University of Economics in Katowice

Journal of Economics and Management

ISSN 1732-1948 Vol. 29 (3) • 2017

Tomasz Zalega

National Economy Department
Faculty of Management
University of Warsaw, Warsaw, Poland
tomasz.zalega@wp.pl

Housing conditions and the use of alternative energy sources in households of senior citizens in Poland

DOI: 10.22367/jem.2017.29.08

Accepted by Editor Ewa Ziemba | Received: February 27, 2017 | Revised: June 20, 2017; July 3, 2017 | Accepted: July 4, 2017.

Abstract

Aim/purpose – The article aims to show the housing situation, satisfaction with housing conditions and place of residence, and the use of renewable energy sources in urban households of Polish seniors.

Design/methodology/approach – Direct research in the form of a survey questionnaire was carried out on a sample of 2537 households in 2014-2015 in ten Polish cities of various populations and sizes. In accordance with the research assumptions, the sample included persons over 65 years of age who took independent purchasing decisions in the market. In order to select the sample, the selective quota sampling procedure was used. The survey was conducted among participants of the University of the Third Age at state universities in: Warsaw, Kraków, Łódź, Poznań, Gdańsk, Katowice, Lublin, Białystok, Toruń and Wrocław, as well as among members of parochial clubs in parishes located in the Archdioceses of Warsaw, Kraków, Łódź, Białystok, Gdańsk, Katowice, Lublin, Poznań, Wrocław and the Dioceses of Warsaw-Praga and Toruń.

Findings – The survey reveals that more than half of seniors' households are satisfied with both the place of residence and housing conditions. The use of RES in seniors' households looks slightly worse. Only 1.5% of all the surveyed households of persons aged 65+ invest in alternative energy sources to produce electricity and heat. Financial problems are the key barrier to the development of RES-related projects in their households.

Research implications/limitations – Given the limited financial capacities, the study of housing conditions and the use of RES among people aged 65+ was confined solely to seniors' households in the largest Polish cities. In those households, a relatively low share of RES often results from inadequate technical conditions for the connection of RES installations. Rural households generate slightly more electricity and heat from RES.

Originality/value/contribution – This is one of the first studies published in Poland that attempt to provide some insight on RES used in urban households of people aged 65+.

Keywords: household, seniors, dwelling, housing conditions, renewable energy sources.
JEL Classification: D23, Q42, Q48.

1. Introduction

The main objective of each household is to satisfy individual and collective consumer needs. This objective is the starting point for the choices and decisions made by household members. For the assessment of the structure of household consumption, what is of key importance is the dwelling and housing conditions, in addition to income earned by each household member. The dwelling is characterized by durability, longevity and a fixed location, and also plays a crucial role in the functioning of every human being as an indispensable element in the development of the family. It is there that the basic processes of family life related to the fulfilment of biological, psychological, cultural and social, economic and utilitarian functions unfold [Korzeniewski 2008, p. 27; Zalega 2012, p. 159]. The dwelling may, therefore, be said to fulfil an extremely important role in the biopsychological and social existence of humans, becoming an instrumental value in the satisfaction of many human, both primary and higher-order, needs (the latter being connected with equipping the dwelling with higher-order goods). All this has a direct impact on individual attitudes and behaviors of consumers and influences market behaviors of households, regardless of the relationship with the objective situation [Zalega 2015, p. 79].

As a result of the constantly increasing electricity and heat prices, more and more households, in particular those living in single-family detached and semi-detached houses, are interested in alternative energy sources. The share of renewable energy consumed in Polish households is currently limited and represents less than 3% of the national primary energy output [GUS 2011]. It should be noted, however, that this share is growing year by year.

Household applications most frequently include a combination of several methods of generating energy, in particular hybrid solar-wind systems consisting of photovoltaic modules and an electricity-producing wind turbine. In order to independently supply houses with energy, also a number of different devices are used simultaneously. Most commonly, these are separate systems such as power-generating PV modules and thermal solar collectors providing heat. Mutual work for mutual purposes may be efficient as well, for example a heat pump that de-

livers heat to the building and is powered by a photovoltaic system generating electricity solely for the pump [Nazari et al. 2014, pp. 2936-2937]. Rarely, however, do household applications involve solutions such as concentrated solar power systems (only parabolic troughs are used for household applications) [van der Schoor & Scholtens 2015, pp. 669-670].

This article outlines the factors determining the fulfilment of needs of seniors' households in Poland as regards housing and their use of alternative energy sources. Given the length constraints, its primary goal is to show the housing situation as well as satisfaction with housing conditions and place of residence in the surveyed households. The structure of the article is as follows. A brief theoretical introduction and a synthetic discussion of the research methodology, assumptions and the characteristics of the research sample are followed by an analysis of the housing situation, conditions and types of occupied dwelling, together with satisfaction with the place of residence of the elderly's households. The final part focuses on the basic motives driving households of people aged 65+ to resort to renewable energy sources for electricity and heat. A conclusion of the analysis and major findings end this article.

2. Literature review

2.1. Factors determining the fulfilment of households' accommodation needs

The dwelling and its furnishings are important factors in the fulfilment of households' basic needs. Material household possessions represent a tangible aspect of the consumption process as specifically reflected by the dwelling and its furnishings. The dwelling and its durable household movables form a material and spatial framework for the functioning of households, building a unique household consumption infrastructure. The possession of a dwelling, its standard, and durable goods owned, on the one hand, mirror the financial capacity of a household and, on the other hand, are associated with education, family age, and the duration of the household [Zalega 2013, p. 161]. Nonetheless, it should be borne in mind that since the early 1990s the polarization of housing conditions of Polish households has been in progress. As stated by H. Kulesza, "[...] the relatively poor housing situation of the average family is accompanied by a large and multifaceted diversity, with the gap between standard extremes continuing to deepen each year as a consequence of general social and income disparities, in the absence of regulatory instruments" [2002, pp. 45-46].

The dwelling is defined as a space governed by the family and allowing the family's basic tasks and related activities to be carried out, a space that the family acquires according to its possibilities, needs, system of values and preferences. Furthermore, the dwelling satisfies basic needs; otherwise, higher-order needs cannot develop fully. Its location, size and standard are frequent indicators of social status, define – to a large extent – group membership, point to economic capacities, and show the tastes and preferences of the dwelling owner. Owning a dwelling is a key condition for the proper functioning of every household, because it allows almost all family-life-related activities to be performed within it, on the one hand, and makes it possible to accumulate tangible assets, on the other hand [Zalega 2016, pp. 200-201].

The dwelling standard understood as its location and size (area, number of rooms), technical and sanitary installations, construction material, interior layout and technical condition are important factors enabling the use of a specific dwelling. A modern home becomes a place of rest, regeneration, a factor in the consolidation of family life, social relations, and a material basis for individual development of members of society. The dwelling is also the epitome of individual aspirations and ambitions of every human being, offering the opportunity for externalizing one's own lifestyle. Moreover, it is there that the key functions of family and household are served. Hence, it should promote both the organization and proper fulfilment of such important household functions as [Kusińska 2009, p. 38]: preparing and eating meals, sleep, leisure, raising and educating offspring, further training of adult members of the household, hobbies and social contacts.

2.2. The use of renewable energy sources to produce electricity and heat in households

Economic growth, increasing demand for electricity and heat, and ensuring the security of energy supply are key drivers for the development of clean, environmentally friendly energy. In particular, the unfavorable climate change resulting from carbon dioxide emissions and fossil fuel combustion in the atmosphere has been regarded as the biggest economic and environmental challenge for the entire world in the last three decades. Therefore, modern societies promote an eco-friendly approach to life. The consequences of such an approach include the development of energy-efficient car technologies, energy-efficient houses and small power installations for households. This is inextricably linked with the development of renewable energy sources (RES). In this field, the lead has un-

doubtedly been taken by Scandinavian populations, which may be ascribed the term of 'eco-culture' largely supporting households and local producers, particularly the food industry. It is also there that a considerable proportion of installations for energy savings and the so-called 'green energy' generation is concentrated. Consumers are encouraged to buy solar equipment that produces energy from sunlight for household needs. For example, in Norway, the use of Smart Grid and AMS has reduced energy consumption and ensured energy self-sufficiency of both households and small residential areas as well as larger urban and rural communities [Bremdal 2011, pp. 21-22].

The development of renewable energy can help solve many environmental problems posed by conventional energy. Hence, supporting the development of such sources comes as an ever more serious challenge for almost all countries around the world. Accordingly, it should be presumed that renewable energy sources will develop dynamically in the coming years.

Renewable energy sources (RES) can serve as a supplement to energy supply, yet they will not ensure complete energy security. This is primarily because no efficient method of storing energy has been found so far. In addition, if used efficiently, RES do not entail any consumption of production factors (resources) and emit relatively few harmful substances and greenhouse gases throughout their lifecycle. As the only ones among energy generation technologies, they somehow fit in the environmental principles of sustainable development economics [Quaschning 2008, p. 17; Rogall 2010, p. 419]. Therefore, in addition to efficiency maximization, energy policy should aim to provide the methods for the use of renewable energies that will increasingly contribute to energy supply.

The goals of the government environmental policy with regard to RES are defined, among others, in "Energy Policy of Poland until 2030" and "Renewable Energy Development Strategy". The Polish Energy Law imposes an obligation on municipalities to supply electricity, heat and gaseous fuels (Article 18). This offers considerable opportunities for the development of renewable energy sources in Poland.

Poland's accession to the European Union on 1 May 2004 has entailed many legal implications that are currently taking effect. The implementation of the requirements of the EU directive on the promotion of energy from renewable sources is vital for the development of household energy security. That document – Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market [OJ L 283, 27.10.2001] – requires the Polish legislator to ensure that 20% of energy is generated from renewable sources. This requirement must be met by 2020 [Eurostat, 2016]. Forecasts show that the current

pace of growth of the RES share will allow Poland to achieve 15% by 2020 [Wiśniewski 2015]. The share of renewable energy in Poland's gross final energy was 11.5% in 2015, having increased by only 0.1% as compared to 2014 [European Commission 2016]. The slight rise may be a consequence of the disturbance of political and legal stability as well as of the expected revision of the Law, the draft of which contains many ambiguities and interpretative inaccuracies. In addition, the Law does not take into account real investment costs of individual energy technologies [Derski 2016].

Currently, it is estimated that a majority of 150 000 potential new installations with a total capacity of up to 800 MW [Krześniak & Hanas 2015, pp. 18-19] will be interested in generating energy for their own needs, given a systematic increase in energy supply costs.

The constantly rising electricity price means that more households living in single-family detached or semi-detached houses would be willing to use alternative energy sources. The share of renewable energy consumed in Polish households is currently limited and represents less than 3% of the national primary energy output [GUS 2011]. It should be noted, however, that this share will be growing year by year.

Renewable energy can be supplied to households through heat or electricity grids and produced by single-family houses. The former case concerns a centralized trading system for energy from renewable sources, where the building is only an energy consumer, meaning that it is the final element of the system. In the latter case, the building is a producer, distributor and consumer of energy; therefore, the entire renewable energy trading system is located within the building, more specifically, within its premises [van der Schoor & Scholtens 2015, pp. 669-670].

Household applications frequently include a combination of several methods of energy generation, in particular hybrid solar-wind systems consisting of photovoltaic modules and an electricity-producing wind turbine. In order to independently supply houses with energy, also a number of different devices are used simultaneously. These are not, however, hybrid systems as above, but separate systems such as power-generating PV modules and thermal solar collectors providing heat. Mutual work for mutual purposes may be efficient as well, for example a heat pump that delivers heat to the building and is powered by a photovoltaic system generating electricity solely for the pump [Nazari et al. 2014, pp. 2936-2937].

To conclude, a resident of a single-family house who wants to use renewable energy should consider how to do so, as this is possible both through networked systems and through self-supply. Nonetheless, it should be borne in

mind that energy self-generation allows for deciding how much energy comes from renewable sources, whereas such a decision is made by the system operator, not the energy consumer, in the case of networked systems [www 1].

2.3. Prosumer-based method of energy generation

A new present trend in consumer behavior of households comprises actions taken for the development of sustainable energy and a wider use of coal alternatives. In the context of public needs and awareness, investments using renewable energy sources (RES) and improving energy efficiency should be made and pollution emitted to the atmosphere should be reduced.

In 1972, Marshall McLuhan & Barrington Nevitt put forward the thesis that more and more consumers will become producers as the development of new electric technologies progresses [1972, p. 84]. Economic entities, in particular households, that use new technological solutions to produce electricity (and/or heat) in order to satisfy their own needs are termed prosumers in the energy market [Hajduk & Zalega 2013, p. 43]. They participate in the prosumption process, meaning that they are both users and consumers who produce products for their own consumption, i.e. products for their personal use. Prosumers are also active consumers-customers who not only buy electricity and/or heat from traditional suppliers but also enter into active purchase-sale relationships with them. They produce energy using distributed energy resources (DER) and sell surplus energy. They also sell system services such as demand reduction. Prosumers acquire storage DER technologies ensuring standby power supply (especially electricity) should the grid fail.

The notion of prosumer also includes energy consumers who use energy technologies available in a competitive market in order to meet their energy needs. It is also applied, inter alia, to producers and consumers of energy from micro and small renewable sources[1]. A household deciding to generate electrici-

[1] In the Polish legal system, there is no formal definition of prosumer/prosumption in the energy market. Within a long development and consultation process concerning the Act on Renewable Energy Sources (finally adopted on 20 February 2015), a reference was, however, made to this kind of activity. According to Article 4 of the Act, "[...] a producer of electricity from renewable energy sources in a micro-installation who is a natural person not performing any economic activity governed by the Act of 2 July 2004 on Freedom of Economic Activity [...] and who produces electricity for his own consumption purposes may sell unused electricity generated by him in a micro-installation and transferred into the distribution network". Such production and sale of electricity from renewable sources does not constitute an economic activity within the meaning of the Act on Freedom of Economic Activity (Journal of Laws (Dz.U.) 2013, item 672, as amended). Under the Act on RES, "[...] a micro-installation is a RES installation with a total installed electric capacity of not more than 40 kW, connected to the electricity grid of rated voltage of less than 110 kV or a thermal cogeneration capacity not exceeding 120 kW" [Ustawa z dnia 20 lutego 2015 r.].

ty (and/or heat) for its own purposes not only can reduce its electricity bills but also can sell electricity. In this case, the energy input and output are measured by a bidirectional meter that directly communicates with the power company, facilitating the calculation of the actual account balance [McLuhan & Nevitt 1972, p. 86].

Prosumers can either produce electricity (and/or heat) to cater for their own needs exclusively or make the surplus available to other users. The former is called off-grid and the latter on-grid prosumption.

In Poland, the greatest opportunities for becoming a prosumer in the heat market are offered by the installation of solar collectors converting solar radiation into thermal energy needed to heat utility water or support home heating from time to time. In the electricity market, this can be achieved by installing photovoltaic panels, or solar cells.

In the case of on-grid production, a photovoltaic system converts solar energy into electrical energy that is transferred directly to the grid. In addition to a solar panel, such an installation must be composed of an inverter that changes direct current produced by photovoltaic panels to alternating current, a meter for measuring the electricity supply to the grid, and a two-way meter that indicates the power source for domestic appliances (household's own source or a public grid). The resale of excess energy allows the photovoltaic system to be economically viable [Burchard-Dziubińska 2015, p. 8].

The prosumer-based method of electricity and heat generation from RES has considerable potential in households living in orbital parts of large cities or in nearby localities belonging to urban agglomerations.

3. Research methodology

3.1. Conceptualization of research

The empirical material contained in this article comes from direct research conducted in the form of a survey questionnaire on a sample of 2537 households in 2014-2015 in ten Polish cities of various populations and sizes. In accordance with the research assumptions, the sample included persons over 65 years of age who took independent purchasing decisions in the market. In order to select the sample, the selective quota sampling procedure was used. The characteristics (quotas) covered by the research were: sex and age. The survey was conducted as part of statutory research and fully funded by the Faculty of Management of the University of Warsaw.

The characteristics and properties of the group investigated were complemented by means of explanatory research that was treated by the author as a supplement to the information obtained in the questionnaire-based interview. To that end, in the first half of February 2015, personalized in-depth interviews were carried out with 11 people selected in a targeted manner, taking into account the key socio-demographic characteristics such as: sex, age, education and place of residence. Those were interviews with inhabitants of Warsaw, Katowice and Toruń. An interview lasted approximately 45 minutes. Later, the in-depth interviews were transcribed and analyzed in line with the qualitative research methodology.

This research method was chosen in view of the older age of respondents whose openness to new media (Internet, smartphone, i-Pod) often used in research is limited. The primary objective was to outline the quality of life, the structure of consumption and consumer behaviors of people aged 65+. In addition, the subjects studied were also seniors' households having installations for converting solar energy, geothermal energy and energy from solid biomass into electricity and heat. These households may thus be said to fit fairly well in the idea of prosumer-based production of energy from renewable energy sources.

The surveys were conducted among participants of the University of the Third Age at state universities in: Warsaw, Kraków, Łódź, Poznań, Gdańsk, Katowice, Lublin, Białystok, Toruń and Wrocław, as well as among members of parochial clubs in parishes located in the Archdioceses of Warsaw, Kraków, Łódź, Białystok, Gdańsk, Katowice, Lublin, Poznań, Wrocław and the Dioceses of Warsaw-Praga and Toruń.

3.2. Selection and characteristics of the research sample

The survey covered 71% of women and only every third respondent was male. There were definitely more women than men and people aged 65-74 formed the largest age group in the sample[2]. Place of residence was also an important variable in the research. In line with the research assumptions, the sample comprised respondents who lived in the largest Polish cities.

[2] The Anglo-Saxon literature uses the following division of older people: 1) young old – people aged 60/65-74; 2) old old – people aged 75-84; and 3) the oldest old – people aged 85 and more. The age classification in the study is similar to that proposed by the WHO. The author divided seniors into: 1) young old – people aged 65-74, 2) old old – people aged 75-84, and 3) the oldest old – people aged 85 and more. According to the UN, the conventional old-age threshold is 65. It should be remembered, however, that old age is not just the number of years that a person has lived. We distinguish calendar (chronological) age and biological age. Many factors often cause very large discrepancies between chronological and biological ages.

Respondents were also asked about their level of education. The questionnaire included four categories of education: primary, basic vocational, secondary and higher education. Respondents with secondary education formed the largest group. Nearly 2/5 of those surveyed declared this level. Every fourth respondent was a university graduate, and those with basic vocational education represented a similar percentage. In the sample surveyed, people with primary education were the smallest group (11.4%).

Nearly half of those surveyed were members of households consisting of two persons, while fewer than 2/5 represented three-person households. Every sixth respondent was a member of a single-person household.

The largest group of respondents included people whose monthly income per capita did not exceed PLN 2000.00. For every third respondent, monthly income per household member ranged from PLN 2001.00 to 3000.00. In turn, every fourth person interviewed had monthly disposable income per capita of between PLN 3001.00 and 4000.00. The smallest group of respondents included households where income was above PLN 5000.00 per capita a month.

Nearly 45% of those interviewed described their economic situation as good, while 2/5 as bad. Almost one in ten respondents described their economic status as very bad, whereas only one in ten assessed their material situation as very good.

4. Results and discussion

4.1. Housing conditions of seniors

The dwelling standard understood as its size (area, number of rooms), technical and sanitary installations, construction material, interior layout and technical condition are important factors enabling the use of a specific dwelling.

The conducted survey assumed that a home with adequate facilities inside should be considered as one with its own water supply system, toilet, bathroom, etc. For example, a dwelling with access to tap water in a generally accessible staircase only is not regarded as equipped with a water supply system.

The analysis of the housing conditions of the households studied indicates that the families living in Warsaw, Poznań and Wrocław are best equipped with basic installations (Table 1).

Table 1. Basic installations in households of people aged 65+ (%)

Place of residence	Plumbing	Toilet	Bathroom	Gas pipe	Central heating	Hot water supply
Total	98.6	95.7	91.8	84.6	85.9	63.4
Warsaw	99.7	98.3	95.9	83.7	93.7	79.8
Kraków	99.4	94.5	88.7	85.9	85.4	62.9
Łódź	98.8	92.7	85.1	81.7	81.9	59.3
Poznań	99.1	98.2	92.8	86.4	89.1	63.6
Wrocław	98.6	97.8	94.8	90.3	87.6	70.7
Gdańsk	99.0	97.2	96.3	82.4	87.2	63.1
Katowice	97.7	96.2	94.2	84.2	84.9	62.5
Lublin	98.2	93.3	89.1	84.7	80.7	53.9
Białystok	97.5	92.9	90.3	79.6	80.3	58.5
Toruń	98.4	96.4	91.3	86.7	88.2	59.7

Source: Calculated by the author.

More than 98% of the households surveyed lived in dwellings equipped with a water supply system, 95.7% had also a flushable toilet using running water, and 91.8% had a bathroom with a bath or shower. The situation as regards other installations was a little worse. A relatively large number of dwellings (notably in Białystok and Łódź) did not have gas pipes (20.4% and 15.9%, respectively). Over 14% of respondents lived in homes without central (collective or individual) heating, whereas 36% of those surveyed had no hot running water at home.

The dwellings of the seniors interviewed usually had individual or collective central heating, and those of almost every seventh household were heated by stoves. This type of heating was most frequently present in households of people aged 65+ living in Białystok (19.7%), Lublin (19.3%) and Łódź (18.1%). Hot running water was usually absent in homes of seniors living in Lublin (46.1%), Białystok (41.5%), Łódź (40.7%) and Toruń (40.3%). It should also be noted that dwellings with no hot running water were owned mostly by seniors whose monthly disposable income per capita did not exceed PLN 2000.00 and who had completed primary or basic vocational education.

It should be emphasized that the lack of bathroom or toilet today means that a dwelling is of very low standard. It can, therefore, be stated that approximately 6.25% of seniors' households live in dwellings that currently do not meet the basic requirements for modern homes.

The survey conducted demonstrates that the average usable area of a dwelling was 74.6 m^2. The smallest home was 31.75 m^2, and the largest 189.87 m^2. The average dwelling consisted of 3.56 rooms. The average usable area occupied by the surveyed households was 29.64 m^2 per person, and the number of persons was 1.04 per room.

Most frequently, the area of respondents' homes ranged from 57.8 m^2 to approximately 66.9 m^2. It can thus be concluded that the dwellings of these households usually have basic facilities and a satisfactory usable area.

A significant correlation was noted between the number of rooms and the usable area of homes and characteristics of respondents such as: age, education, economic situation and place of residence. A detailed list is presented in Table 2.

Table 2. Selected indicators of the housing situation of the seniors surveyed (%)

Items	Number of rooms in a dwelling	Usable area in m^2
Total	3.56	74.6
Age:		
65-74	3.79	79.2
75-84	3.63	75.6
85 and more	3.29	69.0
Education:		
Primary	3.19	68.1
Basic vocational	3.58	75.3
Secondary	3.49	74.7
Higher	3.98	80.3
Income per capita:		
Up to PLN 2000.00	2.79	64.5
PLN 2001.00-3000.00	3.68	75.2
PLN 3001.00-4000.00	3.76	77.6
More than PLN 4000.00	4.01	81.1
Place of residence:		
Warsaw	3.57	73.2
Kraków	3.52	73.9
Łódź	3.46	72.6
Poznań	3.51	73.6
Wrocław	3.64	75.6
Gdańsk	3.62	75.1
Katowice	3.27	71.3
Lublin	3.68	76.8
Białystok	3.72	79.2
Toruń	3.61	74.6

Source: Calculated by the author.

The survey shows that seniors in the 75-84 age group occupied the smallest flats (31.75 m^2 – 39.87 m^2), taking into account both the number of rooms and usable area. The biggest dwellings were used by seniors aged 65-74 years (77.69 m^2 – 82.62 m^2). In the context of the findings, it is worth noting that those households paid the highest fixed costs (of both electricity and gas as well as rent and other fixed charges).

In the light of statistical analyses, it turns out that the income group represented by the seniors' households did not significantly differentiate their housing conditions, notably the number of rooms in a dwelling (Pearson's correlation

coefficient = 0.029, $p \leq 0.01$) and the usable area (Pearson's correlation coefficient = 0.067, $p \leq 0.01$).

Interestingly, seniors with a university degree generally lived in bigger homes (4.26 rooms per home and 84.8 m^2) and obviously paid the highest charges arising from their use. It was also noted that UTA students were more likely to possess larger dwellings than senior members of parochial communities.

Taking into account the place of residence of persons aged 65+, it can be noticed that the smaller the city, the bigger the number of rooms and the usable area of the dwelling. This is chiefly due to the fact that inhabitants of the largest cities (mainly Warsaw, Kraków and Łódź) typically lived in blocks of flats, while single-family detached houses were more popular among inhabitants of smaller cities such as Białystok and Lublin. It should also be highlighted that the smaller the town was in terms of population, the lower the charges for rent and other fixed costs were. The lowest rents were declared by senior inhabitants of Białystok and Lublin.

4.2. Satisfaction with the place of residence and housing conditions

The assessment of seniors' satisfaction with the place of residence and current housing conditions is also an important element of the analysis of housing conditions.

The survey demonstrates that only every fourth respondent was not satisfied and one in five was very satisfied with the place of residence (Table 3).

Table 3. Seniors' satisfaction with the place of residence (%)

Items	Number of respondents (N = 2537)	Percentage share
Very dissatisfied (rating 1)	89	3.5
Dissatisfied (rating 2)	540	21.3
Moderately satisfied (rating 3)	774	30.5
Satisfied (rating 4)	680	26.8
Very satisfied (rating 5)	454	17.9
Average rating on a 5-point scale	–	**3.34**

Note: 1 – very dissatisfied, 5 – very satisfied.

Source: Calculated by the author.

As regards the degree of satisfaction with their place of residence as assessed by respondents, almost every second senior (44.5% of responses) rated it as good and very good, with only a quarter (24.8% of responses) assessing it as bad and very bad. Almost a third of respondents (30.5% of responses) rated their

place of residence as moderate. The survey results indicate that people aged 65+ who actively attended parochial clubs were content with their place of residence more often than UTA students.

Undoubtedly, the assessment of the level of satisfaction with housing conditions, that is the number of rooms and the dwelling area (Table 4), will be a good complement to the evaluation of their satisfaction with the place of residence.

Table 4. Seniors' satisfaction with housing conditions (%)

Items	Number of respondents (N = 2537)	Percentage share
Very dissatisfied (rating 1)	238	9.4
Dissatisfied (rating 2)	566	22.3
Moderately satisfied (rating 3)	713	28.1
Satisfied (rating 4)	746	29.4
Very satisfied (rating 5)	274	10.8
Average rating on a 5-point scale	–	**3.1**

Note: 1 – very dissatisfied, 5 – very satisfied.

Source: Calculated by the author.

Respondents' ratings of their satisfaction with housing conditions are slightly lower than for the place of residence. The survey reveals that one in three seniors (31.7% of responses) was not content with his/her housing situation, and one in ten (12.1% of responses) declared high satisfaction with both the number of rooms and the dwelling area. Based on the examination of the research material, it can be concluded that UTA students (46.3%) were more likely to be satisfied with their housing conditions than members of parochial communities (34.1%).

Total ratings of satisfaction with both the place of residence and the housing situation are depicted in Table 5, with account being taken of dependent variables.

Respondents' opinions in this respect were different depending on age (Pearson's correlation coefficient $r = -0.132$, $p = 0.01$). Dissatisfaction with housing conditions and place of residence was mostly voiced by respondents aged 85 years and more, as most of them indicated the "1"or "2" rating. Such low ratings prove dissatisfaction with not only housing conditions but also the place of residence. The proportion of such ratings was 28.1% in this age group. In the 75-84 age group, the share of the lowest ratings amounted to 30.9%. The smallest proportion of those dissatisfied with their place of residence and housing conditions was noted for the youngest seniors aged 65-74 years, with every four indicating dissatisfaction in this regard.

Table 5. Structure of seniors' households by satisfaction with the place of residence and housing conditions (%)

Items	Percentage shares of satisfaction ratings for housing conditions and place of residence				
	1	**2**	**3**	**4**	**5**
Total	6.5	21.8	29.3	28.1	14.3
Age:					
65-74	4.7	21.2	27.7	30.3	16.1
75-84	7.2	23.7	30.4	27.4	11.3
85 and more	7.6	20.5	29.8	26.6	15.5
Education:					
Primary	4.5	24.7	31.6	25.3	13.9
Basic vocational	6.3	23.9	30.2	27.2	12.4
Secondary	6.8	20.2	28.7	29.8	14.5
Higher	8.4	18.4	26.7	30.1	16.4
Income per capita:					
Up to PLN 2000.00	10.8	25.3	30.3	26.3	7.3
PLN 2001.00-3000.00	7.3	22.6	29.8	28.0	12.3
PLN 3001.00-4000.00	5.2	20.1	27.6	29.6	17.5
More than PLN 4000.00	2.7	19.2	29.5	28.5	20.1
Place of residence:					
Warsaw	7.1	22.3	30.4	27.6	12.6
Kraków	6.2	20.6	28.9	29.2	15.1
Łódź	8.7	24.0	28.8	26.8	11.7
Poznań	5.9	21.3	29.0	28.3	15.5
Wrocław	6.0	21.9	27.9	27.7	16.5
Gdańsk	5.8	21.5	29.2	28.6	14.9
Katowice	7.5	22.3	30.8	26.9	12.5
Lublin	6.8	21.2	30.0	27.6	14.4
Białystok	5.4	21.5	29.1	28.3	15.7
Toruń	5.6	21.4	28.9	30.0	14.1

Note: A five-point scale was used to rate satisfaction with housing conditions and place of residence: 5 – very satisfied, 4 – satisfied, 3 – moderately satisfied, 2 – dissatisfied, 1 – very dissatisfied.

Source: Calculated by the author.

Education proved to be another variable with a significant statistical effect on the degree of respondents' satisfaction with their place of residence and housing conditions (Spearman's correlation coefficient $r = -0.097$, $p = 0.01$). It was noted that the higher the level of education of seniors, the less satisfaction in this respect. Among people with higher education, dissatisfaction with these aspects was stated by almost every third respondent. A similar share of the lowest ratings ("1" and "2") was also observed for those aged 65 years and older who had completed secondary education. The share of respondents dissatisfied with their place of residence and housing conditions was the lowest among people with primary education. Almost every third senior with the lowest level of education indicated dissatisfaction with their situation in this respect.

Seniors' opinions differed depending on their financial situation. Generally, the better the financial situation was assessed by those interviewed, the more often they declared being more content with the place of residence and housing

conditions. Most "4" and "5" ratings were indicated by respondents with a monthly disposable income of above PLN 4000.00 per capita. Almost half of those with such income assessed the level of satisfaction in this regard as very high. The share of such ratings among people aged 65+ who earned between PLN 3001.00 and PLN 4000.00 was 47.1%. The smallest proportion of those content with both the place of residence and housing conditions was recorded for seniors' households with the lowest monthly income (up to PLN 2000.00 per capita), with every third respondent indicating satisfaction.

The survey reveals that the place of residence was another variable differentiating the seniors' households in terms of the degree of satisfaction with both characteristics of their place of residence and housing conditions. This variable much less affected the differences in the population studied than demographic properties such as education, age or professional activity. It can be stated that the larger the city where respondents lived, the higher the percentage of those dissatisfied with these aspects (Cramér's V = 0.024, with $p \leq 0.05$). Dissatisfaction was most frequently declared by respondents living in Łódź, Katowice and Warsaw. Seniors from these cities most often indicated the lowest ratings ("1" and "2") clearly demonstrating their dissatisfaction. The share of such ratings was 32.7% for Łódź, 29.8% for Katowice, and 29.4% for Warsaw. By far the smallest proportion of respondents dissatisfied with their place of residence and housing conditions was noted for inhabitants of Białystok, Kraków and Poznań. Among them, 26.9%, 26.8% and 27.2%, respectively, gave the lowest ratings, and more than 2/5 were satisfied or very satisfied, indicating "4" and "5".

4.3. The use of renewable energy sources in seniors' households

Renewable energy sources (RES) are used exclusively in households of older people living in single-family detached or semi-detached houses. Such buildings were inhabited by merely 126 households of people aged 65+, representing 4.9% of the surveyed households. Most households of seniors living in single-family detached or semi-detached houses were recorded in Białystok (5.1%), Katowice (5.0%), Poznań (4.9%) and Warsaw (4.8%). However, only 29 seniors' households stated that they had invested in alternative energy sources to produce electricity and heat, representing 1.5% of all the households surveyed (23% of all interviewed households living in single-family detached or semi-detached houses). Most commonly, these were households in Warsaw (1.8%), Kraków (1.7%), Poznań (1.6%) and Katowice (1.6%). They may be thus said to

fit fairly well in the prosumer-based method of electricity and heat production from RES.

Empirical research conducted in 2014–2015 among people aged 65+ reveals that more than 4/5 of respondents mention financial problems as the key barrier to the development of RES-related projects in their households. The lack of money often leads to seniors refraining from actions to improve energy efficiency of their homes, despite real benefits that these may offer. However, all people aged 65+ who used renewable energy sources in their households and 87% of all the seniors surveyed supported the development of RES in Poland. Furthermore, 95% of respondents believe that an increase in the RES share in the overall structure of energy consumption is beneficial.

Table 6. The ways of electricity and heat generation from RES in seniors' households

Renewable energy source used in the household	Number of households (N = 29)
Biomass	15
Solar energy	9
Geothermal energy	5

Source: Calculated by the author.

The survey shows that among seniors' households that have invested in electricity (and/or heat) generation from alternative energy sources, half produce it from biomass, every third from thermal radiation, and one in six from geothermal energy. Moreover, fourteen households use more than one renewable energy source (both biomass and solar energy or geothermal and solar energy).

Energy from biomass (wood briquettes, wood pellets, wood logs) as a renewable energy source is most commonly used by households in Warsaw and Gdańsk, solar energy (photovoltaic panels and solar collectors) is used by households of seniors living in Warsaw, Wrocław and Kraków, and geothermal energy (heat pumps) by households of older people living in Warsaw, Poznań and Toruń.

The types of equipment or installations for generating electricity (and/or heat) from renewable energy sources in seniors' households are presented in Table 7.

Table 7. Types of installations used to generate electricity and heat from RES in seniors' households

Type of equipment/installation for generating energy from RES	Number of households (N = 29)
1	*2*
Solar installation	7
Multi-function boiler	5
Fireplace	3

Table 7 cont.

1	*2*
Water-jacketed stove	5
Biomass-fired boiler	2
Ground heat exchanger	4
Heat pump	3

Source: Calculated by the author.

In the case of solar energy, solar installations based on flat-plate or vacuum collectors are used. The survey reveals that almost all seniors' households using alternative energy sources convert solar energy into thermal energy by means of solar systems (solar collectors). Solar energy is, in turn, converted into electrical energy by means of photovoltaic panels. As regards energy from biomass, the range of solutions is slightly broader. Among households producing energy from that source, more than 17% use water-jacketed stoves and multi-function boilers to this end. 10% of seniors' households do this by burning wood in standard fireplaces, whereas 7% of households have a special boiler for burning biomass.

As for energy obtained from geothermal sources, every tenth household obtains it by means of a heat pump (air-water heat pump in two cases, and brine-water heat pump in one case), while one in seven households uses a ground heat exchanger (two households surveyed use tube exchangers, one household uses a gravel exchanger, and one – a plate heat exchanger).

Another issue covered by the research is understanding the motives that drive seniors' households to invest their own funds in electricity and heat generation from renewable energy sources (Table 8).

Table 8. Reasons for investment in installations for energy production from RES made by seniors' households

Reason for investing in RES	Number of households	Percentage share
Expected savings on bills	26	89.6
Willingness to become partially independent of energy prices	22	75.8
Aesthetic value of installation	6	20.7
Higher energy efficiency class of the building	8	27.6
Willingness to be environmentally friendly	4	13.8
Willingness to use an innovative and environmentally friendly heating solution	2	6.9

Source: Calculated by the author.

Senior respondents could select more than one possible answer to the questions contained in the survey questionnaire. In the context of the results, it can be concluded that the most important determinants of the use of alternative energy sources include, on the one hand, expected savings on current bills, and, on the

other, willingness to become partially independent of indeed constantly growing prices of conventional energy sources (almost 90% of respondents indicated the first option, and the second was chosen by more than 3/4 of the seniors interviewed). This distribution of responses reveals the interrelatedness of both motives that drive the households of people aged 65+ to invest in renewable energy sources.

When a part of or all demand for heat is met, bills for energy from conventional sources are lower, resulting in the independence of constantly rising energy prices. A relatively important aspect is also higher energy efficiency class of the building where energy is generated from environmentally friendly sources. Nearly every third respondent pointed to this answer as one of the main reasons for investing in renewable energy sources in their households. In turn, every fifth senior claimed that one of the factors in investing in renewable energy sources is the aesthetic value of products or installations. A certain relationship should be highlighted here. Namely, 4 out of 5 respondents who have a fireplace (standard fireplace system or a water-jacketed stove) do not pay particular attention to the aesthetics of other installations such as heat pumps, ground heat exchangers or solar collectors. Only 7% of seniors reported willingness to use an innovative and environmentally friendly heating solution as a motive for installing a system converting energy from infinite sources (in this case, geothermal energy) into heat. It can thus be stated that the most significant determinant indicated by senior respondents was expected savings and the willingness to become partially independent of primary energy prices. Consumer decisions of seniors were, to a smaller but still substantial extent, influenced by a higher energy efficiency class of the building (27.6%) and the aesthetic value of installations (20.7%). Regarding the second factor, it refers mainly to those households that support the heating of their homes by burning wood in fireplaces, which create the atmosphere and a unique character of the home interior.

The survey does not allow a clear conclusion to be drawn that the studied households of people aged 65+ that invest in RES are characterized by above-average propensity to invest in tangible and financial assets (Table 9).

Table 9. Propensity of seniors' households to invest in tangible or financial assets

Propensity to invest in tangible or financial assets	Number of households (N = 29)	Percentage share
Very high	5	17.2
High	12	41.4
Moderate	9	31.0
Low	3	10.4
Nearly zero	0	0.0

Source: Calculated by the author.

Although 'very high' or 'high' propensity to invest in tangible or financial assets was reported by nearly 3/5 of respondents, 41.4% of seniors were of the opinion that their households were characterized by moderate or even low propensity to invest in this type of assets. Therefore, it seems most reasonable to say that the seniors' households that generate electricity and heat from RES show moderate propensity to invest in tangible or financial assets.

Table 10. Assessment of electricity (and/or heat) consumption in seniors' households investing in RES

Electricity (and/or heat) consumption	Number of households (N = 29)	Percentage share
Very high	4	13.8
High	13	44.8
Moderate	9	31.0
Low	3	10.4
Very low	0	0.0

Source: Calculated by the author.

Considering the assessment of electricity (and/or heat) consumption, more than 2/5 of the surveyed seniors who had invested in RES admitted that the consumption level was high, and every seventh respondent rated it as very high (Table 10). Only every third respondent aged 65+ assessed electricity and heat consumption in his/her household as moderate. Every tenth senior thought that his/her household consumed a relatively low amount of electricity (and/or heat). However, no elderly person assessed the electricity and heat consumption in his/her household as very low.

The seniors surveyed were also asked whether they planned to invest in RES in the following five years. The survey has shown that 9% of respondents inquired about their investment plans for renewable energy generation for their own purposes in a few years to come responded in the affirmative. Simultaneously, 1% of them were already investing in RES. It is worth highlighting that over half of respondents could not connect RES installations for technical reasons, and over 1/3 were uncertain and indicated the 'hard to say' option. Nearly 74% of those interested in RES would like to generate heat and 26% electricity in their households. Only 2% considered selling electricity to the grid. The survey demonstrates that the seniors interviewed prefer solar collectors to produce heat and photovoltaic panels to generate electricity. The share of other sources is small.

5. Conclusions

The analysis of the housing conditions and the use of RES in households of Polish seniors allows for drawing the following conclusions:

1. More than half of the households surveyed are satisfied with both the place of residence and housing conditions.
2. The smaller the city, the bigger the number of rooms and the usable area of the dwelling.
3. Financial problems are most often mentioned by senior citizens as the key barrier to the development of renewable energy projects. The primary reason is high investment expenditure.
4. Seniors' households that benefit from energy from renewable sources are generally those that are wealthy, with a monthly disposable income exceeding PLN 4000.00 per capita, and that report higher or secondary education.
5. The majority of households that use renewable energy sources assess electricity and heat consumption in their houses as high.
6. The propensity of people aged 65+ to invest in tangible and financial is assessed as moderate.

References

Bremdal B.A. (2011): *Prosumer oriented business in the energy market*. Energy and Finance Conference in Rotterdam, October 5-6, The Erasmus School of Economics, Rotterdam.

Burchard-Dziubińska M. (2015): *Prosument na rynku energii w Polsce – próba oceny w świetle teorii kosztów transakcyjnych*. "Gospodarka w Praktyce i Teorii", No. 4, pp. 5-19.

Derski B. (2016): *OZE konkurują już z gazem i węglem*. http://wysokienapiecie.pl/oze/1431-oze-konkuruja-juz-z-gazem-i-weglem (access: 10.08.2016).

European Commission (2016): *Country datasheets*. http://ec.europa.eu/energy/en/statistics/country (access: 10.08.2016).

Eurostat (2016): *Renewables shares summary. Statistics-explained*. http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Renewables_shares_summary_new.png (access: 10.08.2016).

GUS (2011): *Energia ze źródeł odnawialnych w 2010 roku*. Warszawa.

Hajduk M.T., Zalega T. (2013): *Zachowania prosumpcyjne polskich konsumentów na rynku produktów żywnościowych*. "Zarządzanie Innowacyjne w Gospodarce i Biznesie", No. 2(17), pp. 78-88.

Korzeniewski W. (2008): *Funkcje mieszkania w życiu rodziny i rozwoju społeczno-gospodarczym*. "Przegląd Budowlany", No. 3, pp. 26-30.

Krześniak E., Hanas I. (2015): *Ustawa OZE szanse i ryzyka dla przedsiębiorców*. "Czysta Energia", No. 5, pp. 18-19.

Kulesza H. (2002): *Trudne problemy mieszkalnictwa*. "Problemy Polityki Społecznej. Studia i Dyskusje", No. 4, pp. 45-46.

Kusińska A. (2009): *Zmiany w sferze konsumpcji i ich uwarunkowania w latach 1989-2009*. "Handel Wewnętrzny", No. 4-5, pp. 33-43.

McLuhan M., Nevitt B. (1972): *Take today − the executive as dropout*. Harcourt Brace Jovanovich, San Diego.

Nazari M.H., Costello Z., Feizollahi M.J., Grijalva S., Egerstedt M. (2014): *Distributed frequency control of prosumer-based electric energy systems*. "IEEE Transactions on Power Systems" November, Vol. 29, Iss. 6, pp. 1-9.

Quaschning V. (2008): *Erneuberbare Energie und Klimaschutz*. Carl Hanser Verlag, München.

Rogall K. (2010): *Ekonomia zrównoważonego rozwoju. Teoria i praktyka*. Zysk i S-ka, Warszawa.

Schoor T. van der, Scholtens B. (2015): *Power to the people: Local community initiatives and the transition to sustainable energy*. "Renewable and Sustainable Energy Reviews" March, Vol. 43, pp. 666-675.

Ustawa z dnia 20 lutego 2015 r. o odnawialnych źródłach energii, Dz.U. z 2015 r., poz. 478.

Wiśniewski G. (2015): *Jak Polska realizuje unijne zobowiązania dotyczące energii z OZE?* http://odnawialny.blogspot.com (access: 10.08.2016).

Zalega T. (2012): *Konsumpcja. Determinanty, teorie i modele*. PWE, Warszawa.

Zalega T. (2013): *Mieszkanie i warunki lokalowe miejskich gospodarstw domowych w Polsce*. „Zeszyty Naukowe SGGW. Ekonomika i Organizacja Gospodarki Żywnościowej", No. 104, pp. 157-170.

Zalega T. (2015): *New consumer trends*. In: *Towards a green economy*. *From ideas to practice*. Ed. M. Burchard-Dziubińska. Wydawnictwo Uniwersytetu Łódzkiego, Łódź.

Zalega T. (2016): *Segment osób w wieku 65+ w Polsce. Jakość życia, konsumpcja, zachowania konsumenckie*. Wydawnictwo Naukowe Wydziału Zarządzania UW, Warszawa.

[www 1] http://www.pasywny-budynek.pl/dom/wykorzystanie-odnawialnych-zrodel-energii (access: 10.12.2016).