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Energy Poverty in Poland: Scale Analysis and Differentiation on the Example of the Communes of Augustów County

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Abstract

Background: The military conflict between Russia and Ukraine has resulted in a significant reduction in the supply of raw energy materials from Russia to Poland. Energy prices in Poland increased drastically in the second half of 2022. Thus, it seems necessary to investigate the scale of energy poverty in Poland in order to effectively support the affected households. As support policies are only meaningful at the commune level, the aim of the research undertaken by the authors was to analyze the factors and determine the extent of energy poverty in households in the selected area — i.e., Augustów County. The second aim of the study was to highlight that the choice of the research method and the criteria adopted may lead to significantly large discrepancies in the results, which may determine the choice of the survey method by political and economic factors. The following were used in order to verify the hypothesis of a greater extent of energy poverty in rural than in urban communes. Methods: the research used statistical calculation and analysis of the extensive literature on definitions and theories of poverty measurement. Results: the research showed spatial variation in energy poverty in the studied county (27.85%) and in its communes. In the town of Augustów, it was 11.00%, and in the commune of Płaska, with the highest poverty level, it reached over 64.00%. Conclusions: The research method chosen, based on the statutory definition of energy poverty, significantly reduces the incidence of the phenomenon compared to other methods. No consensus has been reached in the literature on the definition of energy poverty. This has led to the adoption of different methods and criteria for the study, resulting in significant differences in determining its scale, thereby obstructing the pursuit of support policies for households.

Keywords: Augustów County, commune, definition, energy poverty (EP), energy transition, measuring method, objective factors, Poland

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Introduction

Energy poverty, although not officially defined in the EU,[1] is already a problem that has been well discussed in the literature since the end of the last century (Boardman 1991; Hagenaars and

1. See: European Parliament Briefing "Energy poverty in the EU." European Union, 2022, available at https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733583/EPRS_BRI(2022)733583_EN.pdf, page 2.

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de Vos 1988; Healy and Clinch 2002; Price et al. 2006; Primc, Dominko, and Slabe-Erker 2021; Sefton 2002). However, contemporary processes, including the energy crisis and high crude oil prices caused by the conflict between Russia and Ukraine, compounded by logistical and economic problems related to the COVID-19 pandemic, have led to an increase in energy poverty (EP) (Allam, Bibri, and Sharpe 2022). The military conflict between Russia and Ukraine, resulting in the restriction of energy imports from Russia, has significantly reduced the availability of coal, gas and oil, drastically increasing energy prices for consumers. The above events have caused the issue of energy availability, price and savings to become a key problem in the economy and social policy of most European Union countries (Baranowski 2022, 7–8). The problem is particularly relevant for Poland, which has completely ceased to import Russian coal and natural gas despite not being prepared to replace the missing energy from alternative sources.[2] In addition, the choice of Poland is supported by high energy prices in relation to the average income and a small number of publications on EP at the level of communes and counties, both in Polish and English. Compared to May 2022 (the date of EP research in Augustów County), it is highly probable that the scope of energy poverty will increase throughout the country at the end of this year. This may be influenced by the resignation from the import of hard coal from Russia to Poland, which has already caused an increase in the price of a ton of coal compared to May 2022. In addition, an increase in inflation may increase the value of EP (Alem and Demeke 2020). It should also be mentioned that in the case of Poland a very large increase in energy prices is influenced by the slow process of energy transformation under the European Union's "Fit for 55" policy, which translates into a low share of energy obtained from renewable sources (Biernat-Jarka, Trębska, and Jarka 2021; Mrozowska, Wendt, and Tomaszewski 2021).

As indicated above, the issue of energy (fuel) poverty already has extensive literature dedicated to both theoretical and definitional aspects (González-Eguino 2015; Moore 2012), poverty measurement methods (Bouzarovski, Thomson, and Cornelis 2021; Herrero 2017; Karpinska and Śmiech 2020b; Thomson, Snell, and Bouzarovski 2017, 879-901), fuel poverty (Roberts, Vera-Toscano, and Phimister 2015), the spatial aspects of the phenomenon at different levels, national aspects (Bouzarovski and Tirado Herrero 2017b; Kahouli 2020; Karásek and Pojar 2018; Karpinska and Śmiech 2021; Phimister, Vera-Toscano, and Roberts 2015), and regional and local aspects (Chai, Ratnasiri, and Wagner 2021; März 2018). However, poverty in Poland is still relatively under-researched (Karpinska et al. 2021; Sokołowski et al. 2020), most notably at the local (municipal) level. This is a critical flaw according to the literature (Karpinska and Śmiech 2020b), especially from the point of view of social politics and practice, as well as the basic level (Rutkowski et al. 2018, 9) at which measures to prevent EP should be taken.[3]

Analysis of the literature on the subject illustrates that EP in most up-to-date research is presented mainly in comparative and structural terms (Karpinska and Śmiech 2021; Recalde et al. 2019), often at the level of particular states, the EU (Bouzarovski and Tirado Herrero 2017a) or regions, and, in the case of Poland, voivodships (Polimeni, Simionescu, and Iorgulescu 2022; Sokołowski et al. 2020). In practice, due to the lack of data and a single widely recognized method of evaluation, it makes it difficult to conduct a coherent public policy at the state and local government levels and counteract the increase in EP in households at the commune level. In addition, there is no universally accepted definition of energy poverty appropriate to Polish conditions, and the definitions adopted, to some extent without criticism, from the extensive English-language literature do not fully correspond to the Polish economic situation or social conditions. In the absence of a universally accepted definition, the importance of the problem encourages the production of successive reports and studies that present the issue in different ways rather than leading to a universally accepted solution. After all, it may not be enough to adopt a new or different energy

2. See: IBS Research Report 01/2022 "The economic effects of stopping Russian Energy import in Poland" by Marek Antosiewicz, Piotr Lewandowski, and Jakub Sokołowski. May 2022, available at https://ibs.org.pl/app/uploads/2022/05/The-economic-effects-of-stopping-Russian-energy-imports-in-Poland.pdf, page 13.

3. See also: "Ubóstwo energetyczne w Polsce" [Energy poverty in Poland]. Report by Rafał Boguszewski and Tomasz Herudziński. Pracownia Badań Społecznych SGGW, [published probably in 2018, no date in document — Ed.] available at https://www.cire.pl/pliki/2/2018/ubostwo_energetyczne_w_polsce_raport_03_09_2018.pdf, page 30.

expenditure threshold in the income criterion or use multiple criteria (Arsenopoulos et al. 2020; Betto, Garengo, and Lorenzoni 2020; Libor and Bouzarovski 2018; Nussbaumera, Bazilianb, and Modi 2012; Papada and Kaliampakos 2020) to obtain different results.[4]

This is due to the fact these approaches significantly hinder the policy of support for energy-poor households. Moreover, energy poverty is multidimensional in nature. It is influenced by a number of factors. Its causes are most often economic deprivation, poor thermal quality of buildings, the use of energy inefficient appliances in households and often a low level of the awareness of the desirability of energy saving (Sokołowski et al. 2020).

Given the above, the aim of the research undertaken by the authors was to factor analyze, assess and present the extent of EP at the municipal level in accordance with the new definition of EP contained in the amendment of the "Energy Law" of March 26, 2022.[5] Article no. 5gb of the law defines energy poverty as a situation in which a household cannot provide itself with sufficient heat, cooling and electricity to power appliances and light a house. Simultaneously, the occupants of this household meet the following three conditions: they have a low income, they have high energy expenses, and they live in a dwelling or building with low energy efficiency.[6] The second objective was to point out that the choice of the right methodology is not a matter of merit. Each method can be justified to some extent. Despite this, the choice of the method for determining the level of poverty is a political and economic issue. It is political due to the fact that politicians make legislative decisions on whether or not to provide support at the government and local government levels, and it is economic because the level of support for families in economic poverty depends on the number of resources available. The paper undertakes a verification of the research hypothesis that EP is greater in rural communes (areas) than in urban communes (areas). This is not always the case due to the fact that the cost of living (expenses) in urban areas is always higher than in rural areas and the income available to households in rural communes is most often lower than in urban households. To sum up, the novelty of the undertaken research, in relation to the previously published literature, is the application of a three-factor method of measuring EP. Also, addressing the problem at the local (commune) level and confirming the spatial differentiation of EP into rural and urban areas makes this paper stand out.

1 Materials and methods

A review and critical analysis of the literature on the subject determined the adoption of a definition of energy poverty after the "Energy Work" Law. The materials for the study were collected by a professional statistical research laboratory team, which carried out 377 questionnaires in households in Augustów County, Podlaskie Province, from 25 to 31 May 2022, which was considered a representative number (the number of households in the surveyed county is 20,123; the confidence level is 95%; the fraction size is 0.5%; the maximum error is 5.0%). The county was selected after

4. See: Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 19 maja 2022 r. w sprawie ogłoszenia jednolitego tekstu ustawy — Prawo energetyczne [Announcement of the Speaker of the Sejm of the Republic of Poland of May 19, 2022 on the announcement of the consolidated text of the Energy Law Act of April 10, 1997]. DzU z 2022 r. poz. 1385, page 66; Ustawa z dnia 5 sierpnia 2022 r. o zmianie niektórych ustaw w celu wzmocnienia bezpieczeństwa gazowego państwa w związku z sytuacją na rynku gazu [Act of August 5, 2022 on amending certain acts in order to strengthen the state's gas security in connection with the situation on the gas market]. DzU z 2022 r. poz. 1723; Ustawa z dnia 7 października 2022 r. o szczególnych rozwiązaniach służących ochronie odbiorców energii elektrycznej w 2023 roku w związku z sytuacją na rynku energii elektrycznej [Act of October 7, 2022 on special solutions to protect electricity consumers in 2023 in connection with the situation on the electricity market]. DzU z 2022 r. poz. 2127; Ustawa z dnia 27 października 2022 r. o środkach nadzwyczajnych mających na celu ograniczenie wysokości cen energii elektrycznej oraz wsparciu niektórych odbiorców w 2023 roku [Act of October 27, 2022 on emergency measures aimed at limiting electricity prices and supporting certain customers in 2023]. DzU z 2022 r. poz. 2243; Ustawa z dnia 29 września 2022 r. o zmianie ustawy — Prawo energetyczne oraz ustawy o odnawialnych źródłach energii [Act of September 29, 2022 amending the Energy Law and the Act on Renewable Energy Sources]. DzU z 2022 r. poz. 2370.

5. See: "Climate of Poland 2021." Report by Zbigniew Ustrnul et al., IMGW-PIB 2021, available at https://www.imgw.pl/sites/default/files/2022-06/imgw-pib-klimat-polski-2021-eng-final.pdf, pages 36–37.

6. Ibid., pages 36–37.

a preliminary analysis of geographical, economic and social factors. Augustów County is located in north-eastern Poland, described in the geographical literature as the region with the longest winter and with the lowest average annual winter temperatures in lowland areas (Szeszko 2019). The choice of Augustów County was also determined by the fact that it includes 8 communes representing all three types of communal administrative units in the country. In the county we have an urban commune (one), an urban-rural commune (one) and rural communes (six), characterized by different levels of urbanization, differentiation of residential buildings and technical condition from the point of view of thermal insulation and modernization of the buildings. Similarly low temperatures characterize nearby Suwałki (the capital of the Suwalskie Voivodship in the administrative division of Poland before the 1999 reform) or the voivodship's capital, Białystok. However, studies in such large cities with well-developed technical infrastructure and populations of over 80,000 (Suwałki) and 293,000 (Białystok) respectively do not show the typical problems of energy poverty in rural areas.

In 2021, Augustów County had over 58,000 inhabitants and 20,123 households (Szeszko 2019, 97), covering seven communes, including the urban commune of Augustów, the urban-rural commune of Lipsk and five rural communes: Augustów, Bargłów Kościelny, Nowinka, Płaska and Sztabin (table 1).

Table 1. Augustów County — the number of the residents and households, and number of surveys

Commune/County	Residents	Households	Surveys
Augustów, urban commune	30,242	11,094	200
Lipsk, urban-rural commune	5,176	1,868	32
Augustów, rural commune	6,778	1,844	52
Bargłów Kościelny, rural commune	5,571	1,414	24
Nowinka, rural commune	2,908	1,038	20
Płaska, rural commune	2,598	1,214	17
Sztabin, rural commune	5,094	1,651	32
Total	58,367	20,123	377

Data source: Obwieszczenie Prezesa Głównego Urzędu Statystycznego z dnia 30 marca 2022 r. w sprawie przeciętnego miesięcznego dochodu rozporządzalnego na 1 osobę ogółem w 2021 r. [Announcement of the President of the Central Statistical Office of March 30, 2022 on the average monthly available income for a total of 1 person in 2021]. Monitor Polski. Dziennik Urzędowy Rzeczypospolitej Polskiej z 2022 r. poz. 377, pages 97–155.

The results of the survey include answers to more than 20 questions describing the location, income, number of people in the household, thermal condition (thermal passport) of the building (dwelling), how it is heated, monthly heating expenses, monthly cost of all energy in the household, the residents' subjective feeling of thermal comfort, subjective assessment of the amount of heating costs, and the types of local government assistance used by the residents. However, in accordance with the assumption of the research undertaken, only three pieces of information were used in the analysis. In accordance with the "Energy Law," the analysis included the amount of monthly income per person in the household, the monthly cost of energy expenditure, and the thermal condition of the buildings.

The research procedure included five stages. In the first stage, after the design and execution of the survey, a classification of all the households was made according to the three criteria given above. Based on data concerning the level of average income in Poland, all the households were divided into two categories, over and under the declared average monthly disposable income, which, according to the information of the Central Statistical Office in Poland (Grzeszak 2022), was assumed to be PLN 2,000 per person (between EUR 420 and EUR 450), depending on the exchange rate in 2021–2022) (criterion A). Then, all the households were divided into two categories, on the basis of the responses from the questionnaires. The first category included those spending more than 12% of their disposable income on total energy costs[7] and the second category included

7. See: "Overview report on the energy poverty concept Energy poverty in the privately-owned, multi-family environment." Report by Eszter Turai, Senta Schmatzberger, and Rutger Broer, Community Tailored Actions for En-

the remaining households (criterion B). The third criterion (C) characterizes the technical condition of the buildings. Taking this criterion into account made it possible to divide the households into three categories in terms of their building condition: C1—the building condition was good or very good; C2—the building condition was bad and required partial thermo-modernization; C3—the building condition was very bad and required full thermo-modernization. The assessment of the technical condition of the building depended on the person being tested, as the possession of an energy certificate will be valid only from April 2023. The second stage involved summarizing all the households according to the three criteria selected and determining the number of the households in each criterion, which enabled, in the next stage of the work, a numerical and percentage determination of the scale of energy poverty in each commune and in the county as a whole, thereby fulfilling the first objective of the study.

The next stage involved comparing the extent of poverty in the county's communes according to one of the five criteria adopted. The first three criteria were based on the size of the total energy expenditure, at levels of 10%, 12% and 20% (Gerbery and Filčák 2014), the fourth criterion was based on the combined criteria resulting from the Energy Law, and the fifth criterion was based on its modification, taking into account the concession of total thermo-modernization. The obtained results illustrated the differences in the scale of EP indicated and, if significant, confirmed the thesis about the factors influencing the choice of the measurement method. The fifth stage involved the analysis of the obtained research results and their discussion. The final, sixth, stage was the verification of the research hypothesis and a conclusion that summarized the findings.

2 Results

The collected research materials helped create a table that demonstrates the number of the households meeting the energy poverty criteria indicated in the "Energy Law." As shown below in the income criterion (A), more than half of the surveyed households in each administrative unit have a below average disposable income under PLN 2,000 per person, the amount given by the CSO as the average income per person in 2021 (table 2 on next page). It should be added that the indicated value was the average at the end of March 2022, when year-on-year inflation was 11.00%, while in November inflation reached more than 17.00%, justifying the determination of the adopted amount as low income. The question of income size is subjective. However, accepting the stated average income as low income at the current rate of inflation with the accompanying increase in fuel prices (the figure below), is justifiable. It should also be noted that the price of hard coal alone has already increased by a factor of 3 to 4 after the survey (May 2022). On the other hand, as can be seen from the answers to the question about the type of fuel used for heating, among the 252 households that do not use the district heating network, almost three quarters (72.62%) use hard coal to heat their homes. In comparison, only 19.84% of the households providing their own heating use wood as fuel. The highest number of low-income households is found in the communes of Bargłów Kościelny (70.83%), Sztabin (65.63%) and Nowinka (65.00%), but the remaining rural communes have a similar share of values in the range of 60.00%–64.00%. Only the urban commune, the county town of Augustów, has a significantly lower share of responses indicating low income (54.50%), which, nevertheless, influenced the average value for the whole county—in criterion (A) it was 59.15% in May 2022.

Low income has a simple effect on the share of monthly expenditure on all energy consumed by the households (heating, electricity, and gas). Analysis of the results shows that in criterion (B), apart from the town of Augustów, an even higher percentage of households in the remaining commune spend more than 12% of their disposable monthly income on energy, thus meeting the definition of energy poverty adopted for the purpose of this research. More than 80.00% of the surveyed households spending more than 12.00% of their income on buying energy are located in the communes of Sztabin (87.50%), rural Augustów (84.62%), Płaska (82.35%) and urban-rural Lipsk (81.25%). In the commune of Nowinka, more than 12.00% of the surveyed households spend more

ergy Poverty Mitigation, April 2021, available at https://www.bpie.eu/wp-content/uploads/2021/05/ComAct-D1.1_Overview-report-on-the-energy-poverty-concept_Final-version_UPDATED-1.pdf, page 48.

Table 2. The number of the surveyed households (n) meeting individual energy poverty criteria and their share (percentage in parentheses) in individual communes and in the Augustów County (May 2022)

Commune	n	Income (A)	Energy expenses (B)	Building condition (C2 + C3) [a]	Building condition (C3) [b]
Augustów town	200	109 (54.50)	88 (44.00)	38 (19.00)	12 (6.00)
Lipsk	32	20 (62.50)	26 (81.25)	19 (59.38)	6 (18.75)
Augustów rural	52	32 (61.54)	44 (84.62)	38 (73.08)	19 (36.54)
Bargłów Kościelny	24	17 (70.83)	16 (66.67)	12 (50.00)	1 (4.17)
Nowinka	20	13 (65.00)	14 (70.00)	13 (65.00)	5 (25.00)
Płaska	17	11 (64.71)	14 (82.35)	13 (76.47)	13 (76.47)
Sztabin	32	21 (65.63)	28 (87.50)	22 (68.75)	14 (43.75)
Total	377	223 (59.15)	230 (61.01)	155 (41.11)	70 (18.57)

[a] Poor and very poor condition of the building altogether.
[b] Very poor condition of the building.

than 70.00% on energy, and in Bargłów Kościelny it is 66.67%. Against this background of rural communes, Augustów again stands out with a value of 44.00%, which once again influenced the average of 61.01% for the whole district.

The third type of criteria that must be met cumulatively in order to address energy poverty according to the definition of the cited law is the technical condition of the buildings (C2 and C3). In these criteria, compared to the previous ones, in less than half of the surveyed households in the county (155 out of 377) the condition of the inhabited building was described as bad or very bad. In terms of the differentiation into urban (Augustów), urban-rural (Lipsk) and rural communes, with an average value for the county as 41.11% (C2 + C3), the most difficult situation in terms of partial or full thermal modernisation is found in the commune of Płaska, where as much as 76.47% of the buildings require measures to prevent heat loss. The rural commune of Augustów comes next (73.08%), followed by Sztabin (68.75%), Nowinka (65.00%), Lipsk (59.38%), Bargłów Kościelny (50.00%), and the city of Augustów, with only 19% of the surveyed households indicating that their buildings require thermomodernization. When examining the above data, it was considered necessary to separate the issue of the condition of the buildings into two categories: those requiring partial modernization (C2) and those requiring full modernization (C3). If we consider buildings requiring full thermal modernization, the best indicators are in Bargłów Kościelny, as only one out of the 12 households surveyed requires full modernization. By contrast, the most difficult situation is in the commune of Płaska, where all the buildings require full thermal modernization. Half of the buildings require full renovation in the rural commune of Augustów, more than half in the commune of Sztabin, and less than half in the communes of Nowinka, Lipsk (31.58%) and Augustów (town).

After determining the number of the households meeting the conditions defining energy poverty, the next stage of the work was to determine the size and differentiation of the inter-layer phenomenon. Out of 377 surveyed households, one criterion — income (A), expenses (B) or building condition (C) — was met by 110 households, two of the criteria were met by 136 households, and three criteria were met by 76 households. A simple calculation shows that in May 2022 the energy and economic situation in Augustów County was difficult. Only 55 (14.59%) households did not meet any of the three conditions: a low income, spending more than 12.00% of the income on energy, and a need for thermal modernization works. In three rural communes (Bargłów Kościelny, Nowinka and Płaska), all the surveyed households met at least one of the EP criteria, and in the remaining communes, apart from Augustów, only single households had no poverty risks. Against this background, Augustów (urban commune) clearly stands out, with 24% of the surveyed households not being at risk of energy poverty (table 3).

The analysis of the results of the questionnaire survey and the division of the households into three poverty criteria made it possible to determine the size of the phenomenon under study. In the

Table 3. The number of the surveyed households that meet none, one, two or three of the three criteria defining energy poverty — income (A), energy expenses (B), building condition (C) — in the communes of Augustów County (May 2022)

Commune	No Criteria	One of three criteria	Two of three criteria	Three criteria (EP)	Three criteria (EP) modified
Augustów town	48	81	56	15	22
Lipsk	2	5	15	10	14
Augustów rural	4	3	24	21	26
Bargłów Kościelny	0	10	8	6	6
Nowinka	0	4	12	4	6
Płaska	0	3	7	7	11
Sztabin	1	4	14	13	19
Total	55	110	136	76	105

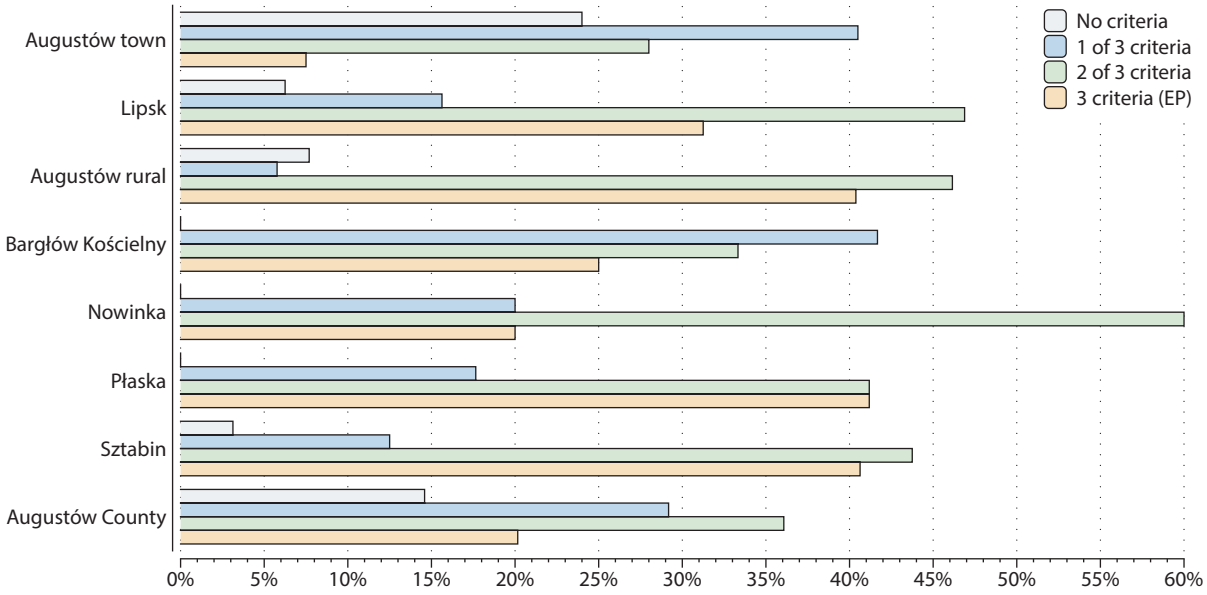

Figure 1. Energy poverty (EP) categorized by communes in Augustów County (May 2022)

county of Augustów, according to the definition adopted in the study, 76 of the surveyed households (20.16%) can be described as energy poor (table 3, figure 1). The study shows that the lowest incidence of poverty is observed in the town of Augustów (7.50%), and the only commune in which the energy poverty indicator values are basically at the average level for the whole county is the commune of Nowinka (20.00%). The remaining communes are characterized by a higher poverty level, from Bargłów Kościelny commune (25.00%), to Lipsk (31.25%), rural Augustów commune (40.38%), Sztabin (40.63%), and Płaska (41.18%). If we exclude the city of Augustów from the data analysis, with 177 households surveyed, the average value for the county is more than a third of the households in EP poverty (34.46%). There is a clear difference between the extent of EP in the spatial variation between the county town and the rural communes. Among the households surveyed, the average for Augustów is 7.50%, while for the other communes the extent of EP is more than four times higher (34.46%).

The obtained results, together with the classification of the buildings that require partial thermo-modernization and total modernization, posed another question leading to a modification of the results of the extent of energy poverty. The modification took into account the greater importance of the buildings requiring full retrofitting by giving them a double value. Such buildings are characterized by greater heat losses, which results in higher heating costs. In table 3, the column

"Three criteria modified" (for 12% expenditure) shows how energy poverty increases when buildings in very poor technical condition are treated as meeting not one but two conditions of energy poverty. As a consequence, it increases the potential number of households meeting the conditions of energy poverty. In Augustów County, the very poor technical condition of the buildings leads to an increase in the number of energy-poor households from 76 to 105, similarly to almost all the communes (figure 2).

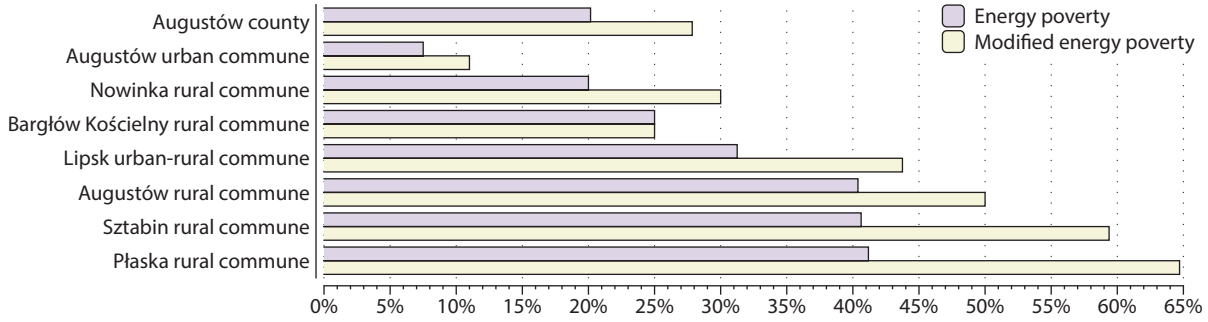

Figure 2. Energy poverty and modified EP categorized by communes in Augustów County (May 2022)

Taking into account the three modified criteria, the commune of Płaska recorded the highest increase (over 20%), and Sztabin is close to this value. An increase of over 10% occured in Lipsk, and below 10% in the other communes except Bargłów Kościelny. In this case, the very poor condition of the building, requiring full thermo-modernization, concerned one farm and did not increase the number of energy-poor farms (tables 2 and 3). Summarizing the obtained results of the research, with the modified criterion, it can be concluded that there is a visible difference in the scale of poverty between the city of Augustów (11%) and the other communes of the county, which positively verifies the thesis presented in the paper. The next statement requires additional research. However, from the analysis of the collected data it can be concluded that the correlation of the subjective assessment of the difficult energy situation is low compared to the criteria that indicate it. Only 5 out of 377 respondents described the total energy costs as: "very high: there are months when it is impossible to pay the bills at the expense of other needs."

Similarly to the modification of the three-criteria method, there will be changes in the number of energy-poor households if different expenditure thresholds are adopted to meet all household energy needs. However, an interesting result when analyzing the collected survey data was the magnitude of these differences depending on the choice of the method for determining energy poverty (table 4).

As the analysis of the data shows, with the same survey sample, the same income and expenditure for all the energy used, the extent of energy poverty in the county can vary from 20.16% (M4) to 75.07% (M1). For M4 and M5, from three different expenditure thresholds, energy expenditure exceeding 12% of disposable income was assumed. That is caused only by the choice of the measurement method. In the town of Augustów, on the other hand, the differences are even greater, depending on the method, ranging from 65.50% (M1) to only 7.00% (M3), with equally large differences in the magnitude of EP characterizing the other communes. This fulfils the second objective of the study. It also leads to the conclusion that the issue of choosing a measurement criterion may or may not, in the absence of a universally accepted method, lead to the selection of a criterion that takes into account post-political factors (support decisions, legislation) or economic factors (resources and the purposes for which they are used). However, this conclusion requires separate research and comparative analysis of the social policies implemented as well as the measurement methods chosen. An extended discussion on the use of absolute energy poverty indicators is needed. Thus, a household would be energy poor if it does not spend on energy what it needs to cover its real needs (Moore 2012). However, the discussion of absolute versus relative measures requires a separate study and case studies.

Table 4. The number of the surveyed (n) households meeting selected criteria of energy poverty (EP) depending on the choice of the measurement method (M) in the commune of Augustów County (May 2022)

Commune	n	Total expenditure on energy over:			Three criteria	Three criteria modified
		10% (M1)	12% (M2)	20% (M3)		
Augustów town	200	131	88	14	15	22
Lipsk	32	29	26	11	10	14
Augustów rural	52	45	44	18	21	26
Bargłów Kościelny	24	17	16	13	6	6
Nowinka	20	16	14	8	4	6
Płaska	17	16	14	5	7	11
Sztabin	32	29	28	13	13	19
Total	377	283	230	82	76	105
EP rate in the county (%)	–	75.07	61.01	21.75	20.16	27.85

3 Discussion

This study addressed two issues: the problem of choosing a method to measure energy poverty and an attempt to determine the extent of EP in a selected county, on the example of Augustów County. As far as the method is concerned, the presented arguments are in line with the conclusions of works devoted to theoretical aspects of EP measurements.

Gerbery and Filčák emphasize an obvious fact, but, for the sake of clarity, it should be reminded that "Poverty is a multidimensional phenomenon, with a complicated nature, roots and many influences. Although generally missing from mainstream definitions, access to energy is becoming an increasingly important aspect of this poverty" (Okushima 2017). Thomson et al. (2017) define, or rather redefine EP (also "energy vulnerability"), as a phenomenon related to a household experiencing an insufficient level of energy services. However, as they write, "measuring energy poverty is a challenge because it is a culturally sensitive and private condition that is dynamic in time and space" (Thomson, Bouzarovski, and Snell 2017, 879). The above confirms the subjective nature of the EP measurement, because the fact of experiencing an insufficient level of services—e.g., heat, by a household (i.e., its inhabitants) is relative. Although the WHO provides recommendations regarding the temperature of indoor rooms, the feeling of thermal comfort may be different for different people at the same temperature. These problems have also been confirmed in other studies (Deller 2018; Halkos and Gkampoura 2021). This leads to the measurement being based on technical indicators.

The indiscriminate development and reporting of EP is pointed out by Tirado-Herrero (Herrero 2017). He argues that there is no reason to favor income/expenditure methods and advises against the use of single-factor methods, such as the British 10% method. This justifies the choice of the method consisting of three criteria in the present research, which, thanks to putting greater emphasis on full thermo-modernization, led to an increase in the number of the households affected by EP. In contrast, Deller et al. (2021) highlight the difficulty in interpreting results from different indicators, pointing out the discrepancy between perception (a subjective indicator) and results based on the expenditure-income criterion (Heindl 2015).

The conclusions of the analysis in terms of poverty line choices and the consequences of these choices are corroborated by a 2015 study by Heindl,[8] who, using data from Germany, undertook an analysis of EP outcomes within different boundaries. However, importantly, Heindl emphasized that the question of boundary choice is normative, which in a way confirms the reasoning about

8. See: Praca badawcza pt. „Pomiar ubóstwa na poziomie powiatów (LAU 1) — etap II. Raport końcowy" [Measuring poverty at the county level (LAU 1)—stage II. Final report]. Report by Maciej Beręsewicz et al., Centrum Badań i Edukacji Statystycznej GUS, Jachranka, październik 2015 r., available at https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/6330/4/1/1/pomiar_ubostwa_na_poziomie_powiatow_lau_1.pdf.

the possibility of political and economic factors influencing the scale of poverty. The question of how to determine the real level of poverty thresholds is a political one. After all, it is possible, using a *reductio ad absurdum*, to move the limits of—for example—the income/expenditure criterion so high or so low that either nearly all the households or none at all fall into the EP sphere. After reviewing the extensive literature on the subject, it was recognized that one could look for a symbolic Grail—a universally accepted definition of poverty, including energy poverty, which, like wealth, is, indeed, subjective in nature. Alternatively, one could choose the defining criteria of EP and justify their choice by pointing out any limitations of the research undertaken. This is what has been done in this paper.

While the discussion of the choice of the definition and measurement method of EP is problematic due to the wealth of literature, the discussion of the results of the selected case study as well as Poland suffers from a lack of studies at the commune and county level. A basic source material where one would expect to find information on this topic, such as "Measuring Poverty at county level (LAU 1)—Stage II" (Thomson, Snell, and Bouzarovski 2017) not only dates from 2015, but contains survey data from 2005, 2008 and 2011, having historical value in relation to the studies undertaken. Yet, it could provide a good basis for a discussion about energy-efficient results. In the present study, the Augustów County was described as having an energy poverty rate below the median for counties in Poland.[9] On the other hand, another document describing the largest commune in this county in terms of its population, "Report on the State of the Commune of Augustów" in relation to poverty mentions the level of total poverty (Thomson, Snell, and Bouzarovski 2017, 78) and provides general information on the need to improve the energy efficiency of the buildings, energy-saving retrofitting of woodwork (windows) and installation of lanterns. However, it does not contain any key information or data on the extent of EP for the households in the current situation. This confirms the need for the research undertaken at this spatial level and demonstrates its diagnostic value as well as the feasibility of implementing its results for all the communes in the county.

The literature on the subject of EP in Poland is richer (Bouzarovski and Tirado Herrero 2017b; Karpinska and Śmiech 2020a; Karpinska et al. 2021; Libor and Bouzarovski 2018).[10] However, some studies are comparative at the national level within the EU (Bouzarovski and Tirado Herrero 2017a; Karpinska and Śmiech 2021; Mamica, Głowacki, and Makieła 2021; Recalde et al. 2019) or selected social groups,[11] which is useless for the present discussion. Although Owczarek and Miazga (2015) focused mainly on defining the EP of social groups, their work points to the importance of the technical factor—the condition of the buildings (Owczarek and Miazga 2015, 43)—which confirms the use of this criteria in the research. On the other hand, the "BISER Report"[12] by region (voivodship) specifies that EP for the Podlaskie Voivodship, according to the LIHC measure, reached 17% (Sokołowski and Frankowski 2020, 15), which confirms the results of EP coverage for the method (M4) of the three factors used in the study (table 4). Interestingly, when measured by subjective and objective criteria, in most Polish voivodships, these dimensions of energy poverty did not co-occur. With a high level of EP according to LIHC, subjective energy poverty in the region was low, and vice versa. The exception was that the Podlaskie Voivodship, characterized by a high percentage of energy poverty according to both measures, which is a different result from the results of the study. This difference is due to the fact that the Augustów County, in principle, should not be, due to its geography, history and socio-economic characteristics, in the Podlaskie Voivodship but in the neighboring Warmińsko-Mazurskie Voivodship, like the counties of Suwałki and Sejny. The data for this voivodship confirms the answers from the surveys we undertook.

9. See: "Raport o stanie Gminy Miasto Augustów za 2021 rok." [Report on the condition of the Municipality of the City of Augustów for 2021], Augustów, maj 2022 r., available at https://bip.um.augustow.pl/raport_o_stanie_miasta/raport-o-stanie-gminy-miasto-augustow-za-2021-r.html, page 116.

10. See also: "Raport o stanie Gminy Miasto Augustów za 2021 rok." op. cit.

11. See: "Ubóstwo energetyczne w Polsce Północnej. Istota zjawiska, polityka łagodzenia, rekomendacje" [Energy poverty in Northern Poland. The essence of the phenomenon, mitigation policy, recommendations]. Report by BISER editorial team, Bałtycki Instytut Spraw Europejskich i Regionalnych, Gdynia 2018, available at https://biser.org.pl/wp-content/uploads/2018/10/Ubóstwo-energetyczne-w-Polsce-Północnej_final.pdf.

12. See: "Ubóstwo energetyczne w Polsce Północnej…" op cit.

Regarding the adopted method for EP studies in Poland, there are several approaches. Sokołowski and others confirm the advisability of using a multidimensional criteria in EP research based on objective and subjective indicators (Sokołowski et al. 2020, 94). In a subsequent paper, Sokołowski and Frankowski (2020), analyzing a survey sample of 800 EP cases in the Łódzkie Voivodship (2.45 million inhabitants), distinguished two groups of factors: the characteristics of the buildings that affect energy efficiency and "the socio-demographic characteristics of the population that determine income level and risk of poverty" (Awaworyi Churchill, Smyth, and Farrell 2020, 48). This corresponds to some extent (the differences relate to the details of the analysis) to the technical and income/expenditure criterion that was adopted in this study, as it differs significantly in terms of the sample size of the households surveyed. In the undertaken study, 377 surveys were conducted on approximately 20,000 households with a population of approximately 60,000 in Augustów County. 26.00% of the households in the Łódzkie Voivodship had high energy expenses, 14.00% had problems with bills, and the poor technical condition of the buildings was characteristic for 12.00%. However, it should be noted that the data for the Łódzkie Voivodship, due to its urban character, cannot be compared to an administrative unit with a rural character, such as Augustów County. On the other hand, the 2018 report on energy poverty in Poland indicates that with a threshold of 13.00% calculated using the LIHC method, in the Podlaskie Voivodship EP affects 38.00% of the households and in the Warmińsko-Mazurskie Voivodship the figure amounts to 28.80%.[13] The report refers to data from 2013, so it is rather historical or testifies to the persistence of a constant level of EP in the studied region. In the study we undertook, for the 12.00% threshold in Augustów County, we obtained, with modified three criteria, a result of 27.85% (table 4), which is similar to the result of the report cited above. The high level of EP in the region is confirmed by another study, in which Karpinska et al. (2021) list the Warmińsko-Mazurskie and Podlaskie voivodships among the three with the greatest EP problems in Poland. The results we obtained confirm the results of previous research from 2018–2019, which is important, conducted by county (Karpinska et al. 2021).[14] Karpinska et al. (Phimister, Vera-Toscano, and Roberts 2015, 7) put the EP level in the Podlaskie Voivodship at 27.50%, with almost identical correlating patterns in the result of EP in Augustów County. Based on the analysis of the answers provided in the surveys, it can be concluded that there are large differences between the subjective and the reported (LIHC) assessment of the amount of the expenses and the feeling of thermal comfort (Awaworyi Churchill, Smyth, and Farrell 2020; Longhurst and Hargreaves 2019).

There are several limitations of the study. Firstly, the results of the surveys are, as always, based on the answers of the interviewed persons, which are difficult to verify — e.g., with regard to the amount of real income.

Secondly, the answers to the questions on the technical condition of the buildings reflect the respondents' subjective perception and are not related to a technical inspection conducted by a specialist. Thirdly, the values given for the income and the costs, as well as the determination of total energy costs as high/low, are only valid at the date of the survey, being a "snapshot" of the status on that given day. Thus, it was assumed that the answers were true and reliable only in the absence of significant factors that could change them. In the case of energy poverty in Poland, such a factor did occur, as the prices of energy carriers increased significantly. Consequently the latter could have caused the number of energy-poor households to increase beyond the 27.85% value.

Conclusions

Summarizing the results of the research undertaken, it should be stated that the level of poverty in the Augustów County and its communes, with the adopted research method (M4) is 20.00%,

13. See: Report "Ubóstwo energetyczne w Polsce." op. cit., page 64.

14. See also: "Ubóstwo energetyczne w Polsce 2012–2016: Zmiany w czasie i charakterystyka zjawiska" [Energy poverty in Poland 2012–2016: changes in time and characteristics of the phenomenon]. Brief report by Katarzyna Sałach and Piotr Lewandowski, Instytut Badań Strukturalnych, Fabruary 2018, available at https://ibs.org.pl/wp-content/uploads/2022/12/IBS_Brief_Report_Ubostwo_energetyczne_w_Polsce_2012–2016.pdf; Report "Ubóstwo energetyczne w Polsce." op. cit.

and with the modified method (M5) it is 28.00% (table 4). The stated aims of the study were pursued by determining the scale of energy poverty in individual communes, depending on the three criteria selected (table 3) and the choice of the method (table 4). Significant differences in results were indicated when a change was made to one of the criteria, as taking into account the poor or very poor technical condition of the buildings resulted in differences in the scale of EP in individual communes and Augustów County, ranging from 3.50% in the urban commune of Augustów to 22.50% in the commune of Płaska (figure 1).

On the basis of the analysis of the literature on the subject, an attempt was made to discuss definitions and methods for measuring energy poverty. Changes in the scale of this phenomenon were simulated with five methods (table 4). The adoption of different thresholds and several criteria instead of one, together with the analysis of the literature, allowed us to conclude that each of the methods used has its justification both in the literature and in practice. However, the difference in the final results showing an EP of about 55.00% (M1 and M4) may indicate other, for example political or economic, criteria for the choice of the survey method. Other factors that may have influenced EP include different levels of poverty and the possibility of implementing different social policies with different amounts of financial inputs to support energy-poor households. However, a confirmation of this thesis requires separate, additional research. Despite this, it is possible to positively verify the study's main hypothesis, according to which EP is greater in rural communes compared to urban communes. The EP value for entire Augustów County was 20.00% (M4), for the town of Augustów it was 7.50%, and in the individual rural communes the values ranged from 20% to 41% (figure 1).

Summing up the analysis and the results of the research, it is possible to determine the differences in the size of EP for urban and rural communes, accomplishing the first objective of the work. In addition, the results of the EP study show that despite the greater diversity of home-heating methods, which can be observed in the answers from the conducted surveys, the EP level in rural areas is higher than in cities. The simulation of five test methods (M1–M5, table 4) showed and confirmed that the determination of EP depends only on the adopted definition of EP and test criteria. This has not only theoretical significance because in the absence of thresholds that define individual criteria, it can be used in national/local government policy. In accordance with the law in force in Poland, EP occurs when three conditions are jointly met: low income, high energy costs, and the building having low thermal parameters. The act of Energy Law[15] does not specify limit values, hence the problem of determining the EP level. That is why the paper presents 5 variants of determining EP for the same output data. This shows that the term EP can be used in political narratives to show the positive/negative action of the government/local government. Another consequence of the discussion of EP research methods is the scope of financial support for farms defined as energy poor. In this case, the choice of the research method directly affects the number of farms requiring support from government programs and/or subsidies from local governments. In conclusion, the size of the actual EP may depend on political decisions. This is why it is necessary to study EP at the lowest (municipal) level to identify households in need of support to prevent (reduce) EP.

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15. See: Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 19 maja 2022 r. w sprawie ogłoszenia jednolitego tekstu ustawy — Prawo energetyczne. op. cit.

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