to evaluate it and identify factors that have a key impact on it. Until now, research has focused on knowing the costs of electricity and the energy consumption of electrical appliances. This paper also includes aspects related to beliefs and awareness of climate change. Previous analyses carried out in Poland did not combine price knowledge with consumer beliefs about electricity consumption. No tool has yet been developed to measure overall energy literacy.

Based on a literature review, van den Broek (2019) proposed a typology of energy literacy (van den Broek, 2019). The four main types of energy literacy are as follows:

- knowledge of energy consumption of appliances,
- ability to assess the impact of activities directed at energy saving at home,
- financial literacy which reflects the ability to make financially effective energy decisions,
- general (multi-faceted) energy literacy which includes all the aforementioned types and attitudes, values, and behaviours related to energy-saving (van den Broek, 2019).

The study applied a questionnaire for assessing energy literacy. In addition, awareness of the effects of climate change has been included in the indicator. Energy literacy is related to knowledge about the environment and attitude towards its protection. People who have the knowledge and are aware of environmental problems display responsible behaviour related to the environment and electricity consumption (Carmi et al., 2015; Echegaray and Hansstein, 2017; Pothitou et al., 2016; Pothitou et al., 2017).

Electric power is a unique good because of its impact on the economy and society. Electric power is a good purchased by everyone, needed for everyday functioning. Ensuring a stable electricity supply is a key factor for national security, and it is the basis for economic development. The consumption of electricity is not observed directly, which makes it difficult for end consumers to determine the quantity purchased. The production of electricity, in Poland mostly based on non-renewable resources, generates external effects, among others, it contributes to climate change as a result of CO_2 emissions. Lack of full control over consumption, ignorance of prices for energy supply services, and lack of knowledge about the external effects of production may lead to suboptimal decisions at the level of end customers (Lindén et al., 2006; Herrmann et al., 2018).

Consumer neoclassical theories use normative models of people's behaviour – decisions optimal for the decision-maker are sought, assuming that he can use available information and set precise goals based on the potential benefits of their implementation. The theory of rational choice, which under-

lies the mainstream microeconomics, assumes that people make decisions rationally and want to maximise their benefits, with a given expenditure of resources. This is tantamount to the principle of minimising the expenditure incurred to achieve the objectives. Rational behaviour can be understood as maximising the utility function – seeking a way to meet the largest number of needs at a given income. However, it should be remembered that decision-making processes are fraught with errors resulting from people's limited cognitive abilities, lack of access to information, or the costs of the decision-making process.

The consumption of electric power is an example of behaviour conditioned by many factors, and the assumption of rational choices is not always met, which shows the existence of an energy efficiency gap (Abrardi, 2019). Households are wasting some of their energy or not investing in energy-saving appliances, by the same – they are not using the potential for saving (Allcott and Taubinsky, 2015).

Households could achieve energy savings by investing in energy-saving appliances; however, through irrational choices, they incur higher electricity costs. Limited rationality in decision-making leads to suboptimal choices, thus contributing to the energy efficiency gap at the household level. The energy gap at the household level may result from a lack of knowledge of services related to the supply of electricity and basic concepts needed to make decisions about its consumption (Smyczek, 2014). Based on research in Switzerland (n = 5931), Blasch et al. (2017) conclude that increasing energy literacy leads to more optimal decisions related to the purchase of electrical appliances (Blasch, 2017). Also, the rationality of decisions related to the purchase of electricity may be determined by knowledge about the functioning of the electric power system and the external effects of electricity production. Knowledge about the impact of consumption on the environment and climate change is of particular importance. Understanding these relationships and knowledge of energy prices make up energy literacy. Greater energy literacy could help households make more optimal and, therefore, rational decisions.

In 2013, DeWaters and Powers developed criteria for measuring energy literacy among high school students. Their proposal deserves attention because it comprehensively describes the components of energy literacy. The authors included three dimensions of energy literacy:

- cognitive (knowledge, cognitive skills),
- affective (attitude, values, personal responsibility),
- behavioural (behaviour).

Behavioural and affective criteria (e.g. awareness of current energy-related events) were described in a general way, which allows the tool to be

adapted to the context. Cognitive criteria refer to skills and knowledge (e.g. knowledge of basic concepts, energy definition, energy units). As research shows, computing capabilities are a strong indicator of rational decisions related to the implementation of energy-saving technologies (Filippini et al., 2020).

Some economists question the impact of energy-saving on the total volume of demand, claiming that progress in energy use resulting in savings ultimately leads to increased energy consumption. They refer to the Jevons paradox: more efficient use of one resource – contrary to what would be expected – only leads to increased demand for this resource. Along with the increase in efficiency, further economic expansion occurs. The paradox, to which Jevons drew attention, was widely confirmed in economic terms, including in the form of Say's law, which states that supply creates its own demand. That is why, despite the growing energy efficiency and the increased share of renewable energy, the countries of the old European Union consume much more energy than, for example, new members, and energy consumption in most of these countries increased in 1991-2008. Increasing energy efficiency may result in increased demand, as some consumers will decide to spend the saved money on purchasing additional energy. However, some consumers are driven by non-financial motivation.

According to research results, the level of knowledge about energy is low in households, despite the positive attitude of people to energy-saving (van den Broek, 2019). For example, in the Netherlands, 56% (n = 1721) of the respondents were able to determine their monthly energy expenditure (Brounen et al., 2013). The energy literacy of the Dutch significantly depended on their attitude towards the environment and towards energy-saving. Socio-demographic variables were less important in explaining energy expenditure awareness (age impact was demonstrated as significant). As for the rationality of consumption decisions – according to the results, environmental attitudes did not have a significant influence; however, the impact of education was demonstrated.

An example of a method of raising energy literacy is the initiative CLEAN – The Climate Literacy and Energy Awareness Network – started in the United States. It provides communication of a wide community of experts, which makes it a valuable source of knowledge about the climate and the use of energy (Ledley et al., 2014). Increasing energy literacy is a constant element of the U.S. policy, and it is particularly reflected in youth education programmes (NOAA, U.S. Department of Energy, 2017). Attention is paid to the role of energy education for conscious consumption, and thus the improvement of energy security while maintaining sustainable development.

Households in Poland consume as much as about 30% of all energy used in all sectors of the national economy. Therefore, the issue of saving potential in the household sector should be more supported as one of the E.U. priorities in energy policy. The use of energy-saving devices and the increase in the use of renewable energy resources had the greatest impact on the energy efficiency index of households in recent years.

Based on recent studies, one can observe a growing energy literacy among the Poles, but there is still an efficiency gap, that is unused potential. The results from 2011 (Sidorczuk-Pietraszko, Zawistowska, 2011) suggest that the Poles know various methods of saving – from the simplest and cheapest to the more expensive ones, although they primarily implement the former one. When asked about ways to save energy, the respondents mainly indicated the following ones: extinguishing lighting, replacing light bulbs with energy-saving ones and thermo-modernization of buildings. According to the results, more expensive solutions in a longer time perspective and related investments are still less frequently chosen (Sidorczuk-Pietraszko, Zawistowska, 2011). A report from 2013 indicates that the Poles relatively rarely invested in energy-saving appliances (RWE Polska, 2013). Every tenth Pole possessed it at home. More than half of the respondents (54%) said they knew how to save electricity, while 18% declared that they did not have such knowledge and 30% never wondered if they could reduce electricity consumption. The results suggest that the Poles were moderately interested in electricity.

Similar results were obtained in 2015 in a study conducted by the ClientEarth Foundation (Bator, Kukuła, 2016). In addition, it was shown that the Poles are not aware of their rights (less than 40% declared knowledge of the rights of energy consumers). The authors pointed out that the charging system in force in Poland based on an electricity consumption forecast increases the ambiguities regarding the price of energy. The bill structure is complex and varies depending on the energy supplier. Most respondents (90%) declared that they were trying to save electricity. Financial reasons were mentioned more often than the improvement of the state of the environment (IPSOS, 2015). Most respondents (74%) were not ready to pay more for energy consumption, even if it came from environmentally-friendly renewable energy sources. The Poles try to reduce consumption mainly by switching off appliances that are not in use and by using energy-saving light bulbs (IPSOS, 2015).

In Poland, energy consumption per flat was decreasing in 2008-2017 at a rate of 1% per year – from 1.61 to 1.46 toe/flat (Central Statistical Office, 2019b). The lowest consumption in this period was recorded in 2017. However, this does not apply to electricity, which consumption per capita is stead-

ily increasing. In recent years, the highest dynamics of the increase in electricity consumption are shown by households that manage around 20% of annual electricity production (Kott, 2015; Central Statistical Office, 2019c). According to the research carried out to date, the Poles are characterised by a lack of awareness of the problem of wasting electricity and the associated consequences (Bator, Kukuła, 2016). This means that they do not invest in high energy efficiency appliances. In addition, consumers are often not aware of how much electricity they consume, and they do not control the meter usage. According to one recent study, the consumers in Poland are characterised by low awareness about their energy consumption; they lack knowledge and commitment to energy-saving (Kowalska-Pyzalska, Byrka, 2019). The number of households in Poland in 2018 was 14.4 million (Central Statistical Office, 2019a). One-person and two-person households were the largest groups (23.3% and 25.9%), the average number of persons belonging to a household was 2.6. Over the past several years, the area and volume of flats have been systematically increasing, while the average number of persons in a household has been falling. The observed changes in lifestyle contribute to a systematic increase in demand for electricity in the household sector (Maj, 2015). Satisfying domestic demand at peak times often requires the mobilisation of power reserves and contributes to an increase in wholesale energy prices. Households have the potential to save energy, however low energy literacy contributes to not using it. According to recent research, ecological literacy is growing in Poland (Głowacki, 2018). There is an increased concern about the state of the environment in society, both on a local and global scale. In a 2018 survey, 29% of the respondents said that they perceived climate change as one of the biggest threats to modern civilisation (Głowacki, 2018). Only 3% of the respondents said that climate change is not dangerous at all, and 1% that such a phenomenon does not exist.

Awareness of the relationship between climate change and electricity consumption could encourage households to save energy. Research shows that increasing energy literacy can improve the effectiveness of programmes that motivate people to change their habits of using electricity (Mogles, 2018). This is particularly important in the development of electricity demand management programmes. Managing electricity demand increases the efficiency of the power system, thereby reducing production costs transferred to energy consumers (Bayer and Rączka, 2017).

Energy literacy study of households in Poland

Sample and data collection method

The study was part of a scientific project dedicated to managing electricity demand. It was implemented in 2019 by the CAWI method by a professional public opinion research centre. The quota sample consisted of 1,000 respondents and was representative of the Polish population with respect to location, education, age, and sex (table 1). In order to examine energy literacy in households in Poland, a questionnaire was constructed for analysis. Questions about energy literacy were displayed to the respondents after they completed the experimental part related to the selection of a contract for the purchase of electricity. The study also assessed social and personal norms related to the use of electricity (single-choice questions, answers on the Likert scale).

Table 1. Characteristics of the sample

	Share [%]	Mean	Std. Dev.	Min	Max
Women	53.16				
Age [years]		46.5	15.43	18	80
Stated net monthly income [PLN]		3,791.25	1,542.6	500	10,500
Net monthly household income [PLN]		5,765.14	1,981.17	500	10,500
Education:					
Primary and secondary	5.15				
Upper secondary education	58.46				
Higher	36.39				
Place of residence					
Village	40.61				
Town up to 500,000 inhabitants	48.53				
Town above 500,000	10.86				

Source: author's work.

Energy literacy questionnaire

Knowledge of energy costs (the main component of energy literacy) was measured based on a tool proposed by Blasch et al. (2018). The questions were adapted to the Polish conditions. Three aspects of knowledge about electricity were examined: price per kWh, cost of using a washing machine and a vacuum cleaner, potential energy savings associated with replacing conventional light bulbs with energy-saving ones. According to the data from

2018, 95% of the households are equipped with a washing machine, and 94% have a vacuum cleaner (Piskiewicz, Radziukiewicz 2018; Central Statistical Office 2019). Questions about beliefs concerning climate change and its effects have been developed based on similar studies (Ibtissem, 2010). Table 2 presents the questions being the basis for calculating the indicators.

Table 2. Measurement of Poles' energy literacy – tool structure.

Variable	Questions	Points
Knowledge of energy costs (single selection, 5 options)	1. What is the average price in Poland for the consumption of one kilowatt-hour (1 kWh), including tax? 2. What is the cost of electricity associated with using a standard vacuum cleaner (1500W power) for 30 min.? 3. What is the cost of electricity associated with using an A-class washing machine for one hour (standard washing, 90 min., 60 degrees, 4 kg load)? 4. What energy consumption can be saved by replacing a standard halogen bulb (100W) with an energy-saving LED bulb?	0-2 (0 points for an incorrect answer, 1 point for a minor error, 2 points for the correct answer)
Beliefs about the positive aspects of conscious electricity consumption	1. Better electricity management is the best way to combat global warming. 2. Saving energy helps to reduce the rate of global warming. 3. The quality of the environment will improve if we use less energy. 4. Saving electricity in households will bring a lot of benefits to Poland. 5. Saving electricity in households will bring a lot of benefits for my family and me.	1-7 (from strongly disagree to strongly agree)
Awareness of the effects of climate change	Global climate change 1. ... will cause extreme weather fluctuations and other natural disasters in Poland (e.g. floods or droughts). 2. ... will cause a rise in winter temperatures in Poland, thanks to which I can save on heating. 3. ... will contribute to saving millions of Polish zlotys spent on healthcare in Poland, by reducing the occurrence of diseases associated with low temperature and lowering the mortality rate due to body cooling. 4. ... will pose a serious problem for various animal and plant species and their natural environment. 5. ... will have a positive impact on food production in Poland (new plant species can be grown, the growing season will be longer). 6. ... will have a negative impact on my health and well-being. 7. ... will have a negative impact on the health and quality of life of people in my region. 8. ... will create new business opportunities. 9. ... will generally be a very serious problem for my family and me. 10. ... will generally be a very serious problem for entire Poland.	1-7 (from strongly disagree to strongly agree)

Source: author's work.

As regards the scale of beliefs and awareness about climate change, the answers: "I don't know"/"It's hard to say" were treated as the middle of the scale. Answers to the questions about climate change have been scaled so that a higher score means higher literacy. The higher the score on the scales of knowledge of energy costs and awareness of the effects of climate change on the scale of beliefs about the positive aspects of conscious electricity consumption, the higher the level of energy literacy.

The sample consisted of 1,000 respondents representative of the Polish population in terms of sex, education, age, place of residence (the structure of the sample is summarised in table 3).

Table 3. Structure of the sample

		Frequency [%]
Sex	Female	54
Subjective income: with your current income you are doing well ...	With great difficulty	3.5
	With difficulty	12.6
	With some difficulty	45.2
	Rather easily	33.3
	Easily	5.4
Net income	< 2,000	6.8
	2,001 – 3,000	22.9
	3,001 – 4,000	32.2
	4,001 – 5,000	17.2
	5,001 – 6,000	7.2
	> 6000	8.6
Education	Primary/lower secondary	2.9
	Vocational/incomplete secondary	24.5
	Secondary	55.7
	Higher	26.9

		Frequency [%]
Professional situation	Full-time job	55.9
	Part-time job	7.8
	Pensioner	18.4
	Student	3.3
	Work at home	5.4
	Own business	3.7
	Unemployed	5.5
Size of locality	< 20,000	11.8
	20,000 – 100,000	19.7
	100,000 – 500,000	17.2
	> 500,000	12
Type of building	Flat	46.1
	Terraced house	11.4
	Detached house	42.5
Type of heating	Electricity	2.2
	Central heating	49.7
	Coal	29.8
Responsibility for household bills	Bill payer	94.9
Electric power usage	Greater than the average for the given district	36.1
	Average	737 kWh (SD=692)
	min.	16.5
	max.	9210

N = 1,000
The average age in the sample is 46 years (SD = 15.3).
Source: author's work.

Results

The results of the study conducted in 2019 show the level of energy literacy in Poland, including three aspects: energy costs, beliefs about positive aspects of energy saving, awareness of the effects of climate change (table 4).

Table 4. The level of energy literacy of the Poles measured by a questionnaire

	Mean	St. dev	min	max
Knowledge of energy costs indicator	3	2	0	8
Beliefs about the positive aspects of conscious electricity consumption	27.3	6	5	35
Awareness of the effects of climate change	47.5	8.4	17	70

N = 1,000

Source: author's work.

The lowest results were obtained on the scale of knowledge of energy costs. Only 1.1% of the respondents obtained the maximum score of 8 points. Figure 1 illustrates the distribution of results on the scale of knowledge of energy costs in the studied sample. The results suggest that the respondents had low knowledge about the price of energy and the costs of using electricity-drawing appliances.

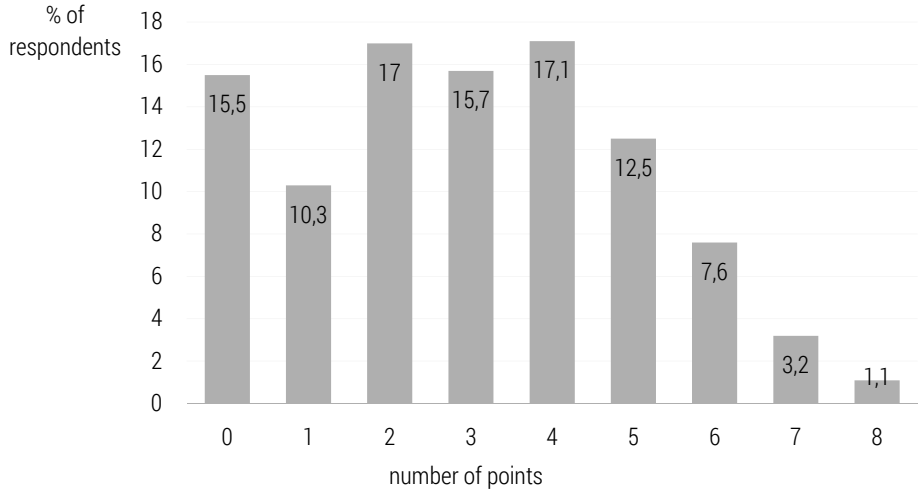

Figure 1. Knowledge of energy costs indicator – distribution of results

Source: author's work.

Relatively high results were observed on the scale of beliefs about positive aspects of conscious electricity consumption; 12.5% of the respondents obtained the maximum possible result (figure 2). The respondents recognised positive issues related to energy saving.

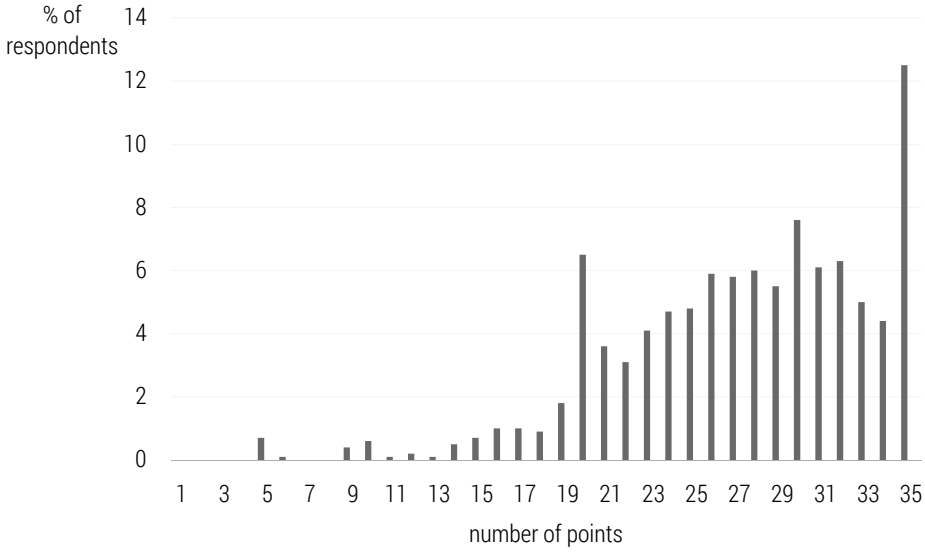

Figure 2. Beliefs about the positive aspects of conscious electricity consumption – distribution of results

Source: author's work.

Among questions testing beliefs about the consumption of electricity, two were directly related to climate change:

- Better electricity management is the best way to combat global warming.
- Saving energy helps to reduce the rate of global warming.

Most of the respondents agreed with these statements (71%, 72.8%, respectively). 30.1% of the respondents strongly agree that better electricity management is the best way to combat global warming, and 33.8% of the respondents strongly agree that saving energy helps to reduce the rate of global warming.

Most respondents declare that they are aware of the effects of climate change, as evidenced by the results on the third scale (figure 3). The respondents moderately agreed with climate change statements. Only as regards the results on this scale, the distribution of the responses is consistent with the normal one ($\chi^2 = 3.67$; $p > 0.1$).

T-student statistics was used to show differences in energy literacy based on gender. Men obtained statistically higher results on the scale of knowledge of energy costs t = -7 2722; $p < 0.001$). Women obtained statistically higher results on the scale of beliefs about positive aspects of conscious electricity consumption (t = 2.7714; $p < 0.001$). Women scored significantly higher on the climate change awareness scale (t = 11.7694; $p < 0.001$).

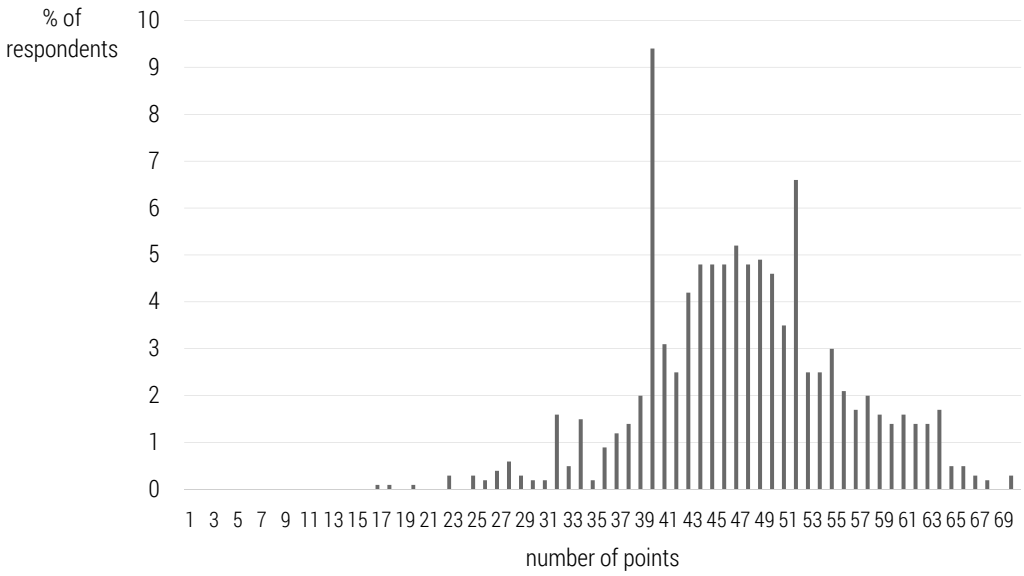

Figure 3. Climate change impact awareness indicator – distribution of results

Source: author's work.

The correlation analysis did not show any correlation between the results on the energy literacy scales and socio-demographic variables such as age, education, occupational situation, income, town size, province (table 4). Similarly, there was no relationship between the results on the energy literacy scales and the annual electricity consumption (table 5).

Table 5. Correlation coefficients for the energy literacy indicators and socioeconomic variables

	annual electricity consumption	age	number of persons in the household	Income[1]	size of locality[1]	education[1]
Knowledge of energy costs indicator	0.03	0.07**	0	-0.02	0.03	0
Beliefs about the positive aspects of conscious electricity consumption	0.04	0.2***	0.08**	0.08**	0.04	0.09**
Climate change impact awareness indicator	0.07**	0.13***	0.09**	0.03	0.02	0.07**

[1] – due to the nature of the variables, the r-Spearman's correlation coefficient was calculated

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$

Source: author's work.

We examined the relationship between energy literacy indicators and the norms (table 6).

Table 6. Correlation coefficients for the energy literacy indicators and norm indicators

	Descriptive norms indicator[1]	Injunctive norms indicator[2]	Personal norms indicator[3]
Knowledge of energy costs indicator	0.02	0.06*	0.03
Beliefs about the positive aspects of conscious electricity consumption	0.38***	0.78***	0.64***
Climate change impact awareness indicator	0.06**	0.48***	0.30***

* p < 0.1, ** p < 0.05, *** p < 0.001

1 – In this study, this was consistent with the statements: People control their electricity consumption; People save electricity as much as possible; People care about the state of the environment; People are interested in the issue of energy security in Poland.

2 – In this study, this was consistent with the statements: People should control their electricity consumption; People should save electricity if possible; People should care for the state of the environment; People should be interested in the issue of energy security in Poland.

3 – In this study, this was consistent with the statements: I feel obliged to save electricity no matter what other people do; I feel guilty when I waste electricity; I'm worried about saving electricity only if it can lower my electricity bill

Source: author's work.

A strong positive relationship between the positive aspects of conscious electricity consumption indicator and the results on the injunctive norms scale was demonstrated, and a moderate positive relationship between the positive aspects of conscious electricity consumption indicator and the results on the personal norms scale. We found a moderate positive correlation between climate change impact awareness indicator and injunctive social norms. Injunctive norms refer to beliefs about how people should use electricity. People with higher energy literacy recognise conscious consumption and care for the environment as a duty. People with higher energy literacy had a stronger sense of personal responsibility for controlling electricity consumption (personal norms). A correlation with the descriptive norms indicator suggests a weak positive relationship. Observation of other people's behaviour associated with the use of energy has a weak relationship with energy literacy.

Discussion of results

According to the results, annual electricity consumption is not related to energy literacy. Polish studies show that saving electricity is mainly financially motivated (Urbaniec, 2017). People with higher energy literacy may make more optimal consumption decisions, but this does not necessarily lead to savings. Probably, households that care about low energy costs will save regardless of the prices they perceive. The level of consumption does not show how households use energy and whether there is potential to increase energy efficiency. Behavioural economists point to the limitations of the human mind and question the assumption of rationality in making decisions (Simon, 1955). Perhaps consumers with greater energy literacy are unable or unwilling to use their knowledge, e.g. because of cognitive costs, the time that must be spent on optimising decisions.

Socio-economic variables, such as income, education, are unrelated to energy literacy. The problem of billing illiteracy and the energy efficiency gap can occur in all types of households. However, differences in the energy literacy of women and men were observed. Men are better informed about energy prices, while women are more aware of the positive effects of conscious consumption and the effects of climate change. Energy literacy is related to social and personal norms. The belief that consumers should consciously use electricity is stronger in people who have higher energy literacy. This relationship can be explained by the theory of cognitive dissonance (Festinger, 1957). According to the theory, people adapt their views to behaviour in order to be consistent. People who are unaware of energy prices are not convinced of the positive effects of conscious consumption and the negative effects of climate change (to which emissions in the electricity production process also contribute), maintain that society is not responsible for sustainable consumption and energy security. Thus, these people eliminate the tension that could arise as a result of the divergence of their beliefs and behaviour. It is probably more difficult for people with lower energy literacy to admit that energy should be saved wherever possible. In this light, it is easier to understand the weak relationship of energy literacy with descriptive norms. The belief about how other people behave has no clear connection with energy literacy.

Conclusions

Improving energy efficiency in households in Poland responds to the growing demand for energy. The energy transformation in Poland may lead to the increased involvement of end consumers, improvement of energy effi-

ciency, and thus a fairer power system that responds to the needs of society and environmental requirements (Bator, Kukuła, 2016). Energy security means the condition of the economy which enables full coverage of the customer's ongoing and prospective demand for fuels and energy in a technically and economically justified manner, with the observance of the environment protection requirements (Act on the Energy Law, Article 3 par. 16). End users can contribute to improving energy security as part of demand-side management. An essential element of managing electricity demand is increasing energy literacy in households by influencing real consumer choices. The conscious use of electricity is a factor for sustainable development, which is why it is important to identify the factors that favour it.

According to research, among the factors that affect the consumption of electricity in households in Poland, the financial ones are the most important (Urbaniec, 2017). Expenditure on energy in households in Poland over the last 20 years accounted for around 10-12% of total expenditure for using a flat (Central Statistical Office, 2019c). At the same time, according to recent studies, most people in Poland do not control consumption or plan to purchase electricity (Kowalska-Pyzalska and Byrka, 2019). This behaviour is not consistent with the theory of rational choice, according to which people make decisions based on available information, guided by the principle of optimisation. Lack of energy literacy can be one of the reasons for irrational consumption decisions and the existence of an energy efficiency gap.

In this study, relatively low energy literacy (measured by knowledge of energy prices, environmental effects of consumption, and knowledge about climate change) was observed in Polish households. The Poles do not know well the prices for electricity consumption, nor do they have a good orientation as to the costs of using energy-consuming appliances. On the other hand, it has been shown that they are convinced of the positive effects of conscious consumption and are aware of the dangers of climate change. Most respondents (72.8%) noticed the relationship between electricity consumption and climate change. Given the awareness of the dangers of climate change, it can be expected that such beliefs motivate to save energy.

This study demonstrates the relationship between energy literacy and social and personal norms related to energy consumption. People who think that conscious electricity consumption has positive effects believe that it is a duty to use electricity in a sustainable way (injunctive social norms). They feel responsible for electricity saving (personal norms). It would be interesting to determine how energy literacy and three types of norms interact with each other. This study could be a starting point for further research.

Poor knowledge of the energy consumption of electrical devices can be a barrier to the efficient use of electricity. Increasing knowledge of energy

prices and energy consumption of appliances in households in Poland could lead to more rational decisions regarding consumption and, as a consequence, improvement of energy efficiency. Increasing energy literacy can reinforce the impact of social and personal norms conducive to sustainable electricity consumption.

Acknowledgements

This research was funded by Narodowe Centrum Nauki (National Science Centre), as a part of the project: "Consumers' preferences for Demand-Side Management in Poland", grant number 2017/25/N/HS4/01458. Funding support is gratefully acknowledged.

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