

Energy Poverty as a Current Problem in the Light of Economic and Social Challenges

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Abstract: Study of the literature and personal research experience have resulted in the identification of many challenges in the field of energy poverty, both in terms of social and technical dimensions. The research problems indicated in the paper and the proposed topics for further methodological and analytical work appear to be important not only from the perspective of the categories of energy poverty but also in the contexts of climate change, the ongoing energy transformation and attempts to implement a new energy model based to a large degree on unconventional and renewable sources of energy. This article also contains both methodological and scientific considerations.

Keywords: energy poverty; perspective; development



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1. Introduction

Energy poverty is a type of poverty in which a household cannot afford to buy energy or where there is a lack of access to an appropriate level of energy services required to ensure basic, everyday needs essential for correct functioning, i.e., heating/cooling, cooking, lighting, etc. [1,2]. Here, it is also worth underlining that energy is vital not only for satisfying basic human needs (e.g., in the field of food safety or optimal heating conditions indoors from the perspective of health) but also for higher needs related to the development of skills and acquiring competences (education, mobility, communication, etc.) [3].

On the basis of the subject literature, it can be said that there is an urgent need for a systemic solution to the problem of energy poverty in Africa and South and Central Asia, including in Senegal, Niger, Sierra Leone, Chad, Afghanistan, Pakistan, Yemen, Nepal, India, Cambodia, Myanmar and Bangladesh [4–9]. The International Energy Agency (IEA) estimates that about 733 million people live without access to electricity, and about 2.4 billion people use unclean fuels for cooking [10]. In turn, the Rockefeller Foundation reports that there are 3.6 billion people who are energy poor, including both those who do not have access to electricity and those who have access to unreliable energy or are underserved [11]. The differences in estimates result from the lack of a uniform definition and measures of energy poverty. Until fairly recently, topics related to energy poverty mainly concerned developing countries and to a small degree, e.g., the countries of Western Europe. However, energy poverty is also a problem in rich states and developed countries (relatively from a global perspective). European countries are also struggling with the problem of energy poverty, and political decision-makers have recently increased efforts to solve this problem. The data from the European Energy Poverty Observatory (EPOV) show that in 2019, at least 50 million people in the European Union were energy poor [12]. According to Eurostat, about 36 million people in the EU (8% of the population) were unable to keep their home adequately warm in 2020 [13]. The worst situation in Europe is found in the countries of Central-Eastern and Eastern Europe (e.g., Bulgaria) [14].

Until recently, it seemed as if global energy poverty was showing a marked tendency to ease [15]. Of course, there are still considerable geographical differences related to

the research topic, connected, amongst others, to the technological and technical issues of generating energy, access to natural energy resources and energy policy, as well as external and internal economic conditions. Nevertheless, in practically the entire world, the current main driving force behind energy poverty is the rising price of energy. This affects European countries in particular (especially the EU-27), which due to the geopolitical situation and the previously adopted climate strategy and policy (manifested in, e.g., the system for trading in rights to CO₂ emissions) are facing an ever greater problem of energy poverty. Furthermore, there is growing public discussion about the possibility of introducing limitations on the supply and consumption of electricity. This not only concerns businesses but also individual consumers. The fear related to unpredictable rises in the costs of energy is being expressed ever more loudly in public debates. This process of increases in the price of electricity will undoubtedly have an effect on the economic condition of households, which will have to face up to this problem. Energy availability and affordability are identified as the main obstacles to alleviating energy poverty on a global scale [16].

The results of research on energy poverty conducted in recent years demonstrate a significant information gap between the needs of decision-makers in the field of social policy and the scope of information provided. This is related to numerous definitions explaining the concept of energy poverty, which result from many external and internal factors, including differences in terms of climate, household preferences, accommodation standards and social and cultural beliefs. There are also problems related to the information basis, e.g., collecting information on the actual room temperature in households. Official statistics respond to these needs to a low degree of detail, and the openness and admission of individual social groups to belonging to energy poor groups (and the consequences related to poor health, malaise, etc.) is varied. The problem still unresolved is the development of systemic solutions that, on the one hand, will cover different cognitive needs and, on the other hand, will be tailored to the subjective feelings of the poor/excluded people with different specificities (taking into account demographic, social, cultural and economic features, considering the technical resources available). These are still challenges facing researchers. The energy poverty measures used often remain controversial, especially in international comparisons [17]. In the last few years, modern concepts have been developed that enable the measurement and analysis of energy poverty in a more comprehensive way, based on (complex) models and indicators. In addition, there has been a dynamic development of IT solutions, which creates a new perspective for researchers.

The main aim of this article is to identify scientific achievements in the field of energy poverty and to attempt to define potential directions for research initiatives. The considerations investigated here may serve as a valuable source of information for scientists, experts and people connected professionally to the energy sector. In addition, the prospective research topics can serve as inspiration for further work, which is important in the light of the highly dynamic changes in energy conditions occurring around the world, including in the field of energy security.

This study consists of three main parts. After the introduction, the progress in the research field is presented, taking into account various selected categories of progress in the area of energy poverty. In the last part of the article, the summarizing section, the most important elements of the analyses and reflections are presented, based on the existing knowledge and experience, which are to a large extent reflective and may constitute a contribution to further considerations in the discussed issues.

2. Progress in the Research Field and the Perspective of Future Research Directions

In recent years, interest in the problem of energy poverty has increased, not only in the scientific literature but also in public debates. The selected spheres and categories of this progress in the research field are presented in Figure 1.

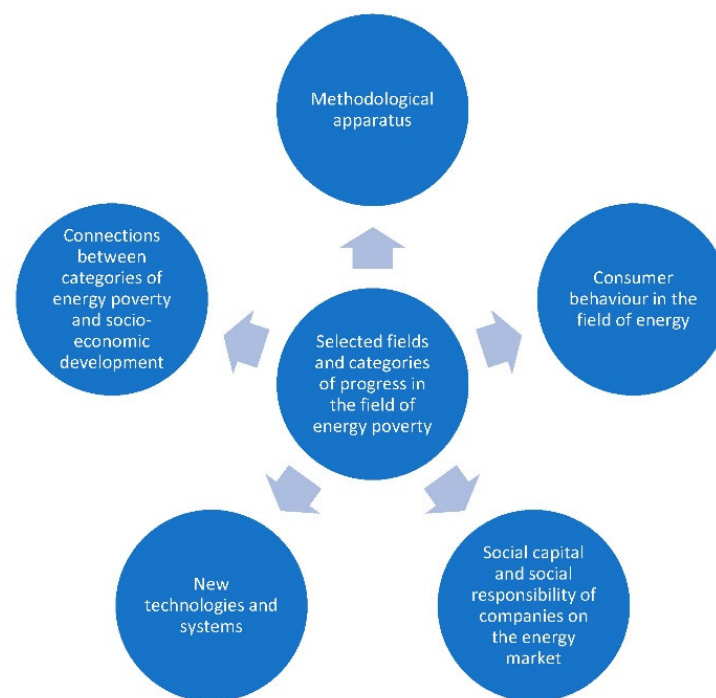


Figure 1. Selected spheres and categories of progress in the field of energy poverty.

In terms of methodology, it must be emphasised that the category of energy poverty is explained and analysed in various ways. This is the result of differences between the absolute and relative ways of understanding poverty and the subjective and objective ways of measuring poverty. From the methodological perspective, it is worth noting that the issue of energy poverty is ever more frequently analysed according to multiple criteria and decidedly more broadly than in first attempts at analysis (simple indicators). Currently, using more advanced measurement tools, it is possible to compare the units studied (countries, voivodeships, districts, communes, households) taking into consideration varied economic, geographical and social conditions. From the methodological point of view, it is important to refer more broadly to a compilation of the three main dimensions of factors affecting the situation regarding access to energy. Researchers must consider the technical perspective (equipment, devices, their energy efficiency etc.), the social perspective (socio-cultural and economic conditions) and the global perspective (in the context of current energy policy and energy structural transformation). Due to the need to conduct interdisciplinary studies, it is important to search for common methodological principles, which will include specific problems concerning current research work in the field of energy poverty. A relatively new, cross-sectional concept and programme of conceptual research in this field is energy justice [18,19]. Jenkins et al. [18] show that energy justice provides a new stimulating framework for connecting existing and future research, e.g., into energy production and consumption. The most recent literature has provided interesting insights into the possibilities for application in economic policy and planning, e.g., the connections between the issue of energy justice and the process of energy transformation [20]. The problem mentioned in the introduction with comparing the scale of energy poverty in international terms was the subject of works, for instance, by Karpinska and Śmiech [17]. With the example of the Central and Eastern Europe countries, the above-mentioned researchers compared the prevalence of hidden energy poverty between 11 countries on the basis of estimated housing costs (the information was based on data from the EU-SILC dataset.). In addition, Rao et al. [21] emphasize the importance and usefulness of comparisons in the area of energy poverty of cross-border regions with similar climatic factors or other circumstances (the analysis was made in the area of N11 countries).

In general, energy poverty is not easy to measure, as different indicators determine different aspects of the issue. An article by Siksnielyte-Butkiene et al. [22] presented a systematic review and assessment of the existing (complex) indicators for measuring energy poverty. However, further modifications to the indicators are crucial, especially in the face of the high variability of features/variables (e.g., prices and price relations within the research topic). For example, Nguyen et al. [23] presented a new approach to measuring energy poverty, i.e., a modification to the Exact Affine Stone Index (EASI) demand system in order to take into account the alleged uselessness of energy consumption. Taking Vietnam as an example, they proved that energy poverty can occur at higher levels of income than that considered in the literature and that higher income can discourage households from using more sustainable, low-emission forms of energy.

Generally, considerable progress in analyses of the research subject has occurred in the case of the objective viewpoint. Meanwhile, the subjective approach, in which the assessment of the satisfaction of needs is conducted by the same units studied (individuals, families, households), provides great potential for creating new research initiatives (e.g., taking into consideration behavioural economics). In this context, an ever-wider debate is developing on the analysis of consumer behaviour with regard to energy. The need to develop research that will bring direct evidence on fundamental issues at the core of energy poverty has been emphasised, among others, by Deller et al. [24]. The authors indicate that where emphasis is placed on temperatures in the home, it is important to gather complete data on temperatures achieved and the temperature preferences of households. An interesting addition to this thread could be the problem of the seasonality of energy poverty (heating/cooling), with consideration of the natural conditions in a given area and economic factors (e.g., price tariffs).

The next important element in progress on the research topic comprises innovative studies related to consumer behaviours. In the context of energy poverty, including the category of access, socio-demographic factors are considered to be key in research into the level of access to energy or energy poverty in poor urban and rural communities [25]. Here, factors such as gender, affluence, age, income, level of education and size of a household/farm are popular. Meanwhile, some factors which could constitute an interesting research challenge are ignored. For example, in only a few studies is an attempt made to understand the thread of race or country of birth ("ethnic origin") and the issue of energy poverty [26–29]. Other interesting research threads also include the wider discussion on the effect of new social phenomena on behaviour in the field of energy consumption. For example, Grossmann et al. [30] studied the relationship between the experiences of households in a state of energy poverty and their trust towards institutions and social networks. Of interest are also reports on the relationships between energy poverty and digital exclusion [31]. Future research threads also include the links between important categories in energy poverty and, for example, co-working and co-living. The current economic situation, with its high inflation and elevated costs of purchase/rent of flats/offices, is forcing many people, especially the young, to share their living and working space with others. Shared accommodation or renting co-working space for group work is becoming ever more of a necessity. In these conditions, what are the processes that make up consumer behaviours in the field of energy? Exploring and understanding consumer behaviours in these areas, including research into the possibility of exerting an influence over other users, are prospective areas of research. This perspective may bring new knowledge on individual and group beliefs and attitudes in relation to the consumption of electricity. The social trends indicated above may affect the needs and habits of users, as well as the scope and manner in which energy services are used. An important thread of new research into energy poverty could be the issue of migration, including migration resulting from conflict, which may contribute to the processes of adaptation, integration and assimilation and have consequences in behaviours with regard to energy. Analysis of the status of research has shown that this issue is very rarely raised in the literature, and rather as an addition to discussion on other issues than as the main topic of consideration.

The links between energy poverty and economic development are another very important aspect dealt with recently in the subject literature. Energy poverty limits economic growth and social prosperity. Analyses have been made in this field for individual countries (e.g., studies by Acharya et al. [32], Munyanyi and Churchill [33]), in addition to supranational research (Amin et al. [34], Tundys et al. [35], Raghutla and Chittedi [36]). Of interest are studies on the influence of government expenditure on energy poverty [37,38]. Equally interesting are analyses of energy poverty in conjunction with climate change [39]. Rising atmospheric temperatures will result in an increase in energy consumption for cooling, providing another area for analysis. A growing number of research studies also deal with the connections between energy poverty and efficiency and productivity in individual sectors of the economy, e.g., in agriculture [40]. Future research work can also be seen in this field, especially in the situation of considerable changes in supply chains, applied technologies (the issue of high prices of agrochemical products and the prospects for limiting their use in agriculture), etc. Issues related to energy poverty in agriculture could be considered and compared in terms of the axis “farming households–farming enterprises”. Furthermore, such issues can be further developed in a wider scope, e.g., as part of the concept of agrobusiness [41]. In this context, assessments could be made of the influence of energy poverty on the food economy over different time periods and locations.

The issue of technological innovations plays a key role not only in the field of energy poverty but also in the development of a low-emission economy [42]. Here, the subject literature underlines the problem of the development of electrification and renewable energy sources. Several initiatives and policies have been proposed with the aim of solving the problem of poor access to new sources of energy in many developing countries. In countries with a relatively high degree of socio-economic development, advanced hybrid technologies are being sought (e.g., electrical heat pumps powered by photovoltaic panels), which are more efficient both from an economic and an environmental perspective. The renewable energy sources sector is continuing to develop, which raises a new research problem, i.e., the issue of technical and economic access to low-emission energy in developed countries. Of key importance are technological issues in terms of the thermo-modernization of buildings in the context of the need for thermal comfort, taking into consideration the use of renewable energy sources in the selection of heat sources [43]. It is important to identify and analyse different solutions for modernising buildings that can be supported by simulation programmes (e.g., TRNSYS) [44]. Most crucial are new technological solutions connected to the storing of energy taking into account the issue of energy poverty and micro-storage in particular. From the point of view of further research, it is vital to undertake analyses and comparisons of hybrid solutions for energy storage (intended for use in multi-unit buildings, detached houses and terraces, etc.) from an energy and economic perspective. Of interest from the point of view of the possibility to reduce energy consumption costs for consumers without disturbing people’s daily lives are analyses of the development of intelligent control systems [45]. Progress on household energy management systems has been significant. In recent years, many papers have appeared on topics related to new, ongoing challenges in the subject area (hybrid systems, thermal comfort, price variability, etc.) [46]. Further improvements are indicated by Thirunavukkarasu et al. [47], who write of the need for comprehensive energy management solutions for micro-network systems, including the function of sharing energy in social micro-networks.

There is also great potential in the field of information technology for combatting energy poverty. In a paper by Venezi et al. [48], a set of innovative digital tools was developed in this regard (including TEL). These tools can influence user behaviour, resulting in the development of energy awareness and education on important topics related to energy poverty.

In the subject literature, the need to reinforce the role of the consumer in shaping the energy system is underlined with increasing frequency. This also concerns people/households suffering from energy poverty, who can also take an active part in this field [49]. The aim of energy cooperatives can be the lowering of energy costs for local communities, which is

a priority in the context of energy poverty. The social dimension of such initiatives must be emphasised, especially the socio-economic potential of such communities. The subject literature ever more frequently discusses the topic of the development of democratic and participatory bottom-up initiatives in the field of energy, their role in the process of energy transformation and the regulatory context [50]. The work covers both developed and developing countries [51–53]. The contemporary phenomenon of civic energy may be an interesting topic for future research initiatives. There are many theoretical approaches from various fields of knowledge and scientific disciplines (sociology, psychology, economics, etc.) that can be used to analyse not only local initiatives but also broader social supranational movements. There is a need for further analyses of, among others, the motives for joining cooperatives, as well as the involvement, attitudes and habits of their members. It is important that interdisciplinary research be used for this purpose to combine qualitative social research and technical and economic analysis. There should be a clear emphasis both on the opportunities as well as the barriers to the development of various forms of civic energy. On the other hand, the development of socially responsible business practices in the energy sector could limit energy poverty. In the field of socially responsible business practices in the energy sector, analysis is more often conducted regarding issues affecting sustainable development in the energy sector (in the meaning of the size and structure of production, emissions, etc.). Enterprises operating in the energy sector, in particular market leaders, should understand in a broader sense the social and economic effects of energy poverty, while at the same time implementing suitable countermeasure and educational programmes.

The above-presented description of the latest achievements in the research topic, along with the identified research gaps (both theoretical, related to the lack of theoretical studies linking the issues of energy poverty with opportunities to participate in social life, and the shortage of empirical research on a particular topic), allowed for the presentation of questions and recommendations for future research. Examples of questions that could be posed in connection with research on this phenomenon and an outline of recommendations for future research and analysis are presented below.

One of the main themes of new research initiatives, especially in the context of the current geopolitical situation and the exacerbation of the problem of energy poverty as a result of rising energy prices, is the relationship between energy poverty and the change of place of residence, change of job, the issue of human choices in the sphere of politics, social values, personal life and consumer practices. An interesting research question is, for instance, whether and to what extent the obtained effects of supporting people at risk of poverty or who are energy poor can be considered sustainable in the current conditions? What is the impact of these activities on the economic and social independence of people covered by aid/support? This requires much greater activity from researchers, and the analyses should be largely local in nature. Even under similar conditions, analogous cause-and-effect relationships may have a different character and dimension. At the same time, there is a large field to be used for relatively less popular research methods and tools, e.g., taking into account economic experiments. It is possible to deliberately or artificially induce a specific phenomenon or its changes (e.g., increase in prices of energy carriers—gradual, rapid, etc.) in order to verify the previously formulated hypothesis. Due to the digitization process, the use of a virtual experiment carried out with the use of information technology (including simulations with the use of augmented and virtual reality), allowing the creation a fictional model of social and economic reality (taking into account the technical and socio-economic elements related to energy poverty), will increase and transform them. The selection of research instruments and techniques should to a greater extent be adapted to the specificity of the research topic/problem. This is especially true as the issue of energy poverty, like the issue of poverty in general, within the scientific discourse, can be considered in terms of philosophy, including the issue of a dignified human life, good for man, as well as in terms of its impact on interpersonal relations. Greater consideration should be given to the context of the information society in the field of energy poverty. In

this context, the results of research on the level and scope of poverty will be different when human needs include, for instance, access to e-culture or the possibility to participate in e-community activities.

3. Summary

The challenges facing the research community that deals with the problem of energy poverty are numerous. Issues related to this topic area will to an increasing degree come up against problems that require an interdisciplinary or even cross-domain approach. Furthermore, the issue of energy poverty is attracting ever greater attention in the activist and political debate, which forces the potential research direction towards new technologies and increased efficiency (technical, economic, environmental). The tense geopolitical situation, limits on international trade and the high price increases of natural energy resources on world markets may lead to an increase in the scale of energy poverty in the nearest future. In this situation, the differentiation between energy practices used in households living in single-family houses (detached houses, semi-detached houses, terraced houses, etc.), with their own heat source, and the practices of residents in multi-family blocks (heat from district heating systems) may deepen. This also raises research challenges in the field of external and internal air pollution, including analyses in the area of spatial heterogeneity within “urban–rural areas”. From the cognitive point of view, the differences taking into account other factors, including property issues (access to energy services and energy poverty of people who rent out flats/houses), are also interesting. In light of the above conditions, the problem of energy poverty is becoming a key issue in the context of energy and social policy. This is because the availability and affordability of energy are of fundamental importance, constitute the basic needs of households and to a large degree shape people’s well-being and determine their living standards.

In addition to presenting the latest developments in the research category, this work also indicates potential research directions—amongst others, a better understanding of the connections between energy poverty and the social context, including new concepts/movements. It is becoming vital to build cooperation between scientists, decision-makers, activists and bottom-up initiatives. This is important not only from the point of view of limiting energy poverty but also in terms of supporting the low-emission transformation at the level of individual households. This requires accelerating research activity in the direction of optimising energy management techniques, including the adoption of innovative ICT technologies and co-management of various energy systems within micro-networks. The innovative approach that uses artificial intelligence (AI) techniques to detect and alleviate energy poverty will also grow.

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