instytut
badań
strukturalnych

IBS WORKING PAPER 16/2015
NOVEMBER 2015

IT'S COLD INSIDE - ENERGY POVERTY IN POLAND

Agata Miazga
Dominik Owczarek

ibs working paper 16/2015

November 2015

IT'S COLD INSIDE – ENERGY POVERTY IN POLAND♠

Agata Miazga♣

Dominik Owczarek♦

Abstract

The aim of this paper is to present a statistical measure of energy poverty in Poland. This is the first research for Poland which is strictly based on the methodology applied in the United Kingdom – the only country with a statutory definition of energy poverty. We calculate three measures: absolute – "10% of income", modified absolute – "13% of income" and relative – Low Income High Costs (LIHC). The results are compared with a subjective energy situation assessment made by households. Moreover, we answer the question to what extent energy poverty coincides with income poverty. After examining the different variants of the definition, we recommend using the relative LIHC definition in Poland. According to this measure, 17% of the Polish population (6.44 million people) are exposed to energy poverty, especially occupants of detached houses, inhabitants of rural areas, households living on non-earned sources, single parents and married couples with at least 2 children.

Keywords: energy poverty, income poverty, energy expenditure

JEL: I32, Q40

♠ The publication was developed by a grant funded by the European Climate Foundation. Part of the results was established in cooperation with Institute for Sustainable Development. Apply the usual disclaimers.

♣ Institute for Structural Research, Warsaw, Poland. E-mail: agata.miazga@ibs.org.pl.

♦ Institute for Sustainable Development, Institute of Public Affairs, Warsaw, Poland. E-mail: dominik.owczarek@isp.org.pl.

Table of contents

1 Context

Energy poverty is a relatively unknown term in Poland. Although the difficulties related to heating an apartment, cooking and use of household appliances and audio-visual-equipment are described quite often (e.g. Tarkowska 2012, Central Statistical Office 2014), they are not considered to be one of the dimensions of poverty. There is no research on energy poverty that could help determine the scale of this phenomenon in Poland. This is caused by methodological inaccuracies – as in the case of Kurowski's research (2012), or the local character of research – as in the case of Frankowski and Tirado-Herrero's study (2015). The aim of our research is to fill this gap and propose an energy poverty indicator for Poland which may become the basis for developing effective public policies. The need to solve this problem arises under the sustainable development agenda approved at the 25-27 September UN Summit as part of the Sustainable Development Goals, and is also included in the Constitution of the Republic of Poland.

Energy poverty may be caused by low income, energy inefficiency of apartments or irrationally managed energy sources in households (Węglarz, Kubalski and Owczarek 2014; Lis and Miazga 2015). Difficulties in paying the apartment heating bill and other necessary energy costs, related for instance to cooking or lighting, may lead to negative health consequences. Energy poverty affects children's physical health by: reducing immunity, elevated incidence of respiratory system diseases, weight gain disorders (Liddell and Morris 2010). Among adults and young people, mental well-being disorders such as stress, anxiety or deterioration in mood can be observed (Liddell and Morris 2010). In extreme cases, hypothermia may prove fatal.

Although the history of research on energy poverty dates back to the 1980s, a widely recognised definition of this phenomenon has not been developed yet. In developing countries, energy poverty is considered to be the lack of, or limited access to, energy mainly due to gaps in energy infrastructure. In some research, this phenomenon is referred to as *energy poverty*. In developed countries, including Poland, *energy poverty* is rather related to failure to use an appropriate amount of energy due to financial limitations. Some research refers to this phenomenon as *fuel poverty*, yet energy poverty and fuel poverty are often used interchangeably in many academic papers (cf. Li et al. 2014). As far as our research is concerned, we use the term *energy poverty*. In "*The Right to Adequate Housing* (UN-HABITAT 2009) report, ONZ HABITAT defines adequate housing by naming in particular the following dimensions: access to energy for cooking, heating, lighting and protection against cold, humidity, heat, which should be considered as constitutive factors for experiencing energy poverty. In the "*European Fuel Poverty and Energy Efficiency*" (EPEE project 2009) report, energy poverty is defined as "a phenomenon consisting in experiencing difficulties in maintaining an adequate heat standard at a place of residence for a reasonable price". These are just two examples of definitions – quite influential in the literature of the field. None of them is accurate enough for the needs of an operative description of energy poverty, and as such they are not useful for public policy instruments. Based on the existing definitions of energy poverty, we propose a definition which satisfies these needs (Owczarek and Miazga 2015):

> *Energy poverty is a phenomenon consisting in experiencing difficulties in satisfying basic energy needs at a place of residence for a reasonable price, such as maintaining an adequate heating standard, and in other types of energy supply used adequately for satisfying basic biological and social needs of household members.*

The operationalisation of this definition requires to specify "basic energy needs" and "reasonable price (of energy)". In order to do so, household energy costs are compared with household income. The only country with an operationalised definition of energy poverty is the United Kingdom. The UK uses two measures:

- absolute measure, the so-called "10% of income": a household is energy poor if its required[1] energy costs are higher than 10% of disposable income,
- relative measure (Low Income High Costs): a household is energy poor if it incurs high required energy costs in comparison to other households and its income is relatively low in comparison to income of other households.

According to the "10% of income" measure, there were 3.20 million energy poor households in the United Kingdom in 2011, whereas according to the LIHC indicator – 2.57 million (DECC 2013). Nowadays, only the LIHC definition is applied. Public policy instruments aimed at the energy poor, e.g. "Green Deal", Energy Companies Obligation (ECO), Warm Zones England, are based on this measure.

The first research on energy poverty in Poland was conducted in 2012. It was a nationwide assessment of the scale of energy poverty based on the British absolute "10% of income" definition carried out by Kurowski (2012). According to the assessment, approximately 40% of households in Poland were energy poor in 2008. These results are overestimated due to using actual energy costs instead of required ones, as in the United Kingdom (e.g. DECC 2013). Answers to questions about experiencing difficulties in heating an apartment in winter, and cooling it down in summer, asked to respondents as part of a European-wide survey – EU-SILC (EU-SILC 2014) are an approximate subjective indicator of energy poverty in Poland. Poland scored above the EU average for both indicators: 13.2% of households in Poland had difficulties in heating their apartment in winter in 2012 (EU average – 10.8 %), and 25.8% declared that their apartment is not cooled down enough in summer (EU average – 19.1%). Apart from that, the Institute for Sustainable Development and Polish Foundation for Energy Efficiency conducted a survey among Polish communes. The results revealed that energy poverty in Poland might have concerned approx. 7.4 million people (ca. 20% of the population) (Stępniak and Tomaszewska 2014). Nevertheless, it is a very approximate number due to the low ratio of completed questionnaires (35%). On the other hand, the results of a survey conducted in 2015 among residents of two districts in Gdańsk (Wrzeszcz and Przymorze) indicate that the scale of the phenomenon is smaller: Wrzeszcz – 10%, Przymorze – 3% (Frankowski and Tirado-Herrero 2015). However, these results concern only a small urban community and cannot be applied to the entire Polish population. According to our knowledge, the described works are the only research projects on energy poverty in Poland. Therefore, Polish literature fails to provide statistical operationalisation of the definition of energy poverty which could serve as basis for developing social policy instruments supporting those who need help the most.

The aim of this paper is to estimate a statistical measure of energy poverty in Poland. Such a measure should help identify groups which are the most exposed to this problem and might be a potential criterion for receiving support under public policy instruments. To this end, we follow the British methodology and apply both absolute and relative definitions. We then compare the results with the subjective energy situation

[1] Required energy costs of household consist of standard use of heating energy and electricity (appropriate for household in specific type of building) with the prices. They could differ from actual energy costs. Detailed description is in part 3.1.2 and in appendix A.1.

assessment made by households and with income poverty. Apart from a statistical description of the phenomenon, we also conduct econometric analyses whose aim is to identify statistical features most related to energy poverty under a given definition. Thanks to the databases we have used: Polish Household Budget Survey (2013 Polish HBS) and Polish National Energy Conservation Agency (pol. *Krajowa Agencja Poszanowania Energii* - KAPE data), the obtained results may be applied to the entire Polish population. Therefore, it is the most complex and methodologically correct study of energy poverty in Poland so far.

This paper is composed of four parts. After an introduction to the subject matter of energy poverty, we describe the methodology of developing the measure of energy poverty in Poland. In chapter 3, the reader will find detailed results of the study with respect to two measures of energy poverty: absolute (measure of 10% and 13% of income) and relative (LIHC). In chapter 4, we discuss the pros and cons of the presented measures and recommend a measure of energy poverty for Poland.

2 Methodology

Defining energy poverty is based on comparing household energy costs to household income. Both approaches, absolute and relative, use required energy costs, while the difference between them consists in applying a different threshold of income poverty. We base our calculations on the British methodology, published in annual reports issued by the Department of Energy & Climate Change (e.g. DECC 2013).

2.1 Absolute definition

We assume that there is a certain share of energy costs in household budgets, that if is overrun, energy costs are an excessive financial burden for a household. Our definition is based on such energy costs which allow a household to maintain an average heating standard in their apartment and on average use of electrical energy. We assume that the heating standard is 21°C (after: DEEC 2014)[2]. Thanks to using such required costs (also known as: model, standard) instead of actually incurred costs, we avoid including persons who overheat their apartments in the group of the energy poor. At the same time, we take into account those who spend little on energy because they live in insufficiently heated rooms.

In the United Kingdom, the absolute limit of energy poverty line amounts to 10% of income, i.e. all households characterised by required energy costs higher than 10% of their income are energy poor. The question is: how should poverty line be chosen? In Poland, the "10% of income" threshold is inappropriate due to higher average energy expenditure than in the United Kingdom. In 2003-2013, they amounted to approximately 10% of the total disposable income, whereas in the United Kingdom – about 4% of the total disposable income (cf. Table 1). Adopting a 10% threshold for Poland would mean that almost a half of the population is considered to be energy poor. We recommend using a threshold of "13% of income". It is equal to the average share of energy costs in disposable income, calculated based on a sample in which such shares vary from 0 to 1[3].

[2] Detailed description of calculating required energy costs is in part 3.1.2 and in appendix A.1.

[3] In this way, 2% of the sample was omitted in calculating the average. The households, which declare monthly energy expenditures higher than monthly income (shares >1), and households with negative income (shares<0) were omitted.

Table 1. Average energy expenditure in relation to disposable income of households in Poland and United Kingdom in 2003–2013.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Poland											
Energy expenditure per capita (PLN)	73,2	70,2	75,8	86,1	84,6	96,4	107,6	118,2	124,2	127,3	129,7
Disposable income per capita (PLN)	712	735	761	835	929	1046	1114	1201	1235	1278	1299
Energy expenditure / disposable income (%)	10,3	9,6	10,0	10,3	9,1	9,2	9,7	9,8	10,1	10,0	10,0
United Kingdom											
Energy expenditure / disposable income (%)	3	3	4	4	4	5	5	5	5	5	-

Source: Central Statistical Office of Poland 2014 and ONS 2014.

We have calculated energy poverty according to the absolute definition in the following manner:

1. calculating required energy costs
2. calculating the share of required energy costs in household disposable income[4]
3. comparing the share with the threshold of 10% or 13% of income.

2.2 LIHC definition

In the relative approach, both energy costs and household income are compared with costs / income of other households. In this approach, energy poverty occurs if the following two criteria are met: high required energy costs (HC) and low income (LI). This definition is currently used in the United Kingdom. We have calculated it according to the methodology used by DECC in the following steps:

- High costs (HC) criterion:
  1. calculating required energy costs
  2. equivalising energy costs – to compare costs among households irrespective of the number of household members. It is based on the assumption that energy consumption in a household grows with every member, but the growth is not linear. To this end, we calculate the equivalence scale, which states how higher energy costs in a household with a given number of people as compared to a base household (2 persons) should be in order for such a household to maintain the energy consumption standard (cf. Table 2). The equivalence scale is calculated by dividing the median of energy costs of a household with a given number of people by the median of costs of a 2-person household. For instance, the equivalisation factor of 1.19 means that required energy costs of a 4-persons household must be higher than costs of a 2-persons household by 19% in order to maintain the same heating standard and electrical energy consumption. Equivalising energy costs means dividing required energy costs by the equivalency coefficient.
  3. Calculating the median of required energy costs – we assume that a household has high required equalised energy costs if they are higher than their median.

[4] Disposable income is income except taxes, social security contributions and health insurance contributions.

Table 2. A median of required energy costs and equivalisation factor depending on number of persons in a household in Poland and United Kingdom in 2013.

No. of persons in a household	Median of required energy costs (PLN)	Equalisation coefficient – Poland	Equivalisation factor – UK
1	220.59	0.96	0.82
2	230.35	1.00	1.00
3	235.16	1.02	1.07
4	273.27	1.19	1.21
5 and more	435.91	1.89	1.32

Source: Own study based on 2013 Polish HBS.

- Low income (LI) criterion:
  1. calculating disposable income after housing costs (AHC) – disposable costs less lease costs, value of loans and mortgage-secured loans as well as bills for water and other utilities. We assume that costs are always incurred, which is why they should not be taken into account in actual household income.
  2. equivalising household income – a procedure similar to the one described for HC. The coefficients proposed by OECD are used as equivalency coefficients, which is why the first adult in a household equals to 0.58, another adult is 0.42, whereas every child above 14 years old – 0.2 (DECC 2015).
  3. calculating the income threshold – in order to do so, we calculate 60% of the median of equalised AHC income. Next, we increase this value by equalised energy costs of every household. In this way we want to examine which households cannot afford to pay energy bills, i.e. those which become income poor after paying the bills. Therefore, we obtain individual thresholds for each household.
- Energy poverty (LIHC definition):

  households which meet both criteria, i.e. their required energy costs are higher than the median and their AHC income is lower than the income threshold, are considered to be energy poor.

In the present paper, we have presented the methodology closest to the British one. During the research on the definition of energy poverty, we have also tested variation versions. For instance, instead of equating energy costs per person, we have used energy costs per m^2. We have also modified the low income criterion – instead of the threshold of 60% of the median, we have applied a threshold of 50% of the mean or the statutory line of income poverty. The results we have obtained can be found in appendix 2 (A.2). A description of the methodology and indicator variant versions of the definition can be found in Owczarek and Miazga's report (2015).

3 Energy poverty in Poland

3.1 Data

We have calculated the scale of energy poverty in Poland based on the data from the Polish Household Budget Survey (Polish HBS) and data related to required space heating energy consumption, provided by the Polish National Energy Conservation Agency (KAPE). We have used the most recent available data – from 2013.

3.1.1 Polish Household Budget Survey (Polish HBS)

This survey is conducted annually by the Central Statistical Office of Poland (GUS). It includes detailed data related to household income and expenditure, for example energy and housing expenditure. Moreover, the survey contains data on social and economic features of household members and descriptions of apartments and their equipment.

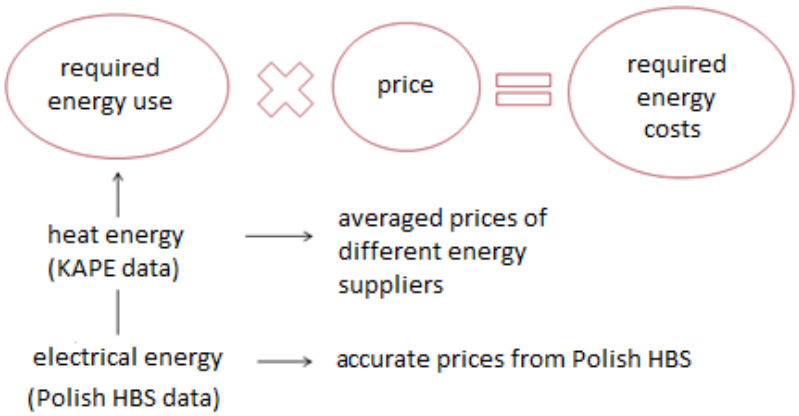
We have used the most recent database as at the time of conducting the survey – from 2013. Households with more than one declared apartment were removed from the original base, consisting of 37,181 observations, due to the lack of information on apartment features. Households for which it was impossible to calculate required energy costs were also omitted. These are households in different types of buildings than those mentioned in the Polish Household Budget Survey (Polish HBS) questionnaire (category: *other*) and heated by means other than those included in the questionnaire (category: *other*). A total of 553 observations were removed from the base (1.49% of the sample). Eventually, the survey was carried out for a sample of 36,629 households (98.5% of the original sample).

While defining energy poverty, from Polish Household Budget Survey (Polish HBS) data, we have mainly used household disposable income. A monthly nature of Polish HBS data impacts the amount of income – in some cases it is equal to 0, whereas in other cases it is negative. This is caused by seasonal income in some households, especially in the case of farms or self-employment.

3.1.2 Required energy costs

Estimating required energy costs for Poland is based on the methodology used in the United Kingdom (Henderson and Hart 2015; DECC 2013). Energy costs are related to energy used for the following purposes: heating rooms, heating water, using light and audio-visual equipment, cooking. We do not analyse costs of fuel and agricultural production into account. The data available for Poland differs from the data for the United Kingdom in terms of time frame (monthly/annual data) and accuracy. Therefore, we have processed the data for Poland in order to make it as similar as possible to the data from the United Kingdom. The structure of required costs is presented in figure 1. Individual components of required energy costs are described below.

Figure 1. Components of required energy costs in Poland.



Source: Own elaboration.

Heat energy costs (data source: KAPE)

Polish National Energy Conservation Agency (KAPE) data contains amounts of heat energy required to heat rooms to a comfortable temperature, which we have set at 21°C (after DEEC 2014). Required amounts of energy are expressed in kWh/m^2/year. The data has been calculated after breaking down into the following categories: type of building, time when the apartment was built, method of heating and insulating the building (in total – 270 values). A description of the methodology of calculating the data by Polish National Energy Conservation Agency (KAPE) and further transformations of obtained data are included in appendix 1 (A.1).

Electricity costs (data source: Polish HBS)

It is impossible to calculate the standard use of electricity with available in Poland data. Therefore, we have assumed that electrical energy costs amount to 60% of the median of electricity costs, separately for each social and economic group (cf. Table 3). We have used the division into social and economic groups since this variable differentiates electricity costs the most[5]. It is consistent with the results obtained in a paper by Lis and Miazga (2015), which shows that electricity costs are more affected by features of households rather than buildings.

Table 3. Required monthly electricity costs of households in Poland 2013 [PLN].

Socio-economic group	Required electricity costs
Employees	PLN 72
Farmers	PLN 84
Self-employed	PLN 95
Pensioners or retirees	PLN 58
Non-earned income sources	PLN 41

Source: Own study based on 2013 Polish HBS.

Overall required energy costs

We assumed that the total amount of required heat (KAPE) and electrical energy (POLISH HBS) costs are required monthly energy costs. In 2013, average required energy costs in Poland amounted to PLN 419 per month, whereas the actual costs were lower – PLN 401 per month. This could mean that a significant number of households in Poland live in insufficiently heated rooms. A comparison of average required and actual costs based on types of buildings can be found in table 4.

Table 4. Required and actual energy costs of households according to types of buildings in Poland in 2013 [PLN].

Type of building	Required energy costs per month (average)	Actual energy costs per month (average)
block of flats	PLN 222	PLN 332
terraced house	PLN 423	PLN 452
detached house	PLN 648	PLN 474

Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by Polish National Energy Conservation Agency (KAPE).

[5] Additionally the differentiation of electricity costs by region, month and city size were checked.

3.2 Results

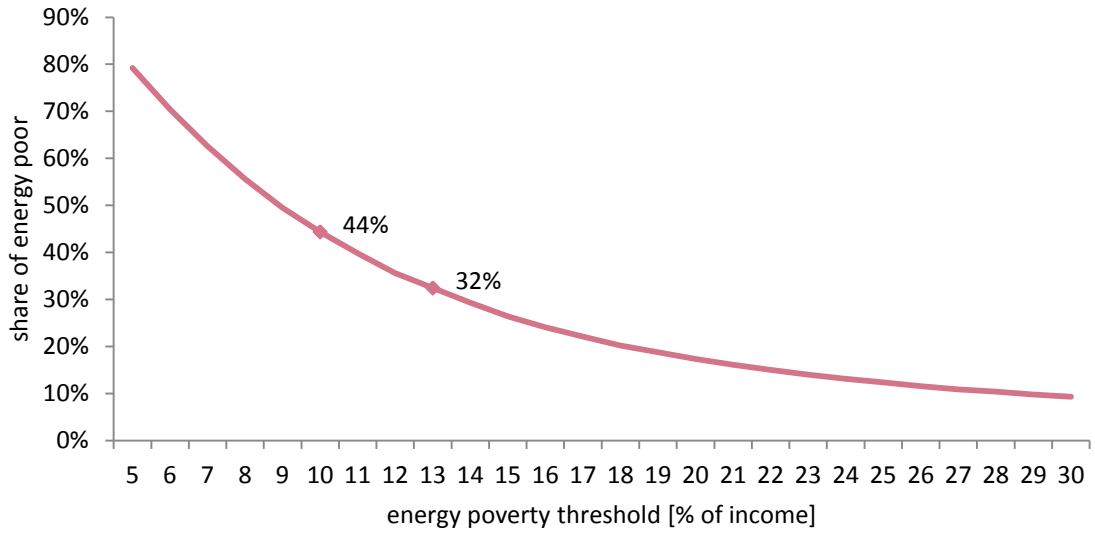
3.2.1 Absolute or relative definition?

Scope of energy poverty

According to the absolute definition of energy poverty with the threshold we proposed (13% of income), in 2013, energy poverty affected 32.4 % of the Polish population (12.7 million people). Using the original British threshold (10% of income) increases the group of the energy poor to 44.4% of the Polish population (17.2 million people).

In the absolute approach, the decision on the threshold of energy poverty is a decision on the scale of energy poverty, so it will always be arbitrary. Increasing the threshold of absolute poverty decreases the number of the energy poor (cf. Chart 1).The most significant changes can be observed in the case of lower thresholds (e.g. a threshold of 5% of income – 79% of the energy poor in Poland in 2013, a threshold of 6% of income – 70% of the energy poor), and the smallest – in the case of higher thresholds (1% changes). Changing the threshold from 10% of income to 13% of income in 2013 in Poland reduces the group of the energy poor by 12 pp.

Chart 1. Share of people living in energy poverty as compared to the absolute threshold of energy poverty in Poland in 2013.



Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

The relative definition is less sensitive to a threshold change. **According to the LIHC definition, in 2013, energy poverty affected 17.1 % of the Polish population (6.44 million people).** Both in the case of considering poverty in terms of deprivation and developing potential support tools, the level of energy poverty in the relative approach is in our opinion more adequate than the very high level obtained by means of the absolute definition (32.4%) (cf. Table 5).Energy poverty defined by means of both definitions is strongly correlated (correlation coefficient = 0.57). The group of people living in poverty according to the LIHC definition is contained almost entirely in the group of people living in poverty according to the absolute "13% of income"

definition: 91% of people living in poverty according to LIHC is poor also according to the absolute definition. This means that the LIHC definition separates the group which actually struggles with satisfying basic needs related to electrical and heat energy in a more accurate manner. Among the group of the energy poor according to the absolute "13% of income", 48% are living in energy poverty according to the LIHC definition.

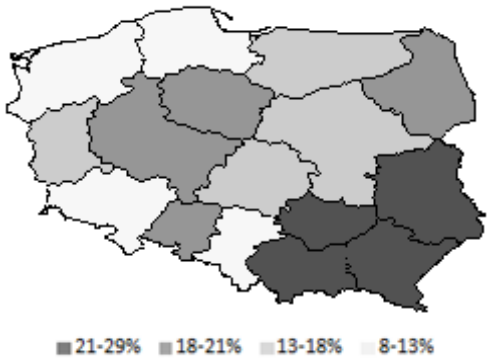
Table 5. Scale of energy poverty in Poland in 2013.

	Energy poverty in Poland according to		
	Absolute "10% of income" definition	Absolute "13% of income" definition	Relative LIHC definition
Share of persons in households	44.4%	32.4%	17.1%
No. of persons	17,200,000	12,700,000	6,440,000

Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

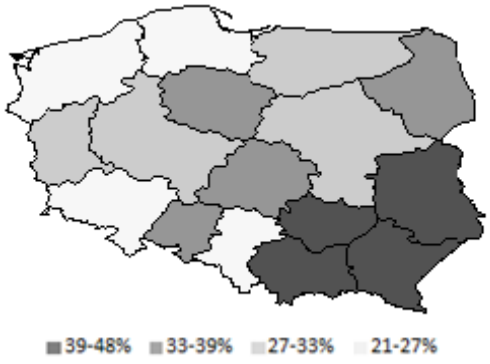
A chosen method of measuring energy poverty has a small impact on regional diversification of the phenomenon (cf. Chart 2 and Chart 3). In Poland, energy poverty concentrates in south-eastern regions: Lubelskie, Świętokrzyskie, Małopolskie and Podkarpackie (according to the LIHC definitions: 21-29% of the energy poor in 2013). The least affected by this problem are the regions in north-western and south-western Poland: Pomorskie, Zachodnio-pomorskie, Śląskie and Dolnośląskie (according to the LIHC definition: 8-12% of the energy poor in 2013). The reasons for such a large share of the energy poor in south-eastern regionss are harsher climate and larger share of income poverty in this region (e.g. in Podkarpackie region – 9.4% of threatened by extreme poverty in 2013 as compared with 7.1% in Zachodnio-pomorskie region (Central Statistical Office for Poland)).

Chart 2. Share of the energy poor according to the LIHC definition in 2013 in Poland per region [%].



Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

Chart 3. Share of the energy poor according to the absolute "13% of income" definition in 2013 in Poland per region [%].



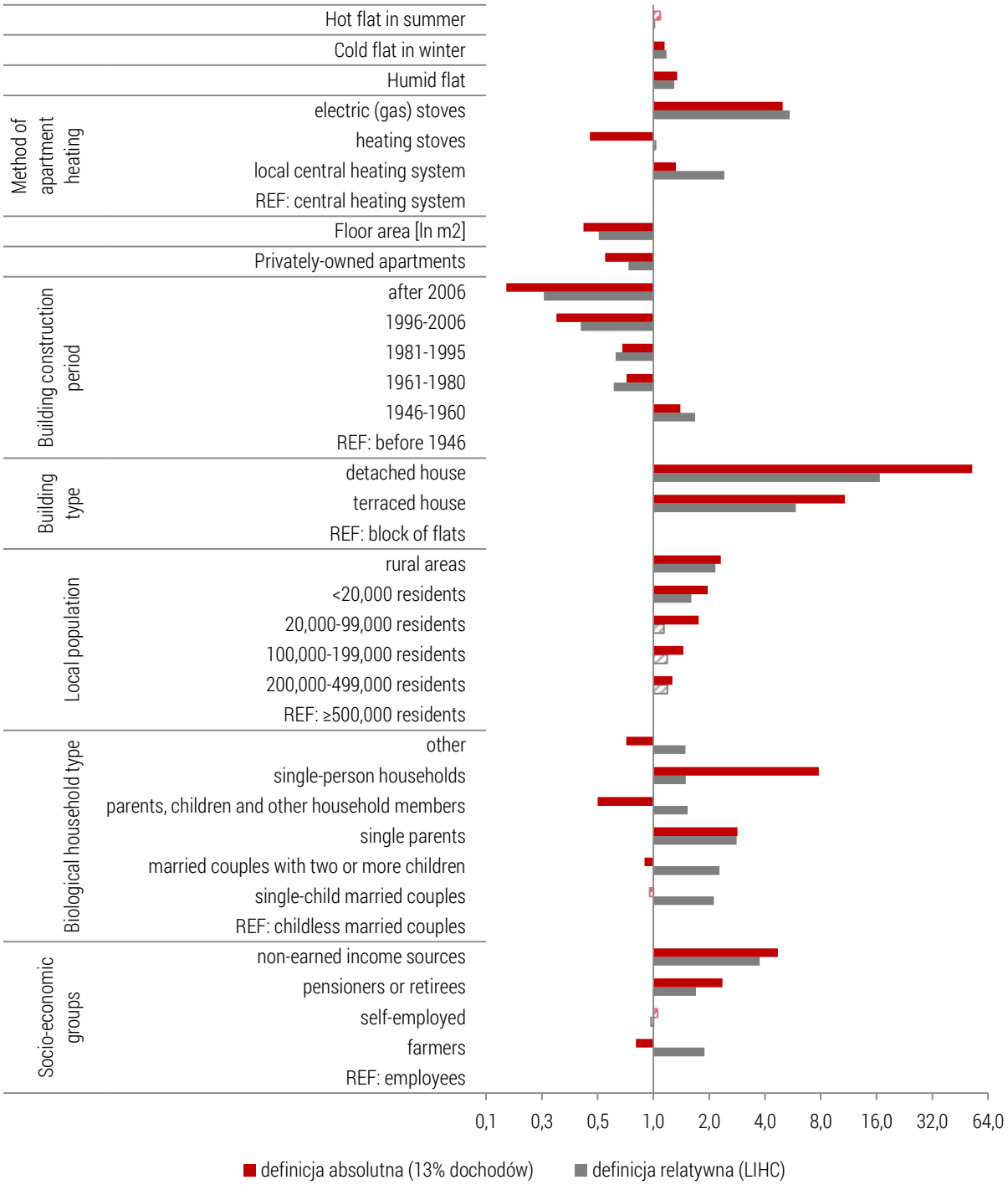
Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

Description of the energy poor

The way of measuring energy poverty results not only in a different scale of energy poverty in Poland but in a different identification of features of household and apartments which are statistically the most related to the risk of energy poverty. The largest difference relates to the biological type of a household (cf. Chart 4). **According to the absolute definition using the threshold of 13% of income, one-person households are the most exposed to energy poverty** (odds ratio = 7.8), **and according to the LIHC – single parents with children and married couples with at least 2 children** (odds ratio – 2.8 and 2.3. respectively). In both definitions, **energy poverty affects persons deriving means of subsistence from non-profit sources**, especially allowances and social aid, **the most** (odd ratio in the absolute "13% of income" definition – 4.7, in the LIHC definition – 2.3 and 1.6. respectively).

No significant differences between both definitions can be observed in terms of features of apartments. **The energy poor usually live in single-family detached or terraced houses.** This feature affects the level of energy poverty the most. Usually these are old buildings: pre-war or built in 1946-1960. Moreover, a greater risk of not satisfying one's needs related to energy is faced by persons living in buildings owned by a cooperative or the State Treasury. In most cases, this problem affects persons heating their apartments with electrical or gas heaters (odds ratio for the absolute "13% of income" definition – 5.0, and LIHC = 5.4). In the LIHC definition, more people exposed to energy poverty use central local heating (odds ratio for the absolute "13 of income" definition – 1.3, LIHC – 2.4).

Chart 4. Probability of energy poverty according to features of households and apartments broken down by the absolute "13% of income" definition and LIHC definition in Poland in 2013 (odds ratio).



Note: In the chart, we presented logistic regression results in the form of odds ratios. Values higher than 1 indicate that a given analysed phenomenon is more likely to occur (here: energy poverty), whilst values below 1 correspond to odds lower than baseline (REF). ***Hatched bars mean statistically significant variables at the 5% significance level.***

Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

3.2.2 Energy poverty – objective versus subjective measures

Our estimations of energy poverty in Poland can be compared to heating comfort assessment made by the respondents to the Polish Household Budget Survey (Polish HBS). In 2013, 11% of the Polish population declared that they lived in buildings with damp walls or leaking roofs, 12% – apartments insufficiently heated in winter and 17.8 % – too high temperature in the apartment in summer (cf. Table 6). Therefore, we may conclude that **in 2013 the subjective energy deprivation of apartments in Poland amounted to 27.7%**, i.e. 27.7% of respondents declare at least one of the three dimensions mentioned above.

Table 6. Scale of energy poverty in Poland in 2013 according to subjective indicators of the absolute "13% of income" and LIHC definitions.

	Damp apartment[1]	Not warm enough in winter	Not cool enough in summer	Subjective energy deprivation of apartments[2]
Share of the population [%]	11.02	12.00	17.75	**27.79**
Share of the subjectively energy poor in the group of the energy poor per definition:				
Absolute "13% of income" [%]	13.31	13.35	15.03	**27.45**
LIHC [%]	14.77	13.59	14.10	**27.70**
"13% of income", excluding the group of poor according to LIHC [%]	11.72	12.98	15.73	**19.50**

[1] *Leaking roof, damp walls, floors, rotten windows.*
[2] *Subjective energy poverty is a disjunction of occupants' three opinions on heat comfort in apartments listed above.*
Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

The group of the energy poor in an objective approach (absolute or relative definition) slightly overlaps with the group of people struggling with energy deprivation of apartments (cf. Table 6). For instance, only 14.7% of the energy poor according to the LIHC definition declare that they lived in damp buildings, and 13.5 % in apartments insufficiently heated in winter. **The overlap between the group of subjective energy deprivation of apartments and energy poverty is similar for relative and absolute definitions.** The analysis of these three indicators does not show any contradictions to choosing the LIHC definition over the absolute "13 of income" definition since it does not omit a significant group of people declaring deprivation of apartments in this respect. Among the energy poor according to the absolute "13 of income" definition who are at the same time classified as the poor according to the LIHC definition, the share of people declaring difficulties with heating or cooling an apartment are comparable with the share of the entire population (e.g. in the case of a damp apartment – 11.7% and 11.0%, respectively).

A small overlap between the group of people declaring heat discomfort in apartments and the energy poor may be caused several reasons. Firstly, the subjective deprivation is related only to heat comfort and ignores electrical energy consumption, which is taken into account when defining energy poverty. Having analysed energy costs of people declaring energy deprivation, we notice no significant difference between the energy poor according to the LIHC definition and the group affected by these problems (the median: PLN 239 and 285, respectively). The second factor might be relatively high income of people declaring heat discomfort in

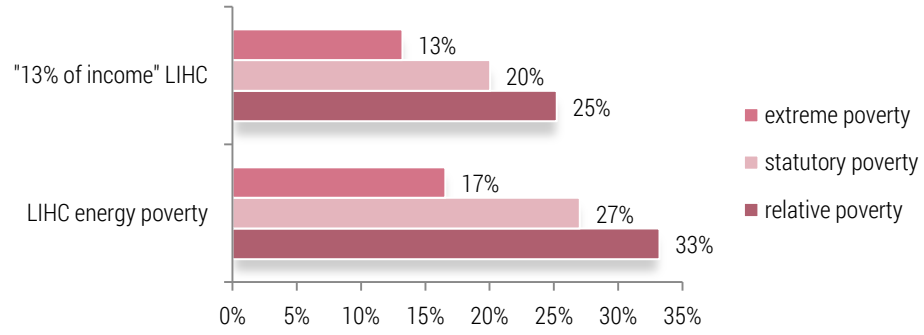
apartments. The median of equivalent income of these households amounts to PLN 1,500 per month, whereas in the case of households declaring problems with heating the apartment – PLN 1,780. One must remember that energy deprivation is a subjective indicator which does not have to reflect reality. A subjective assessment of the financial situation of households is usually described with respect to objective indicators instead of being an indicator on its own (cf. Ciura 2002; Hanusik and Łangowska-Szczęśniak 2013, Central Statistical Office for Poland 2014).

The results of logistic regression indicate correct identification of the group of the energy poor in our research (Chart 4). **Persons declaring that they live in damp buildings are characterised by a higher probability of being energy poor than those who do not declare such a problem** (odds ratio – 1.3; cf. Chart 4). Living in a building that is not warm enough in winter also increases the risk of energy poverty.

3.2.3 Energy poverty and income poverty

Energy poverty is not tantamount to income poverty, though to a certain extent these phenomena affect the same households. This statement is confirmed by low correlation between income and energy poverty, in the case of coefficients calculated for both the absolute (correlation coefficient of 13-16%, depending on income poverty definition[6]) and the relative definition (correlation coefficient of 15-20%) of the latter term. Only 33% of households living in energy poverty, understood in accordance with the LIHC definition, also experience relative income poverty (cf. Chart 5). Energy poverty, as per the "13% of income" definition, overlaps with statutory income poverty to an even lesser degree: only 20% of individuals afflicted by energy poverty are also stricken by income poverty. **Energy poverty can be classed as one of the multiple dimensions of social exclusion,** or – in other words – forms one of the hindrances to satisfying one's income and non-income needs which contribute to the social marginalisation of both households and individuals (Panek, 2008)

Chart 5. Share of income poor households in the group of households experiencing energy poverty in Poland in 2013.



Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

[6] It is possible to discern three poverty thresholds (Central Statistical Office, 2013): the extreme poverty threshold (falling below this poverty line corresponds to failure to satisfy housing and nourishment needs which entails a threat to life and psychological and physical development, calculated by the Institute for Labour and Social Studies (IPiSS) on the basis of equivalence scales), the relative poverty threshold (set at 50% of average costs of all households) and the statutory poverty threshold (pursuant to the Act of Social Assistance, reaching this threshold entitles a household to receive material social assistance; until 2012 this threshold was set at PLN 351 per member of multi-person household, and in 2014: PLN 456, and in 2015: PLN 514).

Households affected by both income and energy poverty can be classified as a case of abject energy poverty. The equivalised income of such households is, on average, lower by PLN 200 than that of households suffering from income poverty alone (relative definition) (cf. Table 7). In terms of the relative definition, equivalised income of households affected by both income and energy poverty amounts to an average of PLN 847 (median: PLN 825), while that of households experiencing only income poverty – PLN 1,078 on average (median: PLN 1,197). To compare, average income of households not remaining in any state of poverty equals PLN 2,241 (median: PLN 2,001).

Table 7. Average and median equated income of households living only in income poverty and of households experiencing both income and energy poverty in Poland in 2013, broken down by definition type.

Household		Equated household income	
		Average [PLN]	Median [PLN]
relative definition	Household stricken by income poverty	1078	1197
	Household stricken by income and energy poverty[1]	847	825
	Relatively "not poverty-stricken"	2341	2001
absolute definition	Household stricken by income poverty	1213	1111
	Household stricken by income and energy poverty[2]	836	779
	Definitely "not poverty-stricken"	2421	2094

1. Relative income poverty and relative energy poverty (LIHC).

2. Statutory income poverty and absolute energy poverty ("13% of income").

Source: Own study based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

Energy poverty is connected with other features of households and apartments than in the case of income poverty. Such conclusions follow from the analysis of the logistic regression performed for income poor population so as to identify correlates of simultaneous energy poverty occurrence (cf. Table 8). As concerns the relative definition of energy poverty, the group formed by single-child married couples, single parents or single-person households is more frequently exposed to energy and income poverty than households living only in income poverty (odds ratios for relative definition equal 2.5, 1.9 and 1.5, respectively). It is much more commonplace for such households to reside in detached and terraced houses than in blocks of flats (odds ratios for relative definition equal 32.5 and 7.7, respectively, and for absolute definition: 33.6 and 4.9, respectively). It is less often the case that such households dwell in new buildings, especially residential facilities constructed after 2006 (odds ratio for relative definition: 0.3, and absolute definition: 0.4). Among the income-poverty-stricken, energy poverty affects rather residents of large apartments (odds ratio: 0.6 and 0.5, respectively). Statistically significant differences are also noted in applied heating methods: households living in income poverty are more likely to qualify as households suffering from energy poverty if they use the local central heating system, i.e. use solid- or liquid-fuel stoves for heating the entire apartment, or electric or gas stoves (odds ratio: 2.8 and 1.8, relatively). This means that **contrary to income poverty, energy poverty is to a large extent determined by physical features of buildings and apartments and the method of space heating.**

Table 8. Likelihood of simultaneous energy and income poverty occurrence as compared with only income poverty occurrence in Poland in 2013 (odds ratios).

		Dependent variable: Income and energy poverty	
		relative[1]	absolute[2]
Socio-economic groups	REF: employees		
	farmers	0.789	0.494***
	self-employed	0.941	1.342
	pensioners or retirees	1.087	1.627***
	non-earned income sources	1.296	2.474***
Biological household type	REF: childless married couples		
	single-child married couples	2.465***	0.653
	married couples with two or more children	1.035	0.238***
	single parents	1.866*	0.509*
	parents, children and other household	0.740*	0.143***
	single-person households	1.552**	5.407***
	other	1.299	0.294***
Local population	REF: ≥500,000 residents		
	200,000-499,000 residents	1.386	0.936
	100,000-199,000 residents	0.991	0.614
	20,000-99,000 residents	1.387	0.630
	<20,000 residents	1.220	0.440
	rural areas	1.548	0.567
Building type	REF: block of flats		
	terraced house	7.704***	4.911***
	detached house	32.522***	33.597***
Building construction period	REF: before 1946		
	1946-1960	1.064	0.848
	1961-1980	0.658***	0.723*
	1981-1995	0.690*	0.892
	1996-2006	0.322***	0.364***
	after 2006	0.298***	0.383**
Privately-owned apartments		0.857	0.970
Floor area [ln m^2]		0.591***	0.471***
Method of apartment heating	REF: central heating system		
	local central heating system	2.843***	1.835**
	heating stoves	0.602*	0.476***
	electric (gas) stoves	9.683***	3.435**
Apartments with excessive indoor humidity		1.215	1.244
Apartments with low indoor temperatures in winter		0.907	0.959
Apartments with high indoor temperatures in summer		0.978	0.925
Constant		0.453	40.289***
No. of observations		4429	3006
Pseudo R^2		0.325	0.333
Linktest		no	yes

[1] *Relative income poverty and relative energy poverty (LIHC).*

[2] *. Statutory income poverty and absolute energy poverty ("13% of income").*

*Note: In the table, we presented logistic regression results in the form of odds ratios. Values higher than 1 indicate that a given analysed phenomenon is more likely to occur (here: income and energy poverty), whilst values below 1 correspond to odds lower than baseline (REF). The response variable assumes 0 value for households affected by income poverty and 1 for individuals suffering from both income and energy poverty. Significance level: * - p<0.05 , ** - p<0.01, *** - p<0.001.*

Source: Own study based on 2013 Polish HBS and estimates of required energy costs published by the KAPE.

4 Discussion of Results and Conclusions

According to the LIHC measure we proposed, energy poverty in Poland affected 17% of the Polish population in 2013 (6.44 million people). This predominantly concerned inhabitants of rural areas and small towns, single-family houses, single parents with children and married couples with two or more children. Similar conclusions may be drawn from the analysis of groups vulnerable to energy poverty as per the absolute "13% of income" definition. In accordance with this definition, a staggering 34% of Poland's population (17.2 million people) was affected by energy poverty in 2013. The largest difference concerns the demographic structure of households – according to the absolute definition, these are one-person households, according to LIHC – single parents with children and married couples with at least two children. In the case of both definitions, energy poverty is most prevalent in south-eastern Poland. The overlapping of the groups of subjective assessment of the heating discomfort of apartments and energy poverty is unsubstantial and similar for relative and absolute definitions: ca. 27% of the energy poor declare problems with ensuring a comfortable temperature in their apartments.

The absolute and relative measures demonstrate various aspects of energy poverty. The absolute measure indicates the percentage of households that cannot afford a certain pre-defined standard of energy use. The structure of the measure is simple, yet the practical difficulty lies in defining the poverty threshold, i.e. the standard of energy use that makes it possible to live in decent housing conditions. Our research demonstrates that the decision on selecting the threshold of energy poverty is a decision on the scale of energy poverty, which is why it will always be arbitrary. The LIHC definition seems a better measure, as it does not assume any arbitrary threshold, and only compares the income and energy costs of all households. The cornerstone of this concept is the assumption that any support should be directed to the most needy as compared to the remainder of the population. When choosing the measure of energy poverty, we should bear in mind that defining the problem is both a methodological and a political decision. This stems from the fact that the next step following the creation of a measure is the proposal of social policy instruments aimed to help the poorest groups (cf. Dubois 2012). This was also the case in the UK, where the transition from the absolute to the LIHC definition caused the bulk of public support to be shifted from pensioners or retirees to families with three or more children.

One value of our research consists in the use of required energy costs – for the first time in the Polish context. These costs allow us to analyse households' demand for energy rather than its real consumption or costs incurred for this purpose, which may stem from irrational energy management. Therefore, we avoid including persons who overheat their apartments to the group of energy poor. At the same time, we take into account those who spend little on energy since they live in underheated rooms. In this aspect, our results provide hitherto the most precise estimate of energy poverty in Poland. Furthermore, this is the first time that we have calculated the LIHC definition for Poland. Further research could be aimed at specifying the standard use of electric energy. Our research assumed 60% of the median of real costs[7] as standard electricity costs.

[7] Divided into socio-economic groups of households.

Owing to the use of Polish HBS data, our results may be generalised to the entire population of Poland. Comparing the results of our study with other research projects on energy poverty in Poland allows us to draw a number of conclusions (cf. Table 9). First of all, on account of using various research methods (qualitative/quantitative) and the different scope of research (local/nationwide studies) – we have obtained a different scale of the problem in Poland. Owing to precise modelling on the British methodology and the possibility to generalise the results to the entire population of Poland, we are of the opinion that our results best reflect the reality (that may not be observed directly). What is more, some of the vulnerable groups overlap with groups singled out in other studies. Similarly to our research, the qualitative research conducted by Frankowski and Tirado-Herrero (2015) revealed that energy poverty most often affected households with children and inhabitants of old buildings.

The subject of energy poverty in Poland is relatively unknown, as can be inferred from the very few studies in this field. It is sometimes argued that energy poverty is one of the elements of income poverty, as it means having insufficient funds to cover energy bills. However, our research proves that the groups of income poor and energy poor overlap but to a limited extent. Only 30% of the energy poor as per the LIHC definition also experience income poverty. This stems from the fact that contrary to income poverty, energy poverty is to a large extent determined by the characteristics of buildings and apartments and their method of heating. Persons with adequately high income may have a problem with paying their energy bills on account of living in energy inefficient houses. The energy and income poor – much more often than "just" the income poor – live in detached houses and older buildings and rely on local central heating. Therefore, energy poverty is to be treated as one of the dimensions of multidimensional poverty, which may lead to social exclusion. Limiting energy poverty may also lead to curbing income poverty.

Table 9. Review of research projects on energy poverty in Poland.

Research	Data	Sample	Method	Percentage of the energy poor*	Groups most at risk from energy poverty	Notes
Miazga and Owczarek (2015)	Polish HBS 2013 and KAPE data	36,628 households	Quantitative analysis	Absolute definition "13% of income": 34%	- one-person households - non-earned income sources households - inhabitants of detached houses - inhabitants of old buildings - inhabitants of towns and villages - using local central heating	Relying on required energy costs; possibility to generalise the results to the population of Poland.
				LIHC definition: 17%	- as above (apart from one-person households) - single parents with children - married couples with two or more children	Relying on required energy costs; possibility to generalise the results to the population of Poland.
Frankowski and Tirado-Herrero (2015)	March 2015	households from Gdańsk districts: 300 – Wrzeszcz (Górny, Dolny), 300 – Przymorze (Wielkie i Małe)	PAPI survey	10% - Wrzeszcz, 3% - Przymorze	- households with children - households of elderly persons - poorest households - inhabitants of the oldest buildings - inhabitants of council flats - using coal or other solid-fuel stoves for heating	No possibility to generalise the results to the population of the entire country on account of the specific demographic and housing characteristics of selected districts.
Stępniak and Tomaszewska (2014)	2014	2,479 communes in Poland	Survey	Ca. 20% (7.4 million)	-	On account of the low percentage of responses provided (35%), it could be said that what was obtained was a measure of knowledge on energy poverty rather than the actual scale of the phenomenon.
Kurowski (2012)	Polish HBS 2008	37,358 households	Quantitative analysis	40%	- pensioners or retirees - small towns - one-person households - single parents with children	British methodology employed using real energy costs.

** Energy poverty defined as: Miazga and Owczarek (2015) – absolute definition of "13% of income" or LIHC definition; Frankowski and Tirado-Herrero (2015) – question: "Are you able to heat your apartment to a comfortable temperature?"; another criterion used by researchers is the income criterion: real energy costs > 20% of income; Stępniak and Tomaszewska (2014) – response to the question "Has the energy poverty problem of the inhabitants been diagnosed within the local government unit? If so, based on what data was it estimated and what is its scope?"; Kurowski (2012) – real energy costs > 10% income.*

Source: Own analysis.

References

Ciura, G. (2002). *Ubóstwo i sfera niedostatku*, Kancelaria Sejmu Biuro Studiów i Ekspertyz, Warszawa.

Department of Energy & Climate Change (2013). *Annual Report on Fuel Poverty Statistics 2013*.

Department of Energy & Climate Change (2014). *Annual Report on Fuel Poverty Statistics 2014*.

Department of Energy & Climate Change (2015). *The Fuel Poverty Statistics Methodology and User Manual*.

Dubois, U. (2012). From targeting to implementation: The role of identification of fuel poor households. *Energy Policy*, No. 49, pp. 107-115.

EPEE project (2009). Tackling Fuel Poverty in Europe. Recommendations Guide for Policy Makers. In: EPEE project, *European Fuel Poverty and Energy Efficiency*.

EU-SILC (2014). *Living conditions in Europe*, Eurostat.

Frankowski, J. & Tirado-Herrero, S. (2015). *Energy vulnerability of the urban areas in Gdańsk. First results of the EVALUATE project*. Presentation given at the workshop "Energy vulnerability of urban areas", Gdańsk.

Główny Urząd Statystyczny (2013). *Ubóstwo w Polsce w świetle badań*.

Główny Urząd Statystyczny (2014). *Budżety gospodarstw domowych w 2013 roku*.

Hanusik, K. & Łangowska-Szczęśniak, U. (2013). Uwarunkowania samooceny sytuacji materialnej gospodarstw domowych w Polsce w 2011 r. *Konsumpcja i Rozwój*, No. 1 (4), pp. 83-97.

Henderson, J. & Hart, J. (2015). *BREDEM 2012 – A technical description of the BRE Domestic Energy Model.*

Kurowski, P. (2012). Zagrożenie ubóstwem energetycznym. Próba ustalenia zjawiska (na podstawie danych GUS), *Biuletyn Urzędu Regulacji Energii*, No. 79.

Kurowski, P. (2014). *Wydatki mieszkaniowe gospodarstw domowych i ubóstwo energetyczne. Skala zjawiska & grupy wrażliwe*. Presentation of Instytut Pracy i Spraw Socjalnych.

Li, K., Lloyd, B., Liang, X. J. & Wei, Y. M. (2014). Energy poor or fuel poor: What are the differences? *Energy Policy*, No. 68, pp. 476-481.

Liddell, C. & Morris, C. (2010). Fuel poverty and human health: a review of the recent evidence. *Energy Policy*, No. 38(6), pp. 2987–2997.

Lis, M. & Miazga, A. (2015). *Kogo obciąży wzrost cen energii? Mapa wydatków energetycznych Polaków*, No. 11/2015, Instytut Badań Strukturalnych.

Office for National Statistics (2014). *Full Report: Household Energy Spending in the UK, 2002-2012*.

Owczarek, D. & Miazga, A. (2015). *Ubóstwo energetyczne w Polsce – definicja i charakterystyka społeczna grupy*, Instytut na Rzecz Ekorozwoju, Warszawa.

Panek T. (2008). Ubóstwo i nierówności: dylematy pomiaru, In: *Statystyka społeczna – dokonania, szanse, perspektywy*, BWS, Vol. 57, GUS, Warszawa, pp. 96-108.

Stępniak, A. & Tomaszewska, A. (2014). *Ubóstwo energetyczne a efektywność energetyczna. Analiza problemu i rekomendacje,* Instytut na Rzecz Ekorozwoju.

Tarkowska, E. (2012). *Ubóstwo i wykluczenie społeczne: sytuacja i kultura*, In: Polska początku XXI wieku: przemiany kulturowe i cywilizacyjne, ed. K. Frysztacki, P. Sztompka, Warszawa: Polska Akademia Nauk, Komitet Socjologii, pp. 223-245.

UN-HABITAT (2009). The Right to Adequate Housing, *Fact Sheet No. 21/Rev. 1*.

Węglarz, A., Kubalski, G. & Owczarek, D. (2014). *Propozycje mechanizmów wsparcia procesu przeciwdziałania zjawisku ubóstwa energetycznego w Polsce*, Instytut na Rzecz Ekorozwoju.

Appendices

A.1. Methodology of calculating required space heating costs in Poland (KAPE)

The demand for usable energy to heat buildings was calculated by Arkadiusz Węglarz, PhD, Eng. (KAPE) and Dariusz Heim, PhD hab., Eng. The data contains modelled amounts of heat energy required to heat rooms to a comfortable temperature, which we have set at 21°C. The required amounts of energy are expressed in kWh/m^2/year. The data broken down into the following categories, in total:

Table A1. Category of buildings, for which the required heating costs were calculated.

Variable	Levels
Building type	block of flats
	terraced houses
	detached house
Building construction period	before 1946
	1946–1960
	1961–1980
	1981–1995
	1996–2006
	after 2006
Method of apartment heating	central heating system
	local central heating system (solid fuels)
	fuel (coal) stoves
	gas heating
	electric heating
Building insulation	yes
	no
	partial

Source: Own elaboration.

The calculations were made according to the PN-EN 13790 norm using the monthly method. Based on the amount of demand for usable energy to heat buildings, the final energy amount was established pursuant to the Regulation of the Minister of Infrastructure and Development of 27 February 2015 on the methodology of establishing the energy characteristics of a building or a part thereof and energy characteristics certificates. Heating calculations were made on two models of buildings: single-family and multi-family, i.e. the most common building types in Polish housing. Terraced and semi-detached houses were constructed as replications of the structure of the single-family house and separate calculations were made for such new models; the results of these calculations (for semi-detached and terraced houses) were averaged (arithmetic mean).

Then, the data was subject to transformations:

1. Calculation of heating costs for the entire apartment: KAPE data * apartment floor area.
2. For apartments connected to the heating network, regional differentiation of energy prices was taken into account. This was done on account of the high differentiation of heat prices in the network between regions (in 2013, differences were as high as 30%) (BDL data[8]).
3. Calculation of monthly heating costs:
   Since heat use is different in various months, we relied on Polish HBS data to calculate monthly differentiation between real heating costs. For our calculations, we applied a breakdown into building classes, i.e. building type, its age and heating method[9] jointly, as different building types may have differ in the seasonality of their heating costs. The resulting monthly ratios were then multiplied by the required costs to obtain hypothetical monthly heating costs.
4. On account of the lack of data on building insulation, we assume partial insulation of all buildings (arithmetic mean from values for houses with exchanged windows, insulated roofs or insulated walls).
5. Data on the required energy use for terraced and semi-detached houses was averaged to one of the Polish HBS categories (*terraced single-family house*).
6. Data on the required energy use for electric and gas heating was averaged to one of the Polish HBS categories (*electric(gas) stoves*).

[8] Bank of Local Data (Bank Danych Lokalnych) – internet database maintained by the Central Statistical Office.

[9] We have used the classification for which we obtained data on hypothetical costs (cf. Table A1). 107 building classes in total.

A.2. The scale of energy poverty in Poland in 2013 according to alternative versions of the LIHC definition

Low Income (LI) criterion	High Costs criterion – equivalised energy costs (original definition)		High Costs criterion – energy costs per m^2 of the apartment (alternative definition)	
	in %	no. of people	in %	no. of people
60% of the median	17.1%	6 437 151	17.9%	6 735 415
50% of the average	16.4%	6 150 608	17.1%	6 403 456
Statutory poverty line	10%	3 760 720	10.8%	4 058 696

Source: Own analysis based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

A.3. Results of logistic regression for the dependent variable energy poverty (parameter estimates)

		Dependent variable – energy poverty according to	
		the LIHC definition	the absolute "13% of income" definition
Socio-economic groups	REF: employees		
	farmers	0.635***	-0.218***
	self-employed	-0.030	0.049
	pensioners or retirees	0.527***	0.858***
	non-earned income sources	1.321***	1.546***
Biological type of household	REF: childless couple		
	single-child couple	0.752***	-0.047
	couple with two or more children	0.822***	-0.109*
	single parent with children	1.033***	1.043***
	parents, children and others	0.424***	-0.691***
	one-person households	0.402***	2.055***
	other	0.398***	-0.337***
Locality population	REF: ≥500,000 residents		
	200,000-499,000 residents	0.172	0.237**
	100,000-199,000 residents	0.169	0.372***
	20,000-99,000 residents	0.129	0.562***
	<20,000 residents	0.471***	0.675***
	rural areas	0.770***	0.837***
Building type	REF: block of flats		
	terraced house	1.768***	2.378***
	detached house	2.813***	3.963***
Building construction period	REF: before 1946		
	1946-1960	0.517***	0.334***
	1961-1980	-0.494***	-0.332***
	1981-1995	-0.469***	-0.388***
	1996-2006	-0.903***	-1.206***
	after 2006	-1.362***	-1.826***
Privately-owned apartments		-0.308***	-0.598***
Floor area [ln m^2]		-0.680***	-0.869***
Method of heating the apartment	REF: central heating system		
	local central heating system	0.880***	0.280***
	fuel stoves	0.025	-0.788***
	electric (gas) stoves	1.692***	1.606***
Apartments with excessive indoor humidity		0.260***	0.296***
Apartment with low indoor temperatures in winter		0.161**	0.139**
Apartment with high indoor temperatures in summer		0.022	0.083

Region	REF: Mazowieckie		
	Dolnośląskie	-0.313***	0.078
	Kujawsko-pomorskie	0.086	0.358***
	Lubelskie	0.442***	0.344***
	Lubuskie	-0.124	0.140
	Łódzkie	0.149*	0.355***
	Małopolskie	0.250***	0.293***
	Opolskie	0.001	0.174
	Podkarpackie	0.428***	0.502***
	Podlaskie	0.125	0.437***
	Pomorskie	0.308***	0.2389**
	Śląskie	-0.132	0.016
	Świętokrzyskie	0.068	0.332***
	Warmińsko-mazurskie	0.033	0.152
	Wielkopolskie	0.102	0.162**
	Zachodniopomorskie	-0.185	0.048
Month of survey performance	REF: January		
	February	-0.128	-0.063
	March	-0.234**	-0.268***
	April	-0.605***	-0.749***
	May	-0.829***	-1.049***
	June	-0.970***	-1.088***
	July	-0.634***	-0.705***
	August	-0.329***	-0.238***
	September	-0.109	0.036
	October	-0.141	-0.041
	November	-0.294***	-0.226**
	December	-0.584***	-0.369***
Constant		-1.643***	0.805***
No. of observations		36628	36628
Pseudo R^2		0.293	0.381
Linktest		yes	no

*Significance level: * - p<0.05 , ** - p<0.01, *** - p<0.001.*

Source: Own analysis based on 2013 Polish HBS and estimates of required energy costs calculated by the Polish National Energy Conservation Agency (KAPE).

instytut
badań
strukturalnych

www.ibs.org.pl