ANNALS OF THE POLISH ASSOCIATION
OF AGRICULTURAL AND AGRIBUSINESS ECONOMISTS

received: 03.01.2020
acceptance: 12.05.2020
published: 25.06.2020

Annals PAAAE • 2020 • Vol. XXII • No. (2)

JEL codes: D10, D15, O13

DOI: 10.5604/01.3001.0014.1385

AGNIESZKA SIEDLECKA

Pope John Paul II Higher State School in Biała Podlaska, Poland

PRO-ENVIRONMENTAL ACTIVITIES OF RURAL HOUSEHOLDS IN THE SCOPE OF REDUCING ELECTRICITY CONSUMPTION

Key words: household, environmental behaviour, use of resources, environment, electricity

ABSTRACT. The aim of the article is to provide examples of activities undertaken by rural households in the pursuit of reducing electricity use. Households are one of the economic entities of the economic system that significantly use electricity to meet the needs of their members. Expenses incurred for the purchase of energy constitute one of the significant elements in the structure of total expenses. Households, by limiting the consumption of electricity, firstly, reduce expenses, and secondly, undertake pro-environmental activities. The article uses the results of surveys carried out in a group of 404 households located in rural areas of Poland. In addition, the analysis of primary data was expanded to include data from the Household Budget Survey carried out by the Central Statistical Office. The conducted research has shown that the most common activities aimed at reducing energy consumption were turning off the light in unused rooms as well as the use of energy-saving light bulbs and home appliances. Activities were mainly influenced by the level of ecological awareness, level of education and age.

INTRODUCTION

Households are responsible for a large proportion of total energy demand and CO_2 emissions [Mendez, Pena 2012]. However, the energy demand of households alone is a derivative of the demand for energy services such as lighting, water heating, cooking, space heating and air conditioning [Trotta 2018]. The global consumption of electricity is characterized by an upward trend. Reducing its consumption in households can be achieved, among others, by improving the insulation of houses, the dissemination of efficient devices and lighting, or striving to increase public awareness in this area [Iwafune et al. 2017].

Households consuming electricity contribute to the consumption of components of the environment known as environmental resources, natural resources or natural wealth in the process of consumption and production. Striving to improve the state of the environment is the leading aim of both the concept of sustainable development, as well as other policy areas implemented as a part of economic policy (e.g. environmental policy) implemented in individual countries. The entity that should play an important role in this process, due to its essence, is the household. The activities of households to reduce the consumption of resources can be implemented by undertaking pro-environmental measures, in other

words, all types of activities carried out and undertaken by households aimed at reducing the use of resources (e.g. water and energy). These measures also include activities and investments aimed at reducing the negative impact of a household on the environment (e.g. the replacement of a coal furnace with a gas furnace).

The subject of analyses in the article are household activities undertaken in the scope of pro-environmental measures related to limiting the use of electricity. The study attempts to determine the impact of demographic and socio-economic factors on household decisions in the context of pro-environmental measures.

RESEARCH MATERIAL AND METHODS

The aim is to provide examples of activities undertaken by rural households in the pursuit of reducing the use of resources of the natural environment by reducing the consumption of electricity in households. To achieve the main aim, empirical research using the CAWI (Computer Assisted Web Interviews) method was carried out. The research was carried out by an external company in the period June – July 2018 in Poland.

According to data from the National Census of Housing and People from 2011, rural areas were inhabited by 356.2 thousand households [CSO 2014]. The minimum sample size for such a population is 390 entities. The research was carried out on a randomly selected group of households located in rural areas. The research covered 404 households. The selection of the sample for research assumed that the minimum number of entities surveyed in each of the 16 voivodships was 20 households. Detailed information about their number in individual voivodships is presented in Table 1.

The empirical study used the diagnostic survey method using a questionnaire addressed to the head of the household. During the implementation of the study, it was mandatory to check whether the questionnaire was completed by the household manager (household head).

Table 1. Number of households participating in the surveys in individual voivodships

Voivodship	Number of households in a voivodship
Małopolskie	34
Śląskie	32
Wielkopolskie	25
Zachodniopomorskie	22
Lubuskie	21
Dolnośląskie	23
Opolskie	22
Kujawsko-pomorskie	23
Warmińsko-mazurskie	23
Pomorskie	23
Łódzkie	22
Świętokrzyskie	23
Lubelskie	24
Podkarpackie	30
Podlaskie	22
Mazowieckie	35

Source: own study based on research results

RESEARCH RESULTS

The socio-demographic characteristics of the household managers surveyed were: gender, age and level of education. The respondents were slightly dominated by women, who constituted 57.4% of respondents. The average age of household managers was 38.1, with a standard deviation of 11.9. The median, on the other hand, was 36 years, which means that half of the respondents were under 36 and half were aged 36+.

Analysing the surveyed group, taking into account the level of education, it should be noted that people with post-secondary, secondary vocational and general education dominated – 39.6%. Household managers with a higher education constituted 31.4% of respondents, while those with a basic vocational education made up 23.6%. The least numerous group were people with a middle school education, primary education and no education – 5.4%.

One of the important factors affecting the use of electricity is the number of people in the household. Three- and four-person households dominated among the surveyed ones (28.0 and 29.5%, respectively). When further characterizing households, it should be noted that the average number of people in the surveyed entities was 3.67 (standard deviation 1.29), while the average number of children under 18 was 0.94 (standard deviation 1.00) . The surveyed households were dominated by entities whose main source of income was employment (55.9%) and income from agricultural activity (14.9%) or business activity (12.1%).

Households bear a variety of expenses related to their functioning. Surveys carried out by the Central Statistical Office as a part of "Household Budget Surveys" distinguish, among others, the following categories: expenditure on food and non-alcoholic beverages, alcoholic beverages, tobacco and drugs, clothing and footwear, home furnishings and

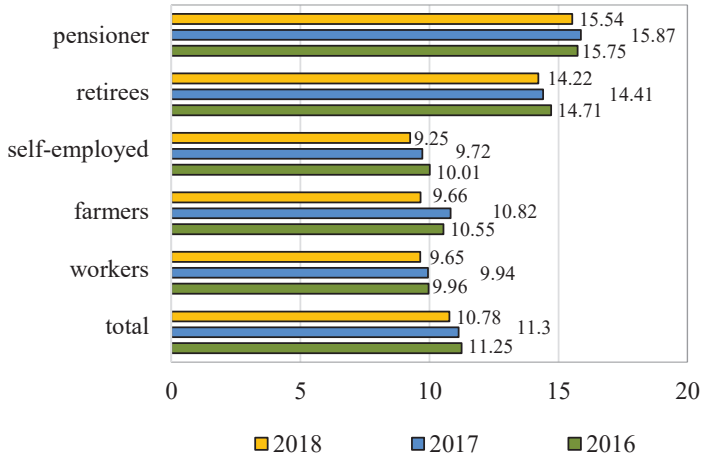

Figure 1. The share of expenditure on energy carriers per person in households in total expenditure on consumer goods and services in 2016-2018 by socio-economic groups

Source: own study based on data from „Household Budget Surveys" for 2016-2018

household running, the use of flats or houses and energy carriers. The category of energy carriers is one of the most significant in the group of expenses incurred. Figure 1. The share of expenditure on energy carriers per person in households in total expenditure on consumer goods and services in 2016-2018 by socio-economic groups.

An analysis of data from "Household Budget Surveys" conducted by the Central Statistical Office of Poland in 2016-2018 indicates that the average expenditure on energy carriers per person in a household was within 10-11% of total average expenditure. Over the analysed years, there was a slight decrease in the share of expenditure on energy carriers in total consumer goods and services, from 11.25% in 2016 to 10.78% in 2018.

However, by making a comparative analysis between individual groups of households by socio-economic categories, it should be noted that the share of expenditure on energy carriers in general average expenditure on consumer goods and services per person in households in individual groups of households is shaped in a differentiated way. Definitely, the largest share of these expenses is in the households of pensioners and retirees. In the period analysed, they constitute about 15% (Figure 1). In the case of retiree households this figure was slightly lower – around one percentage point. It is worth noting that, in most categories of households in 2016-2018, there was a decrease in the share of expenditure on energy carriers per person in a household in the expenditure on consumer goods and services per person in a household. Both due to the scale of expenditure incurred by households on energy and the importance of its consumption in the process of environmental pollution, households may strive to reduce energy use. To this end, they can undertake a number of activities related to running a household.

In order to determine the frequency of undertaking pro-environmental activities aimed at reducing electricity consumption, respondents evaluated the frequency of implemented activities using the Likert scale, which allowed to assess frequency from 1 to 6, where 1 meant that the activity was never undertaken, and 6 – that it was very often implemented (Figure 2).

The activities most commonly undertaken in the surveyed households to reduce energy consumption were turning off lighting in rooms that are not used (average frequency 5.26; standard deviation 1.00) and using energy-saving lighting (average frequency 5.21; standard deviation 1.05). Research results presented by Courtney N. Smith show that replacing lighting with a more energy-saving one significantly improves the energy efficiency of households. This activity is beneficial for two reasons. First, it gives financial savings for households, and secondly, it is associated with a reduction in greenhouse gas emissions, e.g. CO_2 and SO_2. The conducted analyses indicated that replacing light bulbs with LEDs is profitable in all households in the USA [Smith 2016]. It can be assumed that the positive effects of such actions apply not only to the USA, but to all countries in which they were implemented.

The most popular and, at the same time, most effective strategy for saving energy and informing consumers about the impact of the product they want to buy on the environment are energy efficiency standards and eco-labels of household appliances and electrical appliances [Vasiljevic-Shikaleska at al. 2018]. Therefore, from the perspective of households, an extremely important aspect in the context of reducing energy consumption is care for the purchase of home electronics and household appliances, which is energy-

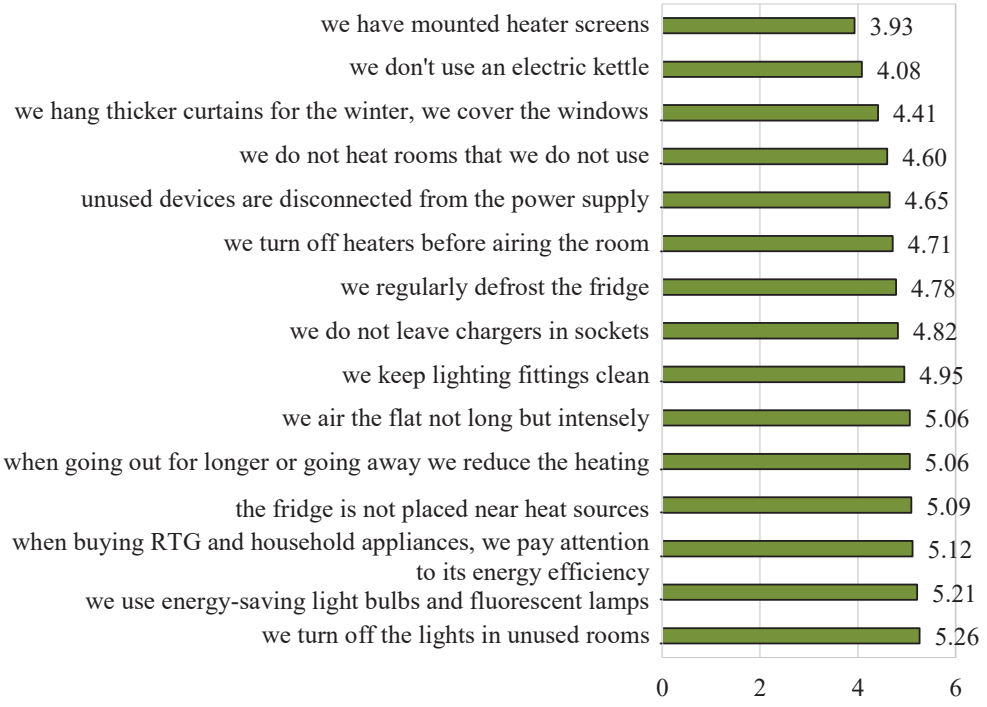

Figure 2. An average rating of the frequency of undertaking energy-related activities in the surveyed households (a rating on a scale of 1 to 6, where 1 meant that the activity was never undertaken, and 6 – that it was very often implemented)

Source: own study based on research results

saving. Analyses carried out by Jan Rosenow and others on households in Great Britain have shown that innovative technologies as well as the improvement of energy efficiency as a result of using energy-saving infrastructure have an impact on reducing electricity consumption [Rosenow at al. 2018]. The research carried out on households operating in rural areas in Poland has shown that one of the frequent undertaken activities aimed at reducing energy consumption is paying special attention to signs indicating an item's energy efficiency when purchasing it. The average frequency rating of this activity was 5.12, with a standard deviation of 1.09.

Another important activity in the field of reducing energy consumption is taking care of restrictions related to heating flats and houses. One of the leading activities is the use of thermal insulation in new buildings as well as residential buildings that were built earlier. This form of pro-environmental measures is associated with incurring significant financial outlays and definitely requires greater involvement. Activities on a much smaller scale include reducing the heating of unused or less used rooms, or the effective ventilation of flats and houses. Activities of this type occurred in the surveyed households, however their scale varied. The installation of heater screens was indicated as the least frequent activity. Screens are a cheap and effective form of thermal insulation limiting the use of energy.

Ismael Al-Hinti and H. Al-Sallami have pointed to the existence of two categories of gaps that are associated with the problem of implementing thermal insulation: the income and educational gap [Al-Hinti, Al-Sallami 2017]. While the income gap can be bridged by introducing favourable low-interest loans, co-financing by the state or local government institutions, when it comes to the educational gap two issues require addressing. First of all, it can be associated with the level of education of household managers as well as the level of ecological awareness. The obtained research results indicate that the higher the level of ecological awareness, the higher the frequency of pro-environmental activities undertaken aimed at economical energy management[1]. In the case of this factor, what is meant is the occurrence of statistically significant differences between the level of ecological awareness and the frequency of almost all analysed activities to save energy in the surveyed households ($p < 0.005$)[2]. Referring to the relationship between the level of education and frequency of pro-environmental activities undertaken to save energy, what is meant is the occurrence of statistically significant differences in the following cases: not placing the fridge near heat sources ($p = 0.013$, $K = 10.827$)[3], the purchase of energy-saving home electronics and household appliances ($p = 0.011$, $K = 11.179$) and the use of energy-saving fluorescent lamps and bulbs ($p = 0.002$, $K = 14.688$). In all three cases, the tendency became apparent that the higher the level of education of the household head, the more frequent the use of these energy saving methods.

Another issue worth discussing is the occurrence of statistically significant relationships between the age of the household manager and the frequency of activities to reduce energy consumption. In ten out of the fifteen activities analysed, this kind of relationship is observed ($p < 0.005$)[4]. Gianluca Trotta has come to similar conclusions in her article indicating that household managers in older age categories are definitely more interested in solutions that reduce energy consumption than younger people (25-34 years old) [Trotta 2018]. The results of the research show that household managers aged 45+ are more likely to undertake activities to reduce energy consumption. This is a kind of hint that can be included in the creation of educational programmes are targeting at specific groups of recipients.

The demographic feature differentiating surveyed household managers was gender. In this case, there were statistically significant differences between gender and the frequency of activities to reduce energy consumption, such as: turning off the light in unused rooms ($p = 0.008$, $U = 17{,}211.00$)[5] and the installation of heater screens ($p = 0.019$, $U = 17{,}273.50$). In women-led households, the possibility of turning off the light in unused rooms was much more often used. On the other hand, the second activity was more often implemented in male-led households. This may be due to, among others, the fact that men are more often responsible for building a house as well as subsequent renovations and repairs.

---

1 Environmental awareness was identified as the household manager's desire to expand his/her knowledge on the environment. It was determined using a scale from 1 to 5, where 1 meant a definite lack of interest, and 5 – a definite interest

2 Excluding the installation of heating screens and not placing the fridge near heat sources.

3 K-test H – Kruskala-Wallis.

4 Excluding: hanging thicker curtains for winter, not using an electric kettle, not heating unused rooms, installing heater screens, ventilating the flat with the heating off.

5 Test U Mann-Whitney's.

With regard to the following variable describing the household, which is the level of income, a statistically significant difference is only observed between the variable and the frequency of not using the stand-by option ($p = 0.001$, $K = 10.951$). It also seems important that there can be no significant statistical difference between the frequency of taking individual activities to save energy and the size of the household characterized by the number of people creating them. Jia Jun-Jun has pointed out similar observations in his study [Jun-Jun et al. 2018].

SUMMARY AND CONCLUSIONS

Obtained research results indicate that energy expenditure incurred by households is an important category charged to their budgets. Undertaking activities to reduce them has two dimensions. Firstly, it is an important element for household budgets, and secondly, it aims at reducing the use of environmental resources as well as reducing gas emissions to the environment.

Among the most common activities undertaken by households, the reduction of electricity consumption in unused rooms at a given time should be indicated. The average frequency of this activity was at 5.26 with a six-grade rating scale. Another pro-environmental measure often undertaken by households was the use of energy-saving lighting in the form of fluorescent lamps and incandescent lamps. It was equally important to pay attention to whether the purchased home electronics and household appliances were characterized by energy efficiency.

An attempt to assess the impact of factors affecting the frequency of activities indicates that, by far, the highest level is the education level of household managers and the level of ecological awareness. This indicates the need for a new approach to educational programmes in schools and higher education institutions, as well as the need for social campaigns to raise public awareness. In addition to the two factors discussed above, other factors such as age, gender and income level are also important.

BIBLIOGRAPHY

Al-Hinti Ismael, H. Al-Sallami. 2017. Potentials and barriers of energy saving in Jordan's residential sector through thermal insulation. *Jordan Journal of Mechanical and Industrial Engineering* 11 (3): 141-145.

GUS (Central Statistical Office – CSO). 2014. *Gospodarstwa domowe i rodziny. Charakterystyka demograficzna. Narodowy Spis Powszechny Ludności i Mieszkań 2011* (Households and families. Demographic characteristics. National Population and Housing Census 2011). Warsaw: GUS.

GUS (Central Statistical Office – CSO). 2017, 2018, 2019. *Budżety gospodarstw domowych w 2016, 2017, 2018 roku* (Household Budget Survey). Warszawa: GUS.

Iwafune Yumiko, Yuko Mori, Toshiaki Kawai, Yoshie Yagita. 2017. Energy-saving effect of automatic home energy report utilizing home energy management system data in Japan. *Energy* 125: 382-392.

Jun-Jun Jia, Xu Jin-Hua, Fan Ying. 2018. Public acceptance of household energy-saving measures in Beijing: Heterogeneous preferences and policy implications. *Energy Policy* 113: 487-499.

Mendez Bartoli, Josiah Pena. 2012. *Household energy: economics, consumption and efficiency*. New York: Nova Science Publishers, http://ebookcentral.proquest.com/lib/pswbppl/detail.action?docID= 3020392.
Rosenow Jan, Pedro Guertler, Steven Sorrell, Nick Eyre. 2018. The remaining potential for energy savings in UK households. *Energy Policy* 121: 542-552.
Smith Courtney N. 2016. Energy savings and marginal emissions factor approach to emissions reductions from household appliance efficiency improvements. Thesis. Rochester Institute of Technology.
Trotta Gianluca. 2018. Factors affecting energy-saving behaviours and energy efficiency investments in British households. *Energy Policy* 114: 529-539. DOI: 10.1016/j.enpol.2017.12.042.
Vasiljevic-Shikaleska Aneta, Goran Trpovski, Biljana Gjozinska. 2018. Environmental awareness and of pro-environmental consumer behaviour. *Journal of Sustainable Development* 8 (20): 4-17.

***

PROŚRODOWISKOWE DZIAŁANIA WIEJSKICH GOSPODARSTW DOMOWYCH CELEM OGRANICZANIA ZUŻYCIA ENERGII ELEKTRYCZNEJ

Słowa kluczowe: gospodarstwo domowe, zachowania prośrodowiskowe, wykorzystanie zasobów, środowisko, energia elektryczna

ABSTRAKT

Celem artykułu jest przedstawienie przykładów działań podejmowanych przez wiejskie gospodarstwa domowe w dążeniu do ograniczania zużycia energii elektrycznej. Gospodarstwa domowe są jednym z podmiotów gospodarczych systemu ekonomicznego, który w znaczącym stopniu wykorzystuje energię elektryczną w celu zaspokajania potrzeb swoich członków. Wydatki ponoszone na zakup energii stanowią jeden z istotnych elementów w strukturze wydatków ogółem. Gospodarstwa domowe przez ograniczanie zużycia energii elektrycznej, po pierwsze – ograniczają wydatki, a po drugie – podejmują działania o charakterze prośrodowiskowym. W artykule wykorzystano wyniki badań ankietowych w grupie 404 gospodarstw domowych zlokalizowanych na obszarach wiejskich Polski. Dodatkowo analizę danych pierwotnych poszerzono o dane GUS, pochodzące z „Badania budżetów gospodarstw domowych". Przeprowadzone badania wykazały, że najczęściej podejmowanymi działaniami, zmierzającymi do ograniczenia zużycia energii były przede wszystkim: wyłączanie światła w pomieszczeniach nieużytkowanych, stosowanie energooszczędnych żarówek oraz sprzętów domowych. Na podejmowane aktywności głównie miały wpływ takie czynniki, jak: poziom świadomości ekologicznej, poziom wykształcenia oraz wiek.

AUTHOR

AGNIESZKA SIEDLECKA, DR HAB.
ORCID: 0000-0002-1853-0590
Pope John Paul II Higher State School in Biała Podlaska
Faculty of Economic Sciences
95/97 Sidorska St., 21-500 Biała Podlaska, Poland