ENERGY POVERTY IN THE CONTEXT OF SMOG AS EXEMPLIFIED BY POLAND

Assoc. Prof. Dr. hab. ing. Aneta Michalak
Silesian University of Technology, Poland

ABSTRACT

This article is aimed at analysing the most important facts and patterns concerning energy poverty as well as at attempted verification of the hypothesis connecting this poverty type and smog. First, the problem of smog in Poland is presented. Next, the work analyses energy poverty, reviewing the adopted measures of that phenomenon and specifying its scale and geographical distribution. It is shown that the areas struggling with the problem of smog are also the ones with the highest quantity of energy-poor households. Those are the most urbanized and heavily populated regions of Poland. According to the analysis, solutions to the problem of smog should be connected directly with liquidating energy poverty of households. The adopted methodology is based on the "Low Income High Costs" (LIHC) index. This index considers modifications proposed by the Institute for Structural Research (ISR), adapting it to the Polish conditions and the level of details of data available for Poland.

Keywords: *energy poverty, smog, low-stack emission*

INTRODUCTION

The problem of polluted air is of particular importance for Poland, including but not limited to its south-western part, as this is where 33 out of 50 most polluted EU towns and cities are situated. At the same time, this is the region with the highest population density resulting in a significant hazard for people and the environment. The problem refers not only to the above region, but also to the neighbouring areas and countries.

This intensified problem has its sources, one of the most important being low-stack emission. Low-stack emission is the emission of dust and hazardous gases from emission sources situated up to 40 m high, e.g. small, local boiler houses and household heating furnaces where coal is burned not efficiently. In Poland, low-stack emission is responsible for more than 50% of PM10 dust emission and close to 90% of carcinogenic benzo[a]pyrene emitted to air.

Smog results from significant accumulation of low-stack emission sources in a relatively densely built areas occurring in towns and cities. Smog is one of the most serious effects of low-stack emission. During the heating season, the standards for PM10 and PM2.5 dusts in air are exceeded even by several thousand percent [10].

Making the smog the basic study problem in this article results from the recent broad discussion of that problem, including but not limited to the need to identify factors generating that phenomenon and to prescribe efficient methods of preventing it and combating its effects.

The problem has no longer been solely an issue brought up by scientists and discussed when publishing environmental reports, but it has become also a subject of dynamic social discussion, gaining broad environmental, social and economic dimension. This theme requires in-depth studies as both the local and governmental authorities and a growing number of residents are willing to undertake definite activities to liquidate smog.

The analysis of smog determinants points to high importance of social factors. They are considered to include energy poverty of residents, the condition of buildings determining their heat demand, possible alternative sources of heat, social awareness and mentality, determination of self-government authorities when executing the policy of reducing low-stack emission and preparation of those authorities to implement such a policy. In this article, the subject of studies is a social aspect of smog, namely the energy poverty of households.

This article is aimed at analysing the most important facts and patterns concerning energy poverty as well as at attempted verification of the hypothesis connecting this poverty type and smog. The adopted methodology is based on the “Low Income High Costs” (LIHC) index.

METHODS AND METHODOLOGY

The research presented in the article is of a diagnostic nature and is based on such general research methods as analysis, comparison and generalization. The deduction and synthesis methods were used to draw the final conclusions. Specific methods used in the research include document analysis method, in particular reports.

Data on energy poverty presented in the study were developed in accordance with the methodology used by National Statistics UK. It is based on the "Low Income High Costs" (LIHC) index, now recognized as the official measure of energy poverty in the United Kingdom. The indicator includes modifications proposed by the Institute for Structural Research (IBS), adapting it to conditions of Poland and the level of detail of data available for Poland. The analysis used the Central Statistical Office of Poland (Central Statistical Office, Central Statistical Office) databases and data of Krajowa Agencja Poszanowania Energii S.A. (KAPE). This data comes mainly from a representative, nationwide Household Budget Survey (BBGD). The database contains data on the inflows and expenses of a representative sample of households (about 37 thousand households in each year).

With regard to air pollution, research was based on the World Air Quality Report, prepared by Swiss company IQAir and Greenpeace based on the set of data concerning air quality, collected by the analyzed states and the European Environment Agency. In addition, data from the reports of the World Health Organization (WHO) and Supreme Audit Office (Najwyższa Izba Kontroli, NIK) were used.

The analysis was based on the data published in 2018 and 2019.

SMOG IN POLAND — ISSUE CONCEPTUALIZATION AND LEGAL SOLUTIONS

In early 20th century city planners noticed there was no sufficient air flow in densely built urban areas. Consequently, the early concept of creating the so-called ventilation corridors appeared. It entailed leaving some areas undeveloped to instigate air motion in cities. In 1970s, the Communist authorities of Poland noticed the problem of air pollution but did not introduce any specific measures. The major poisoner was believed to be the industry, its priority being cost reduction and production increase [7]. In subsequent years, the social awareness and concerns with the condition of air grew. Moreover, the accuracy and scope of reports presented to the society improved [3]. In 1980s and 1990s attention was paid to the so-called acid rains contributing greatly to damaging forests. As the problem was publicized, the process of adapting industrial plants to the new environmental protection standards was started, e.g. filters were installed on stacks [2]. This reduced the occurrence of acid rains. In 2000, however, the Supreme Audit Office (Najwyższa Izba Kontroli, NIK) published a report stating the air did not get cleaner despite the measures adopted. This was believed to result from the absence of qualitative standards for burnt fuel.

Subsequent reports of NIK published in 2014–2018 did not leave any space for doubts. They claimed most pollutants were emitted not from industrial plant stacks but from the ones on private residential buildings. It was pointed out unambiguously that low-stack emission contributes to smog generation highly. The social awareness has grown significantly since then. The topic of smog has been discussed in the media more and more often and has become an important part of the public debate.

Unfortunately, despite the changed perception of the issue by the society and the initiated measures, smog has remained an urgent problem. According to the "World Air Quality Report 2018" prepared by Swiss company IQAir and Greenpeace based on the set of data concerning air quality, collected by the analysed states and the European Environment Agency, Poland is one of states with the most polluted air in Europe. According to the World Air Quality Report dated 2018, it takes the sixth place in the European ranking of states with the worst air quality. Similar results are presented by the report of the World Health Organization (WHO) dated May 2018. According to both sources, the most polluted European cities are situated in the voivodeship of Silesia (Jaworzno, Katowice), Lesser Poland (Kraków), Mazovia (Warszawa), Łódź (Opoczno) and Greater Poland (Poznań). This is presented in Figure 1.

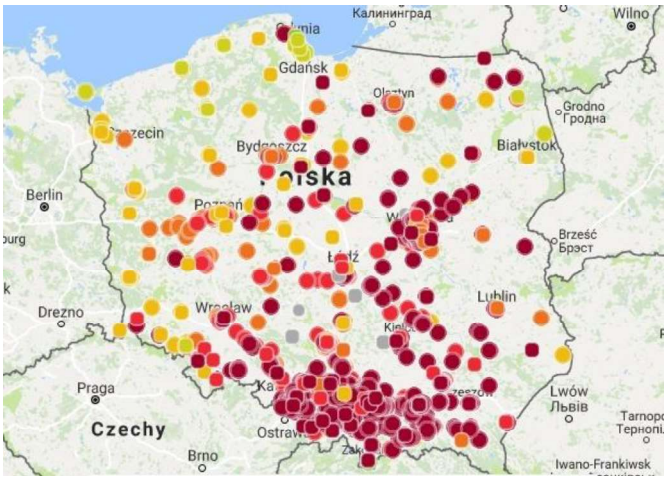

Figure 1. Map of air quality in Poland (source: https://dobrapogoda24.pl/mapa-jakosci-powietrza, accessed 12.2019)

ENERGY POVERTY PARAMETRIC REPRESENTATION

Looking for the causes of the above-mentioned issue, i.e. excessive air pollution when compared to the relevant standard, manifested as the so-called smog, attention in this article was paid to the problem of household energy poverty. Energy poverty is understood as the household difficulty satisfying its energy-related needs connected with heating, hot water and electricity. Energy poverty may be considered a dimension of more broadly taken poverty. It can also be distinguished as a separate phenomenon, not necessarily accompanying the income-related poverty. The reference works keep presenting discussions on the definition and the method of measuring energy poverty [1], [11].

There are many causes of energy poverty, but three most important include [14]:

- low income of households,
- high energy-related expenses,
- low energy efficiency of the occupied buildings and resulting difficulties satisfying energy needs of households.

When it comes to the determination of the energy poverty threshold using parameters referring to the household income and energy expenses, two methods are highly popular. One of them assumes energy poverty is present if the energy-related expenses exceed 10% of household income [1]. It is believed it constitutes excessive financial burden for the household and the household is considered energy poor. Importantly, hypothetical energy expenses of the household should be used for that criterion. Those are expenses which would be incurred by the household considering its housing circumstances if it was able to satisfy its standard energy-related needs fully. Hypothetical energy-related expenses are more reliable than the actual ones, as the actual expenses in energy poor households may be underestimated due to the failure to heat houses sufficiently. To assess the energy

poverty of Polish households, the threshold of 10%, proposed for the United Kingdom is believed too low because of higher energy-related expenses of the Polish residents. In Poland, the energy expenses constitute 10% of disposable income of a household on average, while in the United Kingdom it is ca. 4% Assuming the threshold of 10% for Poland would mean that close to one half of the population is considered energy poor. The Institute for Structural Research (IBS), adapting the threshold to the Polish conditions, proposes the adoption of 13% level [5].

Another commonly used measure of energy poverty is LIHC (*Low Income High Costs*) index [4]. It is currently used as an official energy poverty measure in the United Kingdom [12]. To qualify the household as energy poor, according to the definition of LIHC, it must meet two criteria at the same time: Low Income (*LI*) and high hypothetical energy expenses (*High Costs, HC*) [8]. To calculate LIHC index, first it is necessary to determine if the hypothetical energy expenses of the household are higher than the median for those expenses in other households in the population. Next, it should be checked if the disposable income is below the specified poverty threshold. Such a threshold is the economic poverty threshold assumed by Eurostat for EU states. It is 60% of the median income in a given state [4]. The household is energy poor if its income is below the specified income threshold after they have paid their energy charges [13].

THE MAGNITUDE OF THE PROBLEM AND TERRITORY DIFFERENTIATION OF ENERGY POVERTY IN POLAND

The analysis of the energy poverty magnitude in Poland was based on the "Household Budget Survey" carried out annually by the Central Statistical Office of Poland (Główny Urząd Statystyczny, GUS), data of Krajowa Agencja Poszanowania Energii S.A. (KAPE) and reports of the Institute for Structural Research (IBS). IBS published the distribution of the energy poverty in Poland by regions. Poverty was identified based on the LIHC index. According to it, the highest percentage of energy poor households is present in rural and sparsely populated areas. However, most households suffering from energy poverty are situated in the most densely populated and urbanized regions of Poland. Five most densely populated Polish voivodeships where 52% of all Polish households are situated (Mazovia, Greater Poland, Silesia, Lesser Poland, Lower Silesia) are inhabited by 49% of all energy poor households [15]. Figures 2 and 3 present the territorial distribution of energy poor households in numbers and percentage.

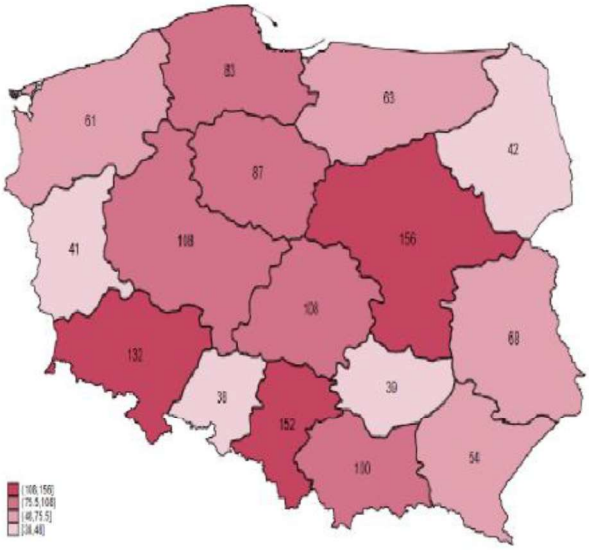

Figure 2. Number of energy-poor households by regions in Poland [thousand]

Source: [15]

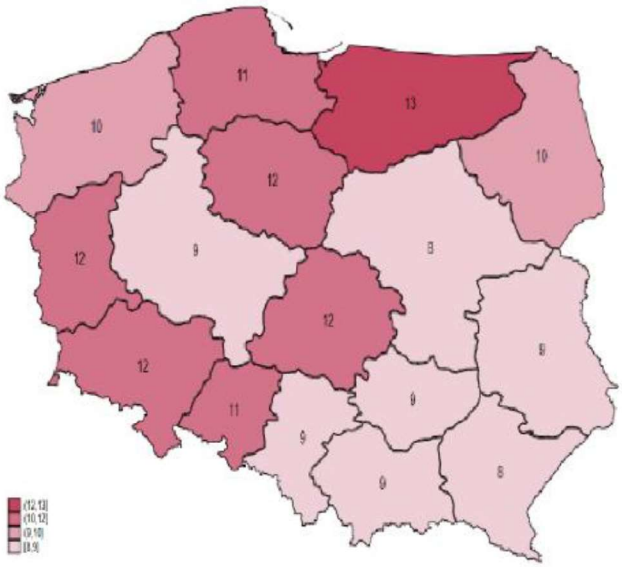

Figure 3. Percentage of energy-poor households by regions in Poland [thousand]

Source: [15]

Most energy-poor households are present in the most urbanized and most densely populated regions. Although we do not intuitively perceive people inhabiting such areas as poor (the mean pay is much higher there than in rural, low urbanized areas), the number of energy-poor households is highest there. As proven by studies, energy poverty should not be perceived as an aspect of the income-related poverty, but as a separate deprivation dimension. Energy poverty affects 12% of the Polish residents, i.e. ca. 4.6 million of people (1.3 million of households). In this group, only 6.6% (2,5 million) are people classified also as economically poor (according to the definition adopted by Eurostat, i.e. the equivalent income below 60% of the median). The remaining 5.6% of residents (2.1 million people) experienced energy poverty though they are above the poverty threshold [14]. This depicts the complexity of the energy poverty issue.

RESULTS

When studying the relationship between the energy poverty and smog, attention should be paid to the connection between the smog presence and the territorial distribution of the energy poverty. The percentage values, presented so often in reports, offer a mistaken view that the highest energy poverty level occurs in rural, low urbanized and sparsely populated areas where the problem of air pollution is not great. The relationship between the air pollution and energy poverty becomes clear only when we have a look at digits. The actual number of energy-poor households in individual voivodeships does not coincide with the percentage. It turns out the percentage of energy-poor households is higher in sparsely populated areas than in the urbanized ones. However, the number of energy-poor households is relatively low there when compared to heavily urbanized and densely populated regions. The highest quantity of energy-poor households can be found in the voivodeship of Mazovia (156 thousand households), Silesia (152 thousand), Lower Silesia (132 thousand), Łódź (108 thousand), Greater Poland (108 thousand) and Lesser Poland (100 thousand). As indicated above, those are also voivodeships where the air pollution with smog is the highest. A certain relationship can be noticed here. Energy-poor households find it difficult to satisfy their basic energy-related needs in their houses. The average monthly energy-related expenses of households are composed 2/3rds of heat expenses (including heating water) and 1/3rds of electricity costs. The majority of the energy poor (ca. 70%) uses a solid fuel boiler or stove as the basic heating device [9]. This results in the ability to buy cheaper (and, consequently, of inferior quality) fuel, e.g. burning culm, wood from forests or even waste to generate heat which, in turn, contributes to the low-stack emission and results in atmospheric pollution.

CONCLUSION

The territorial distribution of the energy poverty is largely identical to the smog presence. The problem of smog is the most acute in heavily urbanized and densely populated regions. According to the empirical data, in the regions where smog occurs, the percentage of energy-poor households is lower though the number of those households is much higher. This is the number of those households which

depicts the number of potential low-stack emission sources and affects air quality in the region.

In the areas where smog is a problem, the highest number of energy-poor households is recorded. Those are the voivodeships of Mazovia and Silesia where the number of energy-poor households exceeds 150 thousand. In the forefront, there are also the voivodeships of Lower Silesia, Łódź and Greater Poland, with the number of energy-poor households exceeding 100 thousand. Those are the most heavily urbanized voivodeships where the largest and oldest Polish cities and towns are situated. A conclusion can be drawn that energy poverty is significant in urban areas.

Because of the long industrial history of those areas, high density of population, absence of free land for new buildings, there are mostly old buildings. Two building types are predominant in the urban landscapes of the above-mentioned voivodeships: working-class districts and city centres with densely built old, multi-family tenement houses. They were usually erected during the pre- and post-war period. The second characteristic building type are housing estates, built in 1960s and 1970s. Poor residents of tenement houses and old-type blocks of flats heated with coal stoves in poor technical condition create the so-called enclaves of poverty in large cities [6]. About one half of households in this group inhabit flats owned by the city. It can, therefore, be claimed energy poverty in Polish towns and cities creates “islands”, clustered usually in the so-called “poor housing estates, districts”, degraded buildings being neglected city property (council and subsidized social housing). The responsibility for the condition of many buildings is scattered due to the absence of the former administrator or poor owners. The owners often bought flats in the course of privatization based on preferential terms and conditions from communities or liquidated companies and now they cannot afford modernizing them. Many residential estates from pre-fabricated panels are poor-quality buildings with low energy efficiency. This is further aggravated by using inefficient energy sources by residents, carrying out random modernizations, unauthorized system alterations and using poor-quality fuel. The situation can get worse soon because of increasing energy prices. The long-term energy price increase scenario is highly possible due to the reduced greenhouse gas emissions (one of three major demands of the climate and energy package implemented now). Moreover, it is necessary to consider the depletion of the non-renewable sources of energy, e.g. hard coal, being the key energy fuel in Poland. Another factor important for the energy prices is the need to modernize the power system in Poland resulting in passing on some of the costs to households by power engineering companies. This may result in aggravating the problem of the failure to satisfy energy-related needs and increasing energy-poor people.

In these circumstances, the implementation of an effective system to counteract energy poverty is of high importance. Reducing the burden on household budgets and ensuring thermal comfort to them may entail a number of positive social consequences. It may contribute to reduced amount of toxic dusts derived from the low-stack emission. The need to counteract energy poverty is mentioned by the European Commission which considered that problem to be one of the most afflictive forms of poverty and social exclusion in 2010. Unfortunately, the

activities initiated to reduce low-stack emission in Poland are not adequate. Air pollution due to the low-stack emission is well identified, but there are no efficient solutions in this respect resulting in its dramatic reduction.

ACKNOWLEDGEMENTS

This paper was financed from the resources of the Silesian University of Technology, project no. BK-231/ROZ1/2018 (13/010/BK_18/0029).

REFERENCES

[1] Boardman B., Fuel poverty synthesis: lessons learnt, actions needed, Energy Policy, 49, 2012, pp. 143-148

[2] Gembalska-Kwiecień A., Skotnicka-Zasadzień B., Innovation and optimization of the occupational health and safety management system in a selected industrial enterprise - a case study., Proceedings of the 6th International Conference Innovation Management, Entrepreneurship and Sustainability. IMES, May 31 - June 1, 2018, Prague. Book of proceedings. Ed. by: Ondrej Dvoulety, Martin Lukes, Jan Misar. Praha : Vysoka skola ekonomicka v Praze, Nakladatelstvi Oeconomia, pp. 347-356

[3] Hąbek P., Wolniak R., Relationship between management practices and quality of CSR reports, "Procedia - Social and Behavioral Sciences", vol 220, 2016, pp. 115-123.

[4] Hills, J., Fuel Poverty: The problem and its measurement. London: Centre for Analysis of Social Exclusion, 2011.

[5] IBS Research Report 2018, https://ibs.org.pl/

[6] Jonek-Kowalska, I., Turek, M. Cost rationalization of maintaining post-industrial regions, Polish Journal of Environmental Studies 22(3), 2013, pp. 727-740.

[7] Jonek-Kowalska, I., Turek, M. Dependence of total production costs on production and infrastructure parameters in the Polish hard coal mining industry, Energies 10(10), 2017, art. no. 1480.

[8] Liddell C., Morris C., McKenzie S.J.P., Rae G., Measuring and monitoring fuel poverty in the UK: National and regional perspectives, Energy policy, Volume 49, October 2012, pp. 27-32

[9] Sałach K., Lewandowski P.. Pomiar ubóstwa energetycznego na podstawie danych BBGD – metodologia i zastosowanie. IBS Research Report 01/2018.

[10] Michalak A., Fight against low-stack emission in the light of European Union and Polish legal conditions, International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2018, 18(5.4), pp. 423-430.

[11] Moore R., Definitions of fuel poverty: implications for policy, Energy Policy, 49 (2012), pp. 19-26.

[12] National Statistics UK, Annual fuel poverty statistics report 2019, https://www.gov.uk/government/publications/fuel-poverty-statistics-methodology-handbook

[13] Owczarek D., Miazga A., Ubóstwo energetyczne w Polsce – definicja i charakterystyka społeczna grupy, Instytut na Rzecz Ekorozwoju, Warszawa 2015.

[14] Rutkowski, J., Sałach, K., Szpor, A., Ziółkowska, K., Jak ograniczyć skalę ubóstwa energetycznego w Polsce? IBS Policy Paper 1/2018.

[15] Sokołowski J., Lewandowski P., Kiełczewska A., Bouzarovski S., Measuring Energy Poverty In Poland With The Multidimensional Energy Poverty Index, IBS Working Paper 07/2019.