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Current challenges of Local Government Units in thermal energy security management at the local level in the face of the challenges of the situation in the east

Introduction

Widely understood heat security has been a hot topic of debate in Poland for a long time, and especially nowadays, during the Russian invasion of Ukraine. Related issues cause concern for creators of various social, economic, financial, and climate policies, both on nationally and locally. However, one specific aspect of energy security – heat security or lack thereof, i.e. heat poverty faced by numerous households – remains vague, and thus insufficiently analysed and discussed in the literature. This manifests itself in a multi-dimensional way, which often leads to various forms of social, economic, or ecological (environmental) destruction. At the same time, its symptoms reflect the level and quality of energy security experienced by households. Numerous studies conducted in Territorial Self-government Units in Poland also demonstrate that this problem is often not well-recognised and sometimes even alien to local authorities. This results from a not acknowledging this issue as heat poverty, although this phenomenon is being increasingly experienced both locally (in multiple Polish towns and municipalities) regionally, and even nationally. Obviously, there are local self-governments that have noticed this problem. However, due to the absence of relevant definitions and instruments, it is only analysed and resolved on an intuitive basis. The situation described above demonstrates that self-governments need a better method to estimate the scale of heat poverty in their territories. It should be as precise as the tools used for calculating the scale of economic poverty. They also need more effective programmes and instruments that might be applied to allow them to eliminate this phenomenon in a more effective way.

Local self-governments seem to assign low priority to the heat poverty issue (even less than in the case of economic poverty). As a result, they do not monitor the phenomenon nor do they develop special plans to reduce its scale. Thus, they also fail to improve the local level of

energy security. The activities of self-government units are practically reduced to the application of standard social policies.

So, to provide a full overview of this topic, several related stages must be covered. The first involves obtaining the broadest possible knowledge about the state of heat security experienced by households in the town of Gniezno. The second requires a diagnosis of the main reasons for the potential lack of energy security in these households. Furthermore, the level of perceived heat security must be defined along with the related threats as perceived by the local self-government of the town. Finally, actions taken by the municipal self-government must be diagnosed and their efficiency in terms of improving the heat security must be evaluated.

The main aim of this article is to determine the current local heat security management challenges faced by Territorial Self-government Units in the town of Gniezno. The objectives presented above lead to the following research hypothesis: It is estimated that the currently applied programmes and instruments used by Territorial Self-government Units to manage heat security do not contribute to the improvement and strengthening of this security. The research problem discussed in the article is of an empirical and theoretical nature. The applied research methods include: analysis, defining, synthesis, generalisation and drawing conclusions, as well as qualitative and quantitative methods and survey (in-depth interviews). Research was conducted among 1200 households and 5 Territorial Self-government Units in the town of Gniezno.

The energy security of households – a review of international research

An analysis of international research shows that there have been no systemic and uniform attempts to define energy security. Both in the theoretical and practical approach, this term is understood in a comprehensive (multi-faceted) and polysemical way. The conceptualisation of this notion has been evolving continuously. This has been significantly influenced by various global, international, national and even local factors, which include political, economic, environmental, or awareness-related aspects. These factors influence the level of this security to a various extent, as well as the values and the related good (common good), which should be protected by such security[355]. Hence, the essence of energy security

[355] J. Augutis, R. Krikštolaitis, L. Martišauskas, S. Urbonienė, R. Urbonas, and A.B. Ušpurienė, (2020) 'Analysis of energy security level in the Baltic States based on indicator approach', Energy, Vol. 199, 2020, 117427. https://doi.org/10.1016/j.energy.2020.117427; L. Chester, (2010) 'Conceptualising energy security and making explicit its polysemic nature', Energy Policy, Vol. 38. https://doi.org/10.1016/j.enpol.2009.10.039; Xue, L., Li, H.,

and its interpretation are highly dependent on the context of the energy landscape of the given state, including the accessibility of energy, power sovereignty and independence, the level of economic development, the progress of power generation technologies, energy efficiency, energy prices, diversification of energy sources, the level and extent of perceiving threats, dominant geopolitical issues, social consequences, and, finally, the growing awareness of climate changes and sustainable growth[356].

The correct understanding of energy security of households, i.e., on the level of the local community, requires a more in-depth, comprehensive approach, as all these aspects overlap and are interrelated. This is clearly shown in the Government Document "Energy Policy of Poland until 2030", which defines energy security as: "ensuring stable supplies of fuels and power on a level that guarantees that national needs are satisfies, at prices that are acceptable for the economy and the community, assuming the optimum usage of national energy resources and by diversifying the sources and directions of supply of petrol, liquid, and gaseous fuels" (Policy, 2009, p. 8, Kaźmierczak, 2013).

The above definition outlines five main preferences, such as the availability of energy, security of energy supplies, reduction of energy prices, which are determined based on justified costs and accepted by the recipients, the use of own energy sources, and, finally, diversification of sources of energy supply[357]. This definition of energy security is complemented by the definition provided by the International Energy Agency (IEA), which, in the document entitled "Energy security. Reliable, affordable access to all fuels and energy sources" defines the essence of energy security as the: "uninterrupted availability of a sufficient amount of energy at an affordable price, as part of sustainable economic growth, with use of environmentally-friendly measures". (Energy Security, 2022; Filho and Voudouris, 2013; Raghoo, Surroop et al., 2018).

Shen, W., Zhao, X., Liu, Z., Zheng, Z., Hu, J. and Meng, S. (2023) 'Applying GeoDetector to disentangle the contributions of the 4-As evaluation indicators to the spatial differentiation of coal resource security', Energy Policy, Vol. 173, 113418. https://doi.org/10.1016/j.enpol.2023.113418 (2023).

[356] Ang, B. W., Choong, T. S. and Ng, T. S. (2015) 'Energy security: Definitions, dimensions and indexes', Renewable and Sustainable Energy Reviews, Vol. 42**.** https://doi.org/10.1016/j.rser.2014.10.064**;** J. Rosenow, S. Thomas, D. Gibb, R. Baetens, A. De Brouwer, and J. Kornilliego, (2023) 'Clean heating: Reforming taxes and levies on heating fuels in Europe".

[357] L. Martišauskas, J. Augutis, R. Krikštolaitis, R. Urbonas, L. Šarūnienė and V. Kopustinskas, (2022) 'A Framework to Assess the Resilience of Energy Systems Based on Quantitative Indicators', Energies, Vol. 15(11), 4040; https://doi.org/10.3390/en15114040; M. Tvaronavičiene, (2020) Innovation in Energy Security and Long-Term Energy Efficiency. Energies. ISBN: 978-3-0365-4661-2. ISBN: 978-3-0365-4662-9. https://doi.org/10.3390/books978-3-0365-4662-9.

A particularly important aspect of this definition, that stresses the timeliness of investment in energy supplies, is the emphasis on the need to implement sustainable development that will take into account the current environmental challenges and the needs of economic growth (Krupnov, Krasilnikova et al., 2022; Jia W., Jia X., Wu L et al., 2022). On the other hand, according to this definition, the essence of energy security focuses on the ability of the power supply system to respond quickly to sudden changes in the balance of supply and demand. A similar definition of energy security can be found in the report of the World Energy Council (WEC) entitled "issues Monitor 2020: Decoding New Signals of Change" of 2020. As far as energy security is concerned, this document points to one very important aspect, which is environmental protection and the related need to apply new, innovative measures (technologies) both in power generation and transmission. These measures should be fully energy efficient, capable of reducing emission and thus mitigate climate change (Word Energy, 2020). This aspect of energy security was also noted by the European Commission, which, in the "New Green Deal" of 2019 defined the notion of energy security by focusing it clearly on climate neutrality and emphasising such measures as: energy efficiency, the greening of the energy system, clean energy or bioenergy sustainability (Announcement of the Commission, 2019, pp. 6-8, European Green Deal, 2021, pp. 16-17, You and Makinaka, 2022; Krupnov, Krasilnikova and Yashchenko, 2022; Igliński, Pietrzak et al., 2022; Caravella, Costantini and Crespi, 2021). The continuation of this approach to defining energy security may be found in the publication by A. Azzuni and C. Breyer, who also emphasised the need to implement the sustainable policy of the given state at the same time, to foster building its security on these values (Azzuni and Breyer, 2018; Krozer, 2019).

Another definition of energy security that is worth noting was provided in the Act of April 10, 1997, on Energy Law. The Act defines the term as: "such a state of the national economy that is able to cover both the current and prospective demand of the recipients for fuels and energy in a manner that is technically and economically justified while maintaining the requirements of environmental protection (Energy Law, 1997, Art. 3 item 16, Wolf, Surroop et al., 2016; Cantarero, 2020).

A similar definition of energy security can be found in the Government Document "Energy Policy of Poland until 2025", where this notion is defined as: "such a state of the national economy that is able to cover both the current and prospective demand of the recipients for fuels and energy in a manner that is technically and economically justified while

minimising the negative impact of the energy sector on the environment and living conditions of the society"[358] (Policy, 2005, p. 5).

It is also worth mentioning the definition of energy security provided by the Polish Institute of International Affairs (PISM), which defined the term as the capacity of the state to ensure the continuity of energy supplies at optimum costs, while, at the same time, maintaining political independence and adhering to the principles of sustainable growth[359]. According to experts from the National Security Bureau, energy security defined in this way constitutes an indispensable part of national security, which includes actions that are related to satisfying the demand of the national economy for specific energy carriers[360]. It is worth noting that this definition points to a very important aspect of energy security, which is the energy independence and sovereignty understood as the ability to provide various sources of energy to satisfy the needs of the whole population and economy, regardless of the geopolitical situation, in particular import[361]. This approach to understanding energy security was continued by G. Bartodziej and M. Tomaszewski, who understand this notion as an absence of threat during interruptions in the supplies of energy (energy resources)[362]. All the above definitions of the analysed term are supplemented by the definition provided by the American economic analyst D. Yergin. According to him, energy security means ensuring an appropriate and secure level of energy supply at reasonable prices, which does not endanger the fundamental interests, values, and objectives of the state[363]. The final part of this definition, which emphasises the strategic aspect of energy security that is manifested in form of securing the national interest, the values and goals of the state, is particularly important. A similar definition of energy security was provided by P. Baxendell, who defined the essence

[358] A.S. Blazev, (2021) 'Energy Security for the 21st Century', in: River Publishers: Aalborg, Denmark. ISBN: 9781498709668.

[359] A. Gradziuk, W. Lach, E. Posel-Częścik, and K. Sochacka, (2002) 'Co to jest bezpieczeństwo energetyczne państwa?', Biuletyn PISM, No. 103.

[360] J. Kowalski, and J. Kozera, (2009) 'Mapa zagrożeń bezpieczeństwa energetycznego RP w sektorach ropy naftowej i gazu ziemnego', Bezpieczeństwo Narodowe, Vol. I-II – 2009 /9-10.

[361] K. Świerszcz, and B. Ćwik, (2016) 'Subjectivity of Energy Security With Respect to Using Geothermal Resources in Selected Regions of Poland', Przegląd Nauk o Obronności, No 1-2. GICID: 01.3001.0012.9704). DOI: 10.5604/01.3001.0012.9704; C. Zou, S. Pan, and Q. Hao, (2020) 'On the connotation, challenge and significance of China's "energy independence" strategy', Petroleum Exploration and Development, Vol. 47 (2). https://doi.org/10.1016/S1876-3804(20)60062-3**;** Caravella, S., Costantini V. and Crespi, F. (2021) 'Mission-Oriented Policies and Technological Sovereignty: The Case of Climate Mitigation Technologies', Energies, Vol. 15 (6), 6854, 2021. DOI: 10.3390/en14206854.

[362] G. Bartodziej and M. Tomaszewski, (2009) Polityka energetyczna i bezpieczeństwo energetyczne, Racibórz-Warszawa.

[363] D. Yergin, (2006) 'Ensuring energy security', Foreign Aff airs, Vol. 85, No 2.

of energy security as the availablity of energy in appropriate amounts, at the appropriate time and place and at an appropriate place to guarantee economic development and to ensure the possibility to create energy reserves not only for the nearest future, but also for longer periods[364]. A review of various definitions of energy security should also include the definition of the Polish Industrial Lobby, according to which the term is understood as: "the continuity and reliability of energy supplies to individual, municipal, and industrial recipients at the lowest competitive costs and prices while adhering to the environmental protection standards in energy production, transmission, and consumption"[365].

In spite of the differences in wording, the referenced definitions of energy security are mutually complementary and create the integrity of the term, pointing to four fundamental aspects. The first is economic, which should be understood as ensuring that the prices of the supplied energy resources, chosen by means of a competitive selection of the economically reasonable energy source, will not create barriers for the economic development of the state, will not lead to energy poverty of the population or expose it to energy vulnerability. The economic aspect of energy security points to the need to create an appropriate framework for the functioning of the energy sector. This may be achieved by applying legal administrative measures of an economic nature. Another important issue is the ability to achieve the competitiveness of the national energy sector on the European or global market. Therefore, the economic aspect of energy security is one of the main dimensions in which the term is defined, as it has a significant, decisive influence on the possibility to pursue the national policy in multiple important aspects of life[366] (Draft Programme, 2022).

The second aspect of energy security is its geostrategic aspect, which is defined as the security of supplies and ensuring the continuity (reliability) and quality of energy supply in the short- and long-term perspective, on a level that is determined by both social and economic needs and expectations. These activities are supported by several key factors that are measures of such security. One of them is the policy of diversification of energy supplies and a developed, diversified network of infrastructure that guarantees not only various methods of generating energy, but also an improved resistance of the system to failures or the exhaustion of one of the energy sources. Another important factor is the technical condition of

[364] P. Baxendell, (1984) 'Oil Companies and the Changing Energy Market', in: The Energy Crisis Ten Years After, D. Hawdon (eds.), London. ISBN: 9781138304857.

[365] P. Soroka, (2015) Bezpieczeństwo energetyczne – między teorią a praktyką. Warszawa: Elipsa. ISBN: 978-83-8017-060-5.

[366] Energy Policy, Vol. 173, No. 113367. https://doi.org/10.1016/j.enpol.2022.113367.

the energy transmission, transport, and distribution systems. The continuous, reliable, and fault-free supply of energy through those systems to the recipients depends on the power of the energy-generating equipment, its technical condition and quality, the standard of distribution systems, and the level of their modernisation and the innovations applied.

The state of energy reserves in an amount that enables maintaining the continuity of energy supplies to recipients is another significant factor (measure). Considering the above, each state is obliged to establish reserves of energy resources that will ensure the continuity of energy supplies to the end users, in particular during natural disasters or in situations of threat or increased defence reediness of the state. These reserves are particularly important in the current, dynamic period, when they are treated as a guarantee and protection against threats (especially military ones) that might occur in the uncertain future. Another important factor (measure) is the degree of balancing the supply and demand for energy. The increasing demand for energy both in developed countries and developing ones results from the increasing needs of humans (of the populations, states) to improve the quality and standards of their existence. The problem of demand exceeding supply is exacerbated by the depletion of fossil fuel sources and by environmental requirements. Due to the latter, energy resources have been divided into environmentally friendly resources (natural gas, petrol, renewable energy sources) and those that contribute to environmental degradation (coal and lignite). This leads to the necessity to implement new technologies of energy generation and to increase technological diversification. Social education, raising awareness of the need to save energy and natural resources and to use them efficiently, is also extremely important[367] (The Act, 2010).

The third dimension of energy security is the environmental aspect, which should be understood as the production of energy in a way that does not lead to excessive environmental pollution and irreversible changes in the environment. In this dimension of energy security, particular focus is placed on sustainable development and climate neutrality that require support and taking action related to energy efficiency, implementing low-emission and renewable heat sources and the connected reduction of greenhouse gas emissions,

[367] Energy Policy, Vol. 173…, op. cit.; W.L. Filho, A.L. Balogun, D. Surroop, A. Lange Salvia, K. Narula, C. Li, J.D. Hunt, A. Gatto, A. Sharifi, H. Feng, S. Tsani, and H. Azadi, (2022) 'Realising the Potential of Renewable Energy as a Tool for Energy Security in Small Island Developing States', Sustainability, Vol. 14(9), 4965; https://doi.org/10.3390/su14094965.

implementing smart power networks and systems and power storage facilities[368] (Draft Programme, 2022, National Strategy, 2019).

Finally, the fourth aspect of energy security is the social dimension, which should be understood as providing stable, continuous, and reliable energy supplies for local communities and households. From the point of view of energy users, who are guaranteed common access to its sources as well as higher quality of services, these areas are extremely important. They determine the quality and comfort of daily life, as well as the freedom. The need to constantly raise social awareness and to provide education on the topic of development are also important[369].

Considering the list of definitions of energy security discussed above, in the general meaning and on the national level, considering all four aspects, one may attempt to refer the notion to a more local level, in the context of households. This definition will take into consideration the overall definition of energy security. In this approach, **the energy security of households should be understood as a state in which the residents are provided with constant (uninterrupted) expected level of access (supply) to specific (diverse) forms and sources of energy that meet the relevant qualitative and quantitative parameters, including technological and environmental ones, that do not cause low emission (air pollution) and that may be purchased by users when necessary and in the required amount, at a price that is affordable (for users), and on a level that ensures the fulfilment of basic needs and social and existential values.**

The above definition of local energy security proposed by the author clearly points to the need of an integral approach to the problem. The absence of even one of the components of energy security mentioned above will inevitably lead to the phenomenon of energetically vulnerable households and further to heat poverty. This is precisely why the phenomenon of heat poverty is a measure of the energy security level both on the national and local scale.

Additionally, the definition proposed by the author demonstrates that there is no single, universal definition of energy security, just as there is no universal definition of security *sensu largo.* Nevertheless, the above definitions of energy security, including the definition of the energy security of households in the local aspect proposed by the author, allow for the identification of its main elements (components) that constitute the necessary

[368] Energy Policy, Vol. 173…, op. cit.

[369] Ibidem; K. Świerszcz, (2022) Stan bezpieczeństwa energii cieplnej w Polsce na tle Europy. Warszawa: WAT. ISBN: 978-83-7938-370-2; K. Świerszcz, (2021c) Stan bezpieczeństwa energii cieplnej w Polsce na tle Europy. Warszawa: WAT. ISBN: 978-83-7938-338-2.

basis for further discussion and the resulting solutions, which should be as efficient and effective as possible.

Level of heat security in the town of Gniezno

Pomimo Gniezno is situated in the Greater Poland Voivodeship. In 2021, average salaries were lower than the rest of the country – 82.3% of the average remuneration in Poland, i.e. 4265.39 PLN. In practice, the conducted survey revealed that 52% of Gniezno households live on an income even lower than 4000 PLN. The research also demonstrated that in 5.1% of households the income was insufficient to satisfy all basic needs, while 25% of households found it difficult to satisfy more than just basic needs. This situation is presented in Figure 1.

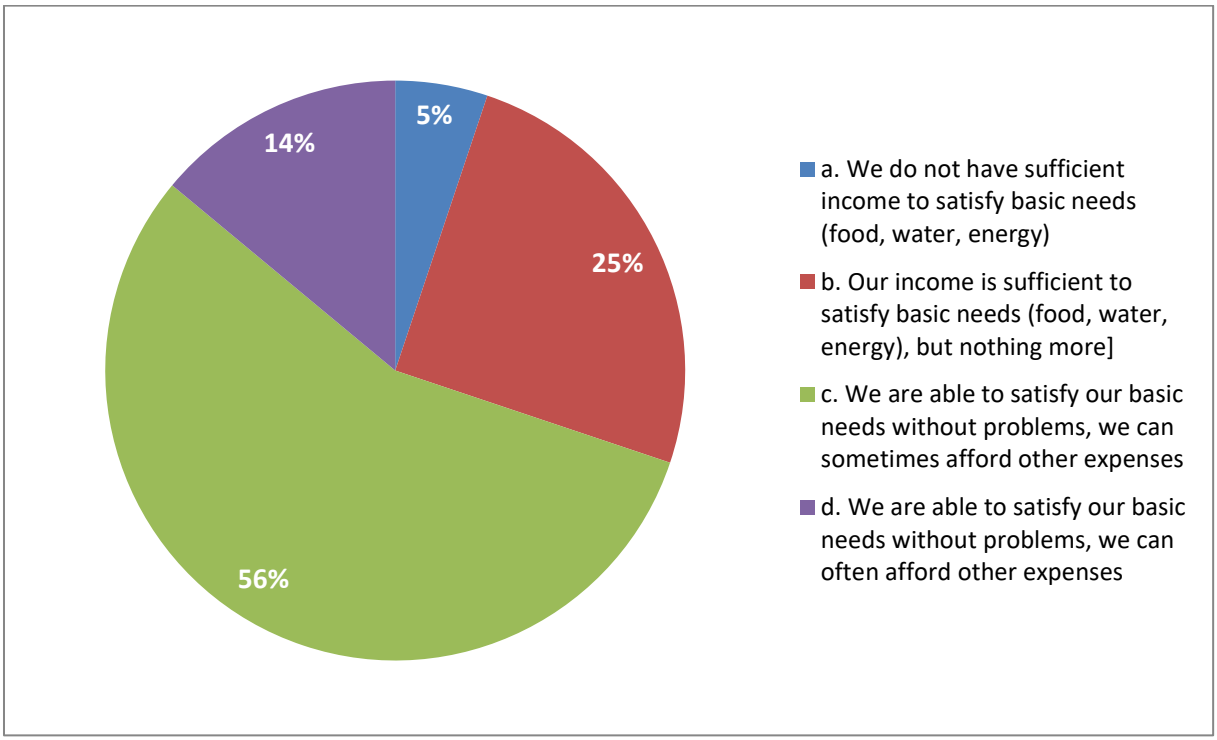


Fig. 1. The satisfaction of existential needs by households in Gniezno.
Source: Own study

The research also revealed that the costs of heating households are relatively low: approx. 417 PLN, although the situation was slightly different for heating water, where the costs were slightly higher: approx. 98.59 more than in other analysed towns. This is shown in Table 1.

Table 1. Heating costs of households in Gniezno

Heat costs	Statistics	Monthly costs (gross) of heating the home during the heating season (in PLN)	Monthly cost of heating water during the heating season (in PLN)

Gniezno	**Average**	417.82	98.59
	Median	400	100
	Minimum	70	30
	Maximum	1300	300

Source: Own study

Most of the households (52.9%) live in single-family houses, while 41.1% live in multi-family houses and approx. 4.4% in terraced and semi-detached houses. This structure is illustrated in Figure 2.

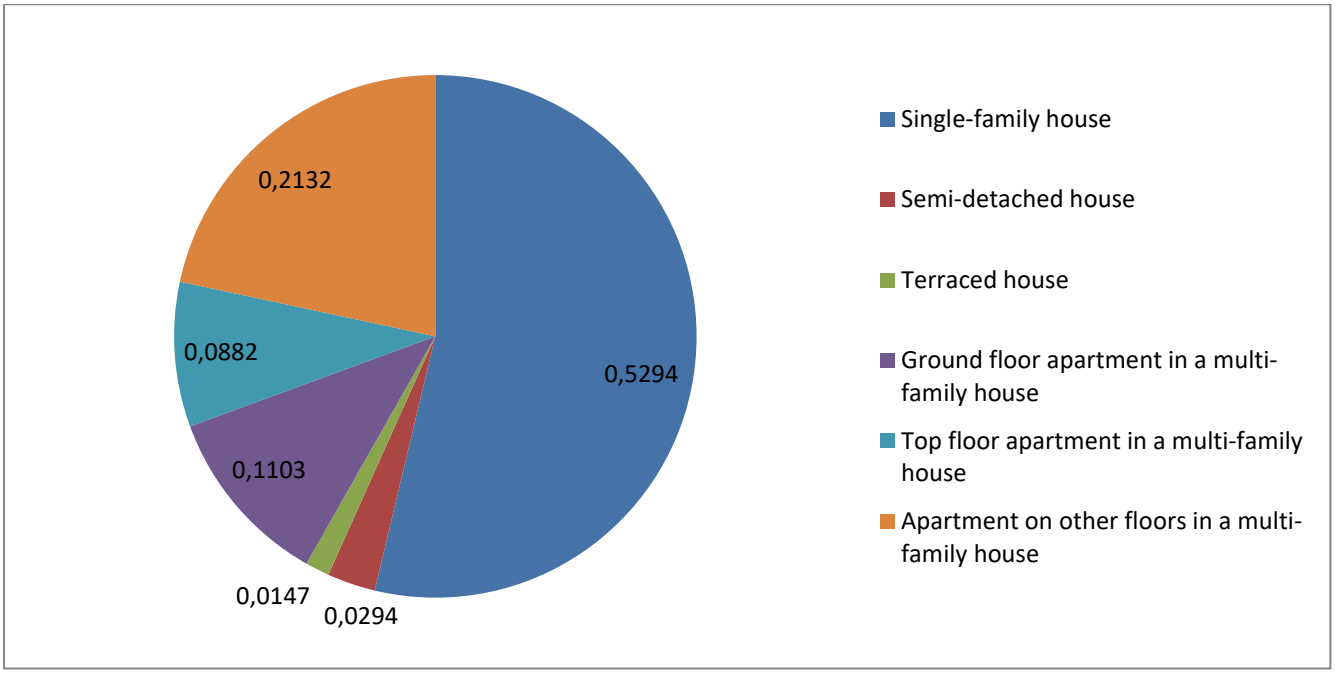


Fig. 2. Structure of residential properties in Gniezno by type of building

Source: Own study

The average size of apartments is approximately 106 m^2. 86.8% of these houses or flats are privately owned; 9.6% are community estates, 2% are subsidized housing, while 0.7% are rented. It should be noted that 24.26% of the households mentioned that their building lacked thermal insulation or energy-efficient windows. According to research, 7.4% of the households live in buildings constructed before 1945, 38.2% in buildings from before 1989, while 54.4% inhabit relatively new buildings, constructed after 1990. This means that the buildings in Gniezno are generally quite new: as many as 32.4% of the buildings were erected between 1990-2004, and 22% after 2005. This is shown in Figure 3.

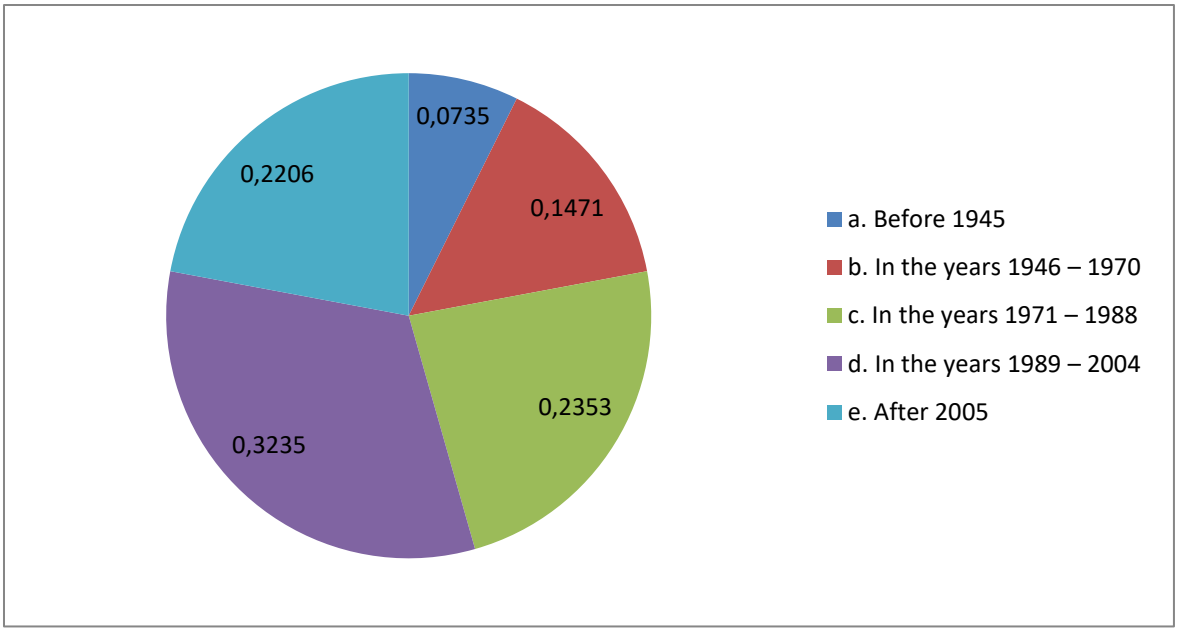
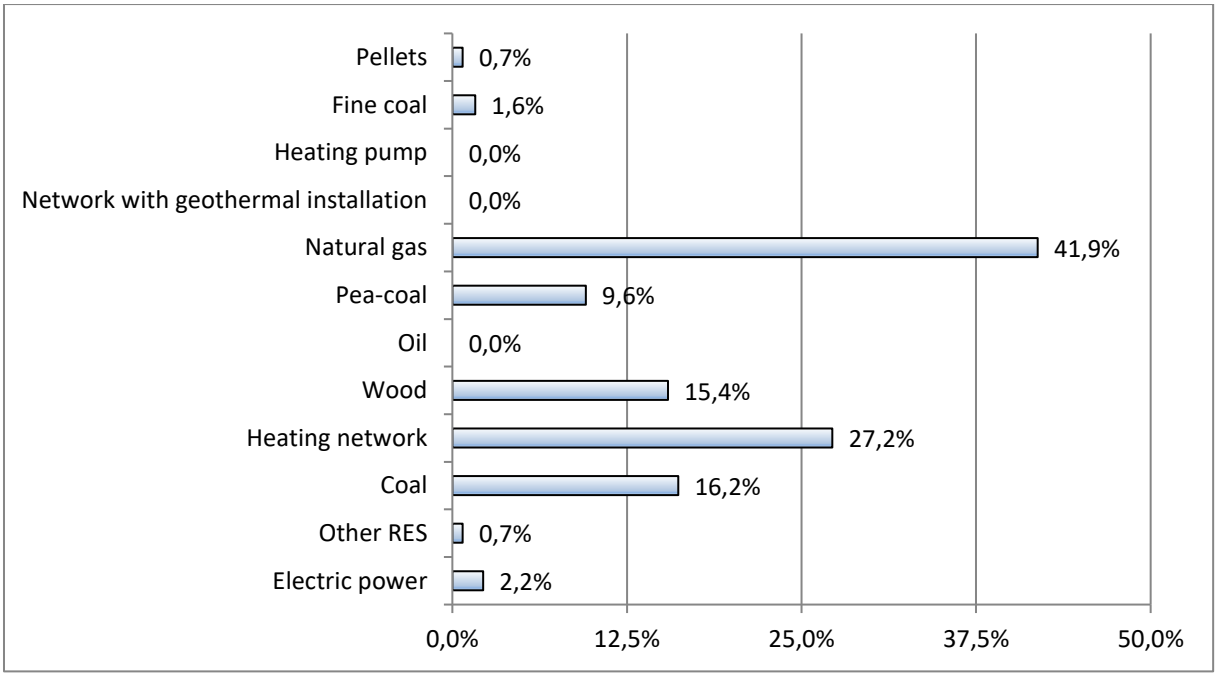


Fig. 3. Structure of building age groups in Gniezno
Source: Own study

As far as heating sources are concerned, research has shown that households use the following sources: 41.9% – gas, 27% – municipal heating network, 16.2% – coal, 15% – wood, 9% – pea coal, and 1.6% – fine coal. This is presented in Figure 4.



Note: The answers do not add up to 100%, because the respondents could choose more than one answer.

Fig. 4. Share of various types of fuel in heating homes in Gniezno
Source: Own study

The overall thermal comfort obtained from the above heating sources is slightly above the standard level and amounts to 21.32°C. However, the answers varied significantly and ranged from 18°C even up to 25°C, which is shown in Figure 5.

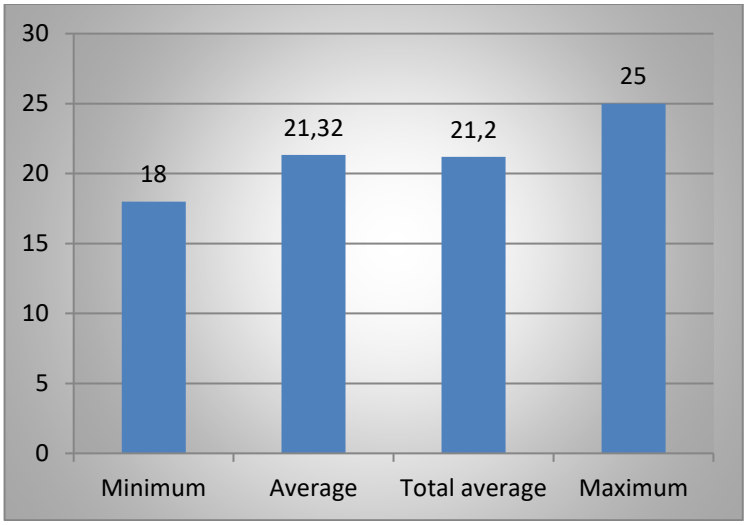


Fig. 5. Temperature of thermal comfort provided by residents of Gniezno
Source: Own study

As far as heating installations are concerned, none of the respondents in the survey used subsidies to replace heating sources. Similarly, only 0.7% of the respondents used subsidies to thermally modernise buildings. Only 15.4% of the participants stated that they were willing to install systems that use renewable energy sources (RES) to produce heat in their homes. Interest in installing power generation systems was similarly low: only 19.1% of the respondents stated that they were willing to do so. Overall, as many as 30.9% expressed reluctance towards RES installations. Such an attitude may result from a lack of appropriate conditions to install such systems, as noted by 25% of the respondents. The situation is rather different when it comes to replacing the current heating system at home: it was an attractive idea for 54.1% of the respondents. They were most willing to change their heating systems to photovoltaic panels (14.7%), solar collectors (9.6%), or heat pumps (9.6%). The distribution of answers is presented in Figure 6.

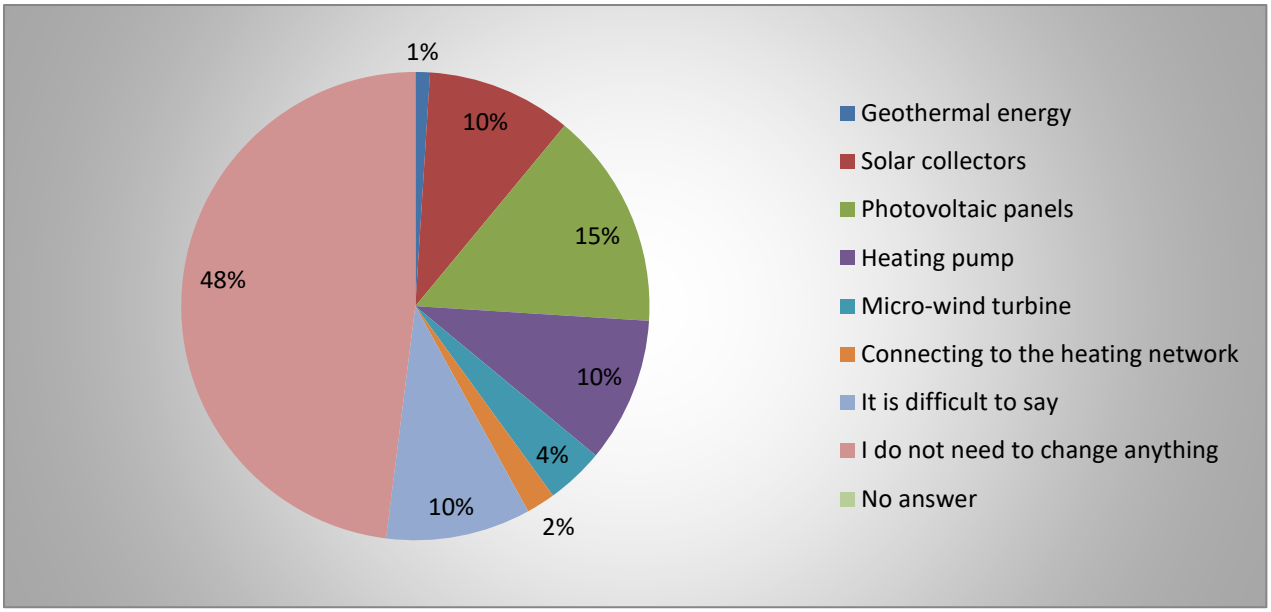


Fig. 6. Distribution of respondents who expressed their interest in various forms of energy generation in Gniezno

Source: Own study

In an attempt to determine the level of energy security in terms of heat poverty facing households in Gniezno, the study took into account the social security benefits granted to the residents of the town. According to the data of the Central Statistical Office (GUS), 24.6% of the residents of municipal housing resources were in arrears with the payments of fees. The average outstanding payment per home was approximately 2,330 PLN. In spite of such rather large outstanding amounts, the municipal authorities actively paid housing benefits to its residents amounting to over 5 million PLN in 2021. According to the information received from the Municipal Social Security Centre, in 2021 in Gniezno, a special needs benefit that includes funds to cover, among others, the gas, power, and water bills was granted to 1,384 families, totalling 2,131,669 PLN; while housing benefit was granted to 1,525 families (5.9%) amounting to 5,148,387 PLN; energy benefit and discount on the purchase of energy was granted to 151 families (1.5%), giving a total amount of 12,840 PLN, and 5.9% of the respondents used some form of social security benefits.

The determination of the heat security level of households also took into account the question concerning the subjective assessment of the quality of life. 71.3% of the respondents gave a positive answer concerning perceived heat security; 36.8% mentioned that poor air quality was not a problem; 29.4% stated that the problem was rather serious, while 14% considered it to be serious. In total, 43.4% of the respondents indicated problems with air quality, which

puts Gniezno in second place among all analysed towns. Furthermore, most respondents (50.7%) mentioned the combustion of rubbish as reason for poor air quality, while 47.1% and 44.1% blamed poor quality coal and poor quality boilers respectively. The distribution of respondents according to the listed reasons for poor air quality is presented in Figure 7.

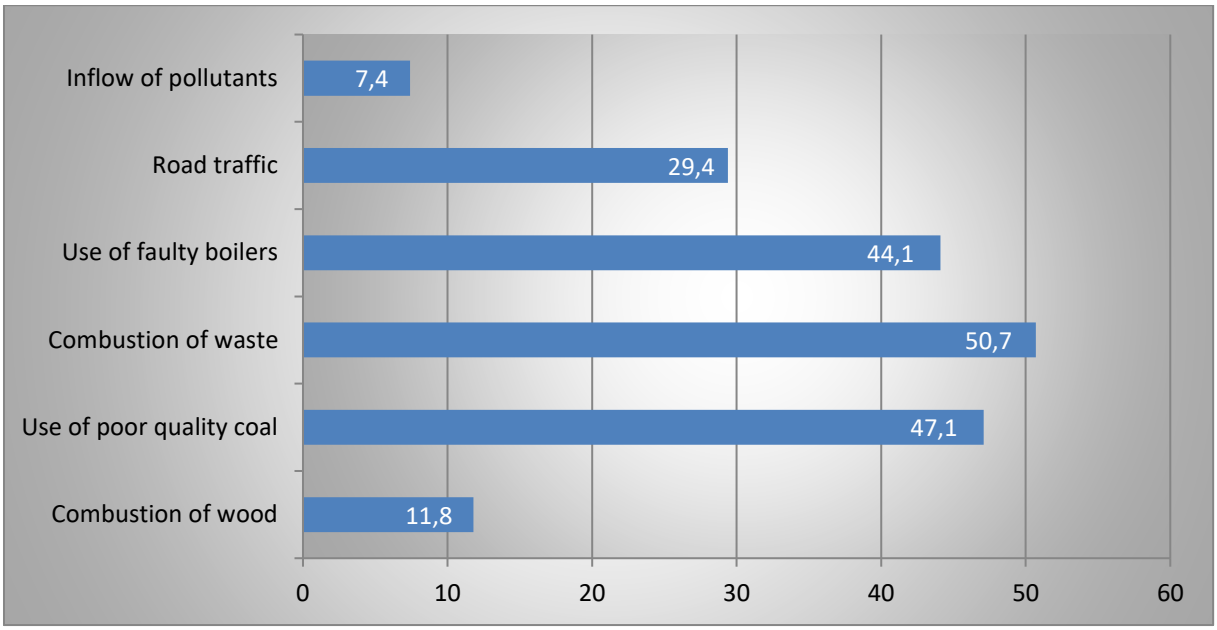


Fig. 7. The share of residents of Gniezno who listed various reasons for air pollution

Source: Own study

It should be noted that such a positive assessment of energy security experienced as opposed to heat poverty, while at the same time identifying the main sources of air pollution as burning rubbish and using poor quality, coal demonstrates the low level of awareness of energy security among the respondents. This is confirmed by further research results revealing that as many as 44.1% of the respondents declared that they have taken no action to prevent air pollution. Those respondents who have taken such action usually declared that they use energy-efficient heating systems (7.4%) or purchased high-quality fuel (5.1%). The relevant results are presented in Figure 8.

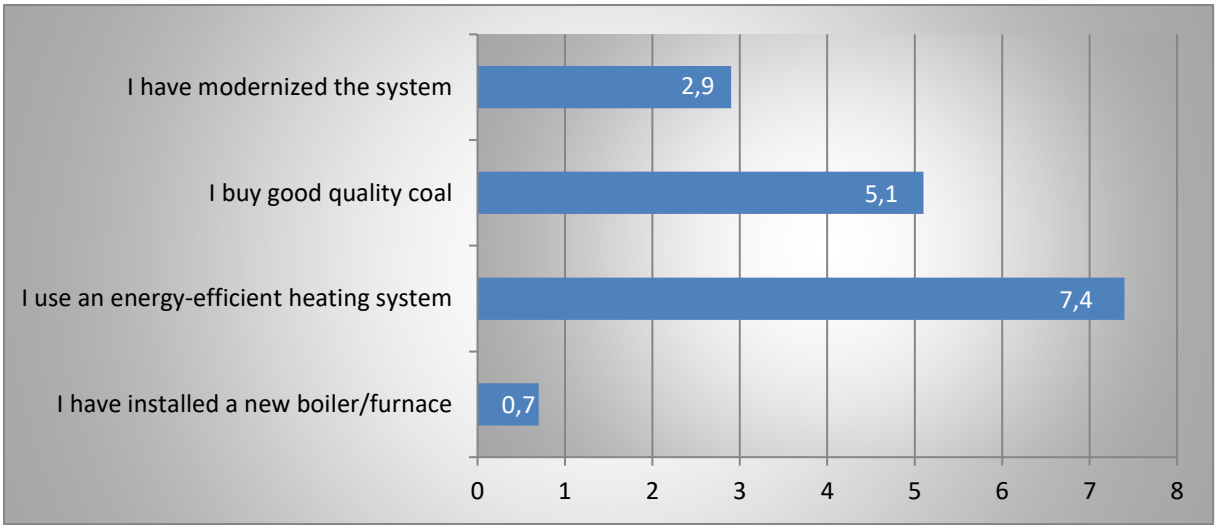


Fig. 8. Actions taken by residents of Gniezno in order to reduce air pollution

Source: Own study

The survey also yielded some interesting results about saving heating energy. As many as 39.7% of the respondents declared that they have taken some action in order to do so. Many respondents (27.9%) declared that they turn down the heating in rooms that are seldom used, while 17.6% turn off the heating when they leave their homes and 3.7% turn the heating down. A large number of respondents (35%) also stated that they save energy used to heat water: water for washing their hands – 19.1%, water used for baths – 31.6%, and water used for cooking – 2.9%. This is shown in Figure 9.

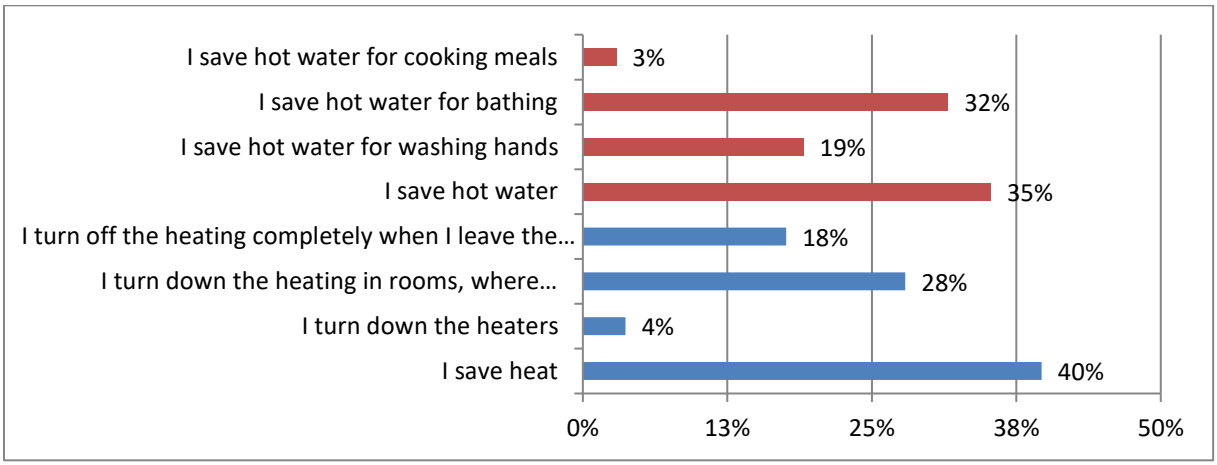


Fig. 9. Ways of saving heating energy by residents of Gniezno

Source: Own study

Main reasons for the lack of heat security in the town of Gniezno

Pandemia The research conducted on households that use traditional heating sources brought to light the main factors that influence the low level of energy security manifested in heat poverty. The first of these factors is the fact that it depends on the financial income among those households where a high percentage of expenses is spent on heating energy[370] and more difficulties in ensuring thermal comfort at home[371]. These are low income households – below 4 000 PLN – and are above the threshold of 10% expenses on energy. This is shown in Figure 10.

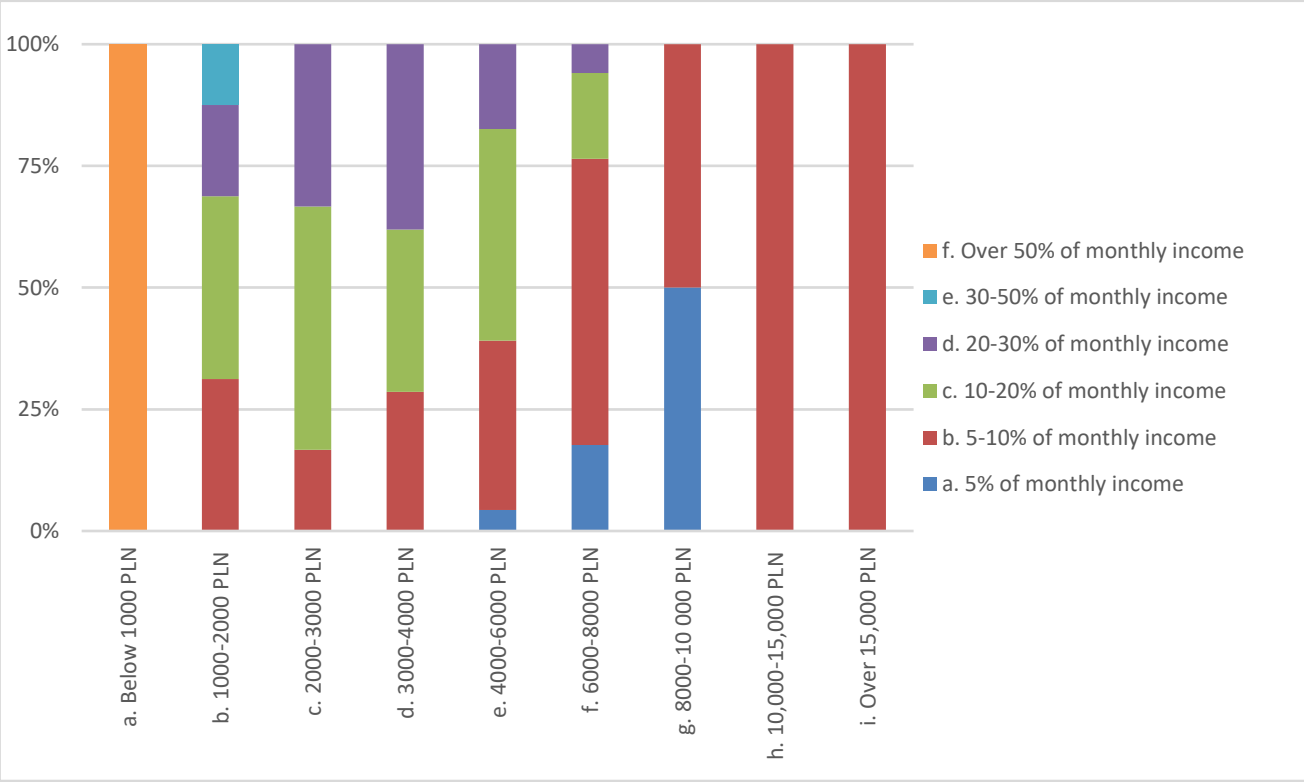


Fig. 10. Dependence of heat poverty on population income in Gniezno

Source: Own study

[370] K. Świerszcz, (2021c) Stan bezpieczeństwa energii cieplnej w Polsce na tle Europy. Warszawa: WAT. ISBN: 978-83-7938-338-2; V. Ballesteros-Arjona, L. Oliveras, J. Bolívar Muñoz, A. Olry de Labry Lima, J. Carrere, M. Martín Ruiz, A. Peralta, A. Cabrera León, I. Mateo Rodríguez, A. Daponte-Codina, and M. Marí-Dell'Olmo, (2022) 'What are the effects of energy poverty and interventions to ameliorate it on people's health and well-being?: A scoping review with an equity lens', Energy Research & Social Science, 87, 102456. Doi: 10.1016/j.erss.2021.102456.

[371] K. Świerszcz, (2021a) 'Current Challenges in Sustainable Management of Local Energy Security in Reducing Heat Poverty - A Case Study of a Selected Region of Poland', in K. S. Soliman, (eds.) Proceedings of the 37th International Business Information Management Association Conference (IBIMA), Innovation Management and information Technology impact on Global Economy in the Era of Pandemic, Cordoba: Spain, pp. 192-202. ISBN: 978-0-9998551-6-4; ISSN: 2767-9640.

The second factor is the type of building, as it turns out that respondents from low-income households live in apartments in multi-family housing rather than in single-family houses. Although the number of respondents who live in single-family houses in the whole sample was higher than of those who inhabit multi-family houses, the number of people who felt low thermal comfort in multi-family housing was higher than of those who feel low thermal comfort in single-family houses. The third factor is the type (form) of home ownership: more people live in municipal or social housing within the group of households with a relatively low income. Approximately 50% of respondents who inhabit social housing claimed a low level of thermal comfort. The number of people who mentioned low thermal comfort was also higher than average among inhabitants of municipal housing: 19.5%. Only 5.6% of respondents who own their property experienced low thermal comfort, although this was the largest group (62 persons). This is shown in Figure 11.

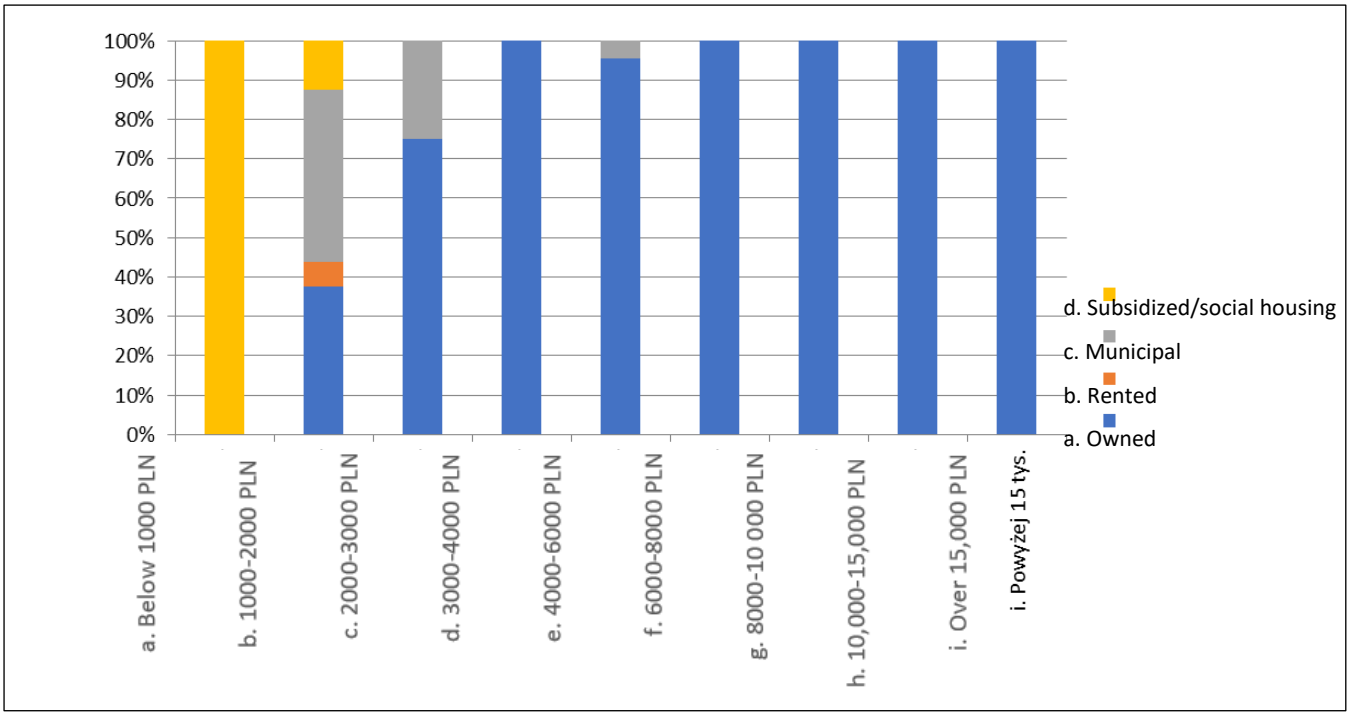


Fig. 11. Correlations between low income and forms of home ownership in Gniezno

Source: Own study

Finally, the fourth reason is the employment situation: even as many as 40% of households that spend a large proportion of their income on energy – i.e., above 30% – are

retirees and pensioners[372]. Another important factor is the age of the building: the older it is, the lower the perceived thermal comfort. As many as 23.3% of respondents who live in houses constructed before 1945 declared a low or very low level of thermal comfort[373]. Only the group living in buildings erected after 1989 featured fewer respondents who felt low thermal comfort falls than the overall average. A building's state of repair also turned out to have a bearing on energy efficiency. People living in houses without even partial thermal insulation had more problems with maintaining thermal comfort at home. The number of respondents who mentioned low or very low thermal comfort was also higher than average among those who live in homes without thermal wall or roof insulation or did not have energy efficient windows. For houses without thermal insulation they accounted for 12.2% of the group (12% in partly insulated buildings), for homes without an insulated roof – 10.6% of the group (and 14.6% for partly insulated roofs), and for houses without energy efficient windows they accounted for 13.3% of the group. The seventh factor concerns the sources of fuel used by the household for heating the home or water: as many as 10.6% of those who use coal for heating mentioned a lack of thermal comfort[374]. However, this group does not include those respondents who use special types of coal, i.e. fine coal or pea-coal. Another manifestation of fuel poverty in households is the tendency to receive various forms of social security benefits: significantly more respondents who claimed a lack of thermal comfort receive such forms of aid. Among the respondents who receive social benefits, 3-4 times as many persons

[372] K. Świerszcz, (2020a) Heat poverty as a measure of local energy security. Warszawa: WAT. ISBN 978-83-7938-251-4; Bardazzi, R., Bortolotti, L. and Pazienza, M.G. (2021) 'To eat and not to heat? Energy poverty and income inequality in Italian regions', Energy Research & Social Science, 73, 101946. doi: 10.1016/j.erss.2021.101946.

[373] K. Świerszcz, (2021a) 'Current Challenges in Sustainable Management of Local Energy Security in Reducing Heat Poverty - A Case Study of a Selected Region of Poland', in Soliman, K. S. (eds.) Proceedings of the 37th International Business Information Management Association Conference (IBIMA), Innovation Management and information Technology impact on Global Economy in the Era of Pandemic, Cordoba: Spain, pp. 192-202. ISBN: 978-0-9998551-6-4; ISSN: 2767-9640; H Rau, P. Moran, R. Manton, and J. Goggins, (2020) 'Changing energy cultures? Household energy use before and after a building energy efficiency retrofit', Sustainable Cities and Society, 54, 101983. Available at: https://doi.org/10.1016/j.scs.2019.101983.

[374] Świerszcz, K. (2020b) 'Indicators and Measures of Thermal Energy Poverty in the Shaping of the National Energy Security Policy, Based on the Example of Poland', in K. S. Soliman, (eds.) Proceedings of the 35th International Business Information Management Association Conference (IBIMA), Granada: Spain, pp. 9193-9210. ISBN: 978-0-9998551-4-0; I. Siksnelyte-Butkiene, D. Streimikiene, and T. Balezentis, (2021) 'Multi-criteria analysis of heating sector sustainability in selected North European countries', Sustainable Cities and Society, 69, No article: 102826. doi: 10.1016 / j.scs.2021.102826.

experienced low or very low thermal comfort (25.9%) than the average among all respondents (6.8%)[375].

Heat security and related risks as perceived by Territorial Self-Government Units

A survey in form of an in-depth interview conducted among the employees of Territorial Self-government Units in Gniezno aimed to determine the level of awareness of heat security among local administration workers, considering in particular the phenomenon of energy and heat poverty.

Respondents gave various answers when asked whether the problem of energy and heat poverty among residents had been diagnosed in the town. Three out of five respondents stated that this problem had been diagnosed, while one person claimed that they were not aware of this phenomenon, and another one – that the phenomenon had not been observed. Most of the respondents who answered the question about the data that constituted the basis for estimating the energy and heat poverty indicated more than one source of data used to estimate the scale of the phenomenon in their area. An analysis of the answers reveals that the main source is data obtained from the Municipal Welfare Centre (MOPS) concerning the number of applications for the purchase of heating fuel submitted by residents, the number of persons who use housing and energy allowances, the level of arrears in housing utility fees or other data concerning the financial and professional situation of the inhabitants. Other sources of information about the scale of heat poverty include inventories of heating sources in the town that form the basis for developing strategic documents that help define the directions to be taken by local energy security policy; information about the use of subsidies for the replacement of coal furnaces with more energy efficient and environmentally friendly heating sources; the draft assumptions for the Plan of Supply of heat, electric power, and gaseous fuels; the Development Strategy of the Town of Gniezno based on the number of filed applications for subsidies in the "KAWKA" programme, and from Voivodeship Environmental Protection Fund programme to replace solid-fuel boilers; information from building administration about residents who economise on heating; information about mould and fungi experienced and noticed in residential buildings; the observed phenomenon of a

[375] K. Świerszcz, (2021b) 'Management of local heat poverty in households - on the selected example', Journal of Eastern Europe Research in Business and Economics, 2021 (2021), Article ID 922351, ISSN: 2169-0367. doi: 10.5171/2021.922351; N. Creutzfeldt, C. Gill, R. McPherson, and M. Cornelis, (2020) 'The Social and Local Dimensions of Governance of Energy Poverty: Adaptive Responses to State Remoteness', Journal of Consumer Policy, 43(3). doi: 10.1007/s10603-019-09442-z.

large number of children using after-hours school facilities as a result of low thermal comfort at home; information about air pollution and the related smog caused by low emissions from households (from the combustion of low-quality fuels or waste). The respondents who answered the question concerning the scope of energy and heat poverty differed in their opinions, as their answers contained all three options: the scope of the phenomenon was defined as small, medium, and large. In their answers to the question about the percentage of households in the town that are diagnosed as the energy/heat poor, the respondents' estimates ranged from 5% to 50%. The answers to the question concerning how energy/heat poverty had changed over time also varied. The respondents either stated that the phenomenon is less common, or at the same level, or even that it has become more widespread. The answers to the question about the percentage of households in the town that might be classified as threatened by energy/heat poverty if the energy/heat poverty was defined as spending over 20%, 15%, or 10% of all household expenses on energy and heating costs were quite varied. The respondents estimated that the scale of heat poverty in their town ranged from 15% to even 70% for the threshold of 20% of all household expenses spent on heating the premises and water. Their opinions are presented in Table 2.

Table 2: The scale of energy poverty and fuel poverty depending on the applied definition (threshold of expenses) in the opinion of the surveyed representatives of Territorial Self-government Units in Gniezno

	Over 20%	**Over 15%**	**Over 10%**
Scale of energy poverty	30-50%	20-70%	10-80%
Scale of heat poverty	15-70%	20-60%	20-60%

Source: Own study

The discrepancies between the answers of most of the respondents and their logical inconsistency in the determination of the scale of energy/heat poverty measured as the

percentage of total expenses of households clearly shows that the respondents understand neither the definition of energy poverty nor the definition of heat poverty. if the definition of energy/fuel poverty is understood as "over 20% of the total household expenses are spent on energy an heating purposes" then the percentage of households threatened by energy poverty should be lower (and definitely not higher) than the percentage of households at risk of energy/fuel poverty according to the definition as "over 10% of the total expenses of the household are spent on energy or heating purposes". Such varied, sometimes completely different opinions among the representatives of municipal institutions reveal a low level of awareness and knowledge of the phenomenon.

Measures implemented by Territorial Self-government Units aimed \ at improving heat security

Currently, TSUs, in cooperation with the state government, are undertaking a series of actions in order to improve local energy security by eliminating, or at least partly reducing the quite common and rather severe phenomenon of heat poverty experienced by households. The aim of the research conducted among employees of municipal authorities of Gniezno who are responsible for this type of security locally was to ascertain what programmes and instruments had been implemented to improve heat security and their outcomes. To this end, the respondents were asked a question about model investments or actions related to counteracting heat poverty that had been introduced by the town over the last 5 years. The answers revealed showed the respondents' spontaneous associations and knowledge about municipal activities. They pointed to three main types of action: thermal modernisation of multi-family housing, the development of the municipal heating network, and the replacement of old heating boilers and furnaces (which are beyond classification standards) with more energy-efficient, low-emission devices, via subsidy programmes such as the "Low Emission Reduction Programme". Additionally, actions that were mentioned include the realisation of generally available government programmes to help fight energy poverty and low emissions; connecting multi-family houses to the heating network based on coal and gas; development of the gas network; financial support from the funds of the Municipal Budget and the Voivodeship Environmental Protection and Water Management Fund (WFOŚiW) in Krakow for assisting households in the transition from heating with coal to gas heating; regular inspections of residents conducted by the City Guard to combat smog; as well as conducting regular activities to educate young people and other residents about energy-efficient and

environmentally friendly use of heating sources, the harmful effects of using low-quality heating sources on the environmental condition of the town[376]. Most respondents who were asked their opinion about the outcomes of such action on improving local heat security stated that the scale of heat poverty had diminished, although only minimally. This proves the low effectiveness and efficiency of both the actions taken by Territorial Self-government Units and of the proposed government programmes that are used by self-governments locally.

Challenges in heat security management: discussion and recommendations

The conducted analysis of the challenges in heat security management that are currently faced by Territorial Self-government Units of the town of Gniezno clearly points to several areas that ought to be addressed both on the level of self-government and household[377]. TSUs should:

- identify the scale of heat poverty;
- define areas that need improvement when it comes to action aimed at preventing the phenomenon locally;
- develop a more effective and efficient system as well as adequate support for the needs of households affected by heat poverty financed (at least partly) from funds other than the self-government budget;
- propose more effective, comprehensive instruments that help counteract the phenomenon;

[376] K. Świerszcz, (2022) Stan bezpieczeństwa energii cieplnej w Polsce na tle Europy. Warszawa: WAT. ISBN: 978-83-7938-370-2; K. Świerszcz, and B. Jagusiak, (2022) 'The level of energy security in the aspect of heat poverty of households on the example of the town Barlinek, Poland', in K. S. Soliman, (eds.) Proceedings of the 39th International Business Information Management Association Conference (IBIMA), Innovation Management and information Technology impact on Global Economy in the Era of Pandemic, Granada: Spain. ISBN: 978-0-9998551-8-8; ISSN: 2767-9640.

[377] K. Świerszcz, T. Szczurek, S. Mitkow, J. Zalewski, and B. Ćwik, (2019) 'Knowledge of the Problem of Fuel Poverty Among Local Government Authorities - in the Aspect of Local Energy Security', Journal of Eastern Europe Research in Business and Economics (JEERBE), 2019 (2019), Article ID 780276, ISSN: 2169-0367. doi: 10.5171/2019.780276. www.ibimapublishing.com http://ibimapublishing.com/articles/JEERBE/2019/780276/**;** Y.M. Xiao, H. Wu, G.H. Wang, and M. Mei, (2021) 'Mapping the Worldwide Trends on Energy Poverty Research: A Bibliometric Analysis (1999-2019)', International Journal of Environmental Research and Public Health, 18(4), No article: 1764. doi:10.3390/ijerph18041764.

- regularly monitor heat poverty to facilitate more precise estimations in the subsequent years and a better assessment of the effectiveness of the actions taken to prevent it; and
- continue to develop informational and educational campaigns in the media on the improvement of heat security in the area; finally, to invest in renewable energy sources as alternative heating sources[378].

On the household level, it is necessary to:

- improve the accessibility of energy services and supplies of high-quality heat for all homes in the area;
- make energy sources, including heating energy, more affordable, at prices that are easily and clearly comparable, acceptable and non-discriminating for all households;
- improve the energy efficiency (of buildings, heating supply networks, and heating sources) for all households;
- improve the heating comfort of flats and houses and the well-being of all households;
- ensure healthier living standards for all households;
- stimulate structural renovation, modernisation and thermal improvement of private buildings for all households;
- improve the budgets of more households; to promote renewable energy sources for heating in most households; and, finally
- to raise awareness of responsibility for energy security in the area[379].

[378] K. Świerszcz, (2019) Postrzeganie bezpieczeństwa energetycznego w kontekście przeciwdziałania ubóstwu energetycznemu społeczności lokalnej z wykorzystaniem zasobów geotermalnych na terenie Gminy Wiśniowa. Warszawa: WAT. ISBN: 978-83-7938-217-0; K. Świerszcz, and B. Grenda, (2018) 'Geothermal Energy as an Alternative Source and a Countermeasure Against Low Emission in the Ecological Security Strategy', in Proceedings of the 2018 Joint International Conference on Energy, Ecology and Environment (ICEEE 2018) and International Conference on Electric and Intelligent Vehicles (ICEIV 2018). ISBN: 978-1-60595-590-2. ISSN: 2475-8833; R. Bardazzi, L. Bortolotti, and M.G. Pazienza, (2021) 'To eat and not to heat? Energy poverty and income inequality in Italian regions', Energy Research & Social Science, 73, 101946. doi: 10.1016/j.erss.2021.101946.

[379] K. Świerszcz, and B. Grenda, (2018) 'Geothermal Energy…, op. cit.; K. Świerszcz, T. Szczurek, Sz. Mitkow,, Zalewski, J. and Ćwik, B. (2019) 'Knowledge of the Problem of Fuel Poverty Among Local Government Authorities - in the Aspect of Local Energy Security', Journal of Eastern Europe Research in Business and Economics (JEERBE), 2019 (2019), Article ID 780276, ISSN: 2169-0367. doi: 10.5171/2019.780276. www.ibimapublishing.com http://ibimapublishing.com/articles/JEERBE/2019/780276/

Conclusions

In these times of dramatically increasing market prices of heat as a result of the geopolitical situation – i.e., the energy policy of Russia, its military aggression on Ukraine, the restrictive requirements of the European Union concerning the reduction of CO_2 emissions and improving energy efficiency, as well as high inflation rate not only in Poland, but also throughout Europe and the world – heat security management represents a great challenge, both locally and nationally[380]. This is confirmed by research conducted on a local scale, among households and Territorial Self-government Units in the town of Gniezno. In spite of various preventive measures that have been taken by the local governments in recent years in form of financial programmes and numerous other European and national instruments, the fact that residents continue to be affected by heat poverty, to a greater or lesser extent, confirms that such endeavours are insufficient. Therefore, both local governments and town residents should continue to improve and modify their efforts to overcome the discussed challenges. This situation also confirms the justification for conducting research in this respect.

Streszczenie:

Głównym celem artykułu jest określenie aktualnych wyzwań w zarządzaniu bezpieczeństwem cieplnym na poziomie lokalnym stojących przed jednostkami samorządu terytorialnego (JST) miasta Gniezno, na tle trudnej sytuacji na wschodzie, związanej z inwazją Rosji na Ukrainę. Realizacja tego celu wymaga kilku kolejnych etapów, do których należą: określenie aktualnego stanu bezpieczeństwa cieplnego gospodarstw domowych w Gnieźnie; diagnozowanie głównych przyczyn potencjalnego braku bezpieczeństwa energetycznego w tych gospodarstwach domowych; określenie poziomu bezpieczeństwa cieplnego i związanych z nim zagrożeń w ocenie samorządu lokalnego miasta i wreszcie zdiagnozowanie działań podejmowanych przez samorząd gminny i określenie ich efektywności w kierunku poprawy bezpieczeństwa ciepłowniczego. Wszystko to prowadzi do następującej hipotezy badawczej: Ocenia się, że obecnie stosowane programy i instrumenty wykorzystywane przez Jednostki Samorządu Terytorialnego do zarządzania bezpieczeństwem cieplnym nie przyczyniają się do poprawy i wzmocnienia tego bezpieczeństwa. Podjęty w

[380] K. Świerszcz, T. Szczurek, Sz. Mitkow,, Zalewski, J. and Ćwik, B. (2019) 'Knowledge…, op. cit; Świerszcz, K., (2022a) 'Air Pollution as an Indicator of Local Environmental Safety Based on the Example of the Town of Barlinek', Polish Political Science Yearbook, 51. doi.org/10.15804/ppsy202231, Y. Fan, and Ch. Fang, (2020) 'Insight into carbon emissions related to residential consumption in Tibetan Plateau–Case study of Qinghai', Sustainable Cities and Society, 61, 102310. Available at: https://doi.org/10.1016/j.scs.2020.102310.

artykule problem badawczy ma charakter empiryczno-teoretyczny. Tematyka badawcza poruszona w artykule ma charakter empiryczny. W celu pogłębionej analizy problemu wykorzystano metody teoretyczne, jakościowe, ilościowe oraz ankietę diagnostyczną (wywiad pogłębiony metodą PAPI (ang. Paper and Pencil Interview). Badania przeprowadzono na 1200 tys. gospodarstw domowych oraz 5 Jednostek Samorządu Terytorialnego na terenie miasta Gniezno Wyniki badań jednoznacznie wskazują na niską skuteczność i efektywność działań podejmowanych przez JST w zakresie zarządzania bezpieczeństwem cieplnym, które polegają na wdrażaniu aktualnie dostępnych programów i instrumentów poprawy i to pomimo licznych działań podjętych w tym zakresie. Wyniki potwierdzają tym samym początkowo przyjętą hipotezę. Autor ma nadzieję, że przedmiot badań i uzyskane wyniki oraz związane z nim wyzwania i rekomendacje mogą pragmatycznie pomóc opracować nową, bardziej efektywną strategię zarządzania bezpieczeństwem cieplnym na poziomie lokalnym, która może być następnie realizowana przez Jednostki Samorządu Terytorialnego.

Słowa kluczowe:

Bezpieczeństwo energetyczne, ubóstwo cieplne, jednostki samorządu terytorialnego, programy i instrumenty na rzecz bezpieczeństwa cieplnego.

Key words:

Eeat security, heat poverty, territorial self-government units, programmes and instruments for heat security.

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