

THE IMPACT OF SOCIAL AWARENESS ON THE DEVELOPMENT OF RENEWABLE ENERGY SOURCES

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Purpose: The purpose of the article is to analyse the impact of social awareness on the development of renewable energy sources in Poland. The study focuses on assessing the level of public knowledge, attitudes toward the energy transition, and the degree of social acceptance of RES technologies. The article also examines public perceptions of the benefits and risks associated with the use of renewable energy sources, including environmental, economic, and infrastructural aspects.

Design/methodology/approach: The article is based on the analysis of survey results and on the analysis of domestic and foreign literature, which allowed for the comparison of the obtained results with the current state of research on social awareness and energy transformation.

Findings: Research results indicate that in Poland, the public awareness of both opportunities and threats resulting from the implementation of renewable energy sources is relatively high. The key factor influencing society's willingness to undertake pro-ecological activities is the level of education and access to information, while economic factors, such as income, play a lesser role in this process.

Research limitations/implications: In the future, it is advisable to expand research to include comparative analysis between regions as well as economic and cultural factors influencing the acceptance of renewable energy sources. The results may provide a basis for further study on the relationship between social awareness and the implementation of energy innovations.

Practical implications: The article points out the need to conduct social campaigns and trainings, and to create local initiatives supporting the development of the power industry. The conclusions are also important for decision-makers developing energy strategies and investment support schemes in the RES sector.

Social implications: Increasing knowledge and social acceptance can contribute to reducing greenhouse gas emissions, improving air quality and increasing citizen involvement in pro-environmental activities. The results can also support the development of public policies promoting sustainable development and environmental responsibility.

Keywords: renewable energy sources; social awareness; energy transformation; environmental education; social acceptance.

Category of the paper: Research paper.

1. Introduction

The modern world is facing the need for a profound energy transformation resulting from growing environmental pressure, ongoing climate change and the depletion of fossil fuel resources (IPCC, 2023). In the face of these challenges, renewable energy sources (RES) are becoming increasingly important, as they constitute the foundation of sustainable economic and ecological development. The implementation of solutions based on solar, wind, water, geothermal or hydrogen energy is no longer just a technological issue, but also a social and cultural one (Devine-Wright, 2017).

Public awareness of renewable energy plays a key role in the success of the energy transformation (Oksman et al., 2021). The level of social acceptance for new technologies, willingness to change consumer behaviour and trust in institutions responsible for the development of the energy sector are fundamental factors determining the success of climate policy. Properly shaped pro-ecological attitudes can accelerate the process of abandoning traditional fossil fuels in favour of cleaner and more sustainable energy sources (Sütterlin, Siegrist, 2017).

In recent years, there has been an increase in public interest in RES, which results from both global ecological trends and the increase in the cost of energy derived from conventional raw materials (Suhaib et al., 2023). The development of photovoltaic technologies, wind turbines and hydrogen solutions has contributed to their increased availability and popularisation. At the same time, however, there are still barriers related to limited public knowledge, lack of infrastructure and concerns about the safety and cost-effectiveness of new technologies (International Energy Agency, 2023).

The purpose of the research was to determine the level of knowledge, attitudes and social concerns regarding the use of renewable energy sources. The analysis aimed to identify factors contributing to and barriers hindering the acceptance of RES in Polish society, as well as to determine the needs for environmental and information education.

2. Review of literature

Contemporary technological development and rising climate goals make renewable energy sources (RES) a key element of the energy transformation (Mielczarski, 2021). However, the mere availability of RES technologies does not guarantee their widespread implementation – more and more attention is being paid to social factors, including the level of social awareness, social acceptance and citizens' knowledge of the benefits and requirements of energy transformation (Żywiołek et al., 2022).

The concept of social awareness in the energy context refers to the level of knowledge, attitudes and willingness of citizens to accept and participate in the RES system. Research shows that the higher the level of knowledge and trust in renewable sources, the greater the likelihood of supporting and implementing such solutions (Żywiołek et al., 2022). Environmental education plays a significant role here, especially from the early stages of education, which shapes long-term orientation towards pro-ecological behaviour and energy decisions (Yüksel Köseoğlu, 2016).

The literature on the subject highlights the important distinction between social awareness and social acceptance (Tortop, 2012). While social awareness mainly refers to the level of knowledge, familiarity with a topic and general understanding of a given technology or phenomenon, social acceptance is more practical and complex in nature. It includes not only a positive attitude towards specific technologies (e.g. renewable energy), but also the willingness of individuals and communities to actively participate in their implementation, financing and even co-management.

Social acceptance is not a one-dimensional phenomenon, but consists of three complementary dimensions:

1. Socio-political (institutional) – including trust in public institutions, energy policies and the legal framework regulating the development of new technologies. In this respect, transparency of decision-making processes and perceived social justice are crucial (Menegatto et al., 2025).
2. Community (local) – relating to relationships within local communities, a sense of belonging and shared responsibility for the implemented projects. Acceptance at this level often depends on the degree of residents' involvement in the consultation process and the actual benefits for the local community (Menegatto et al., 2025).
3. Market (commercial) – related to market functioning, investment attractiveness of technologies, as well as trust in economic entities which implement solutions. This dimension reflects the belief that the development of new technologies is economically rational and consistent with the principles of sustainable development (Devine-Wright et al., 2020).

The aforementioned study proves that only by taking these three aspects into account simultaneously, it is possible to fully understand the mechanisms of social acceptance of technological innovations – including renewable energy sources and energy communities.

The literature on the subject emphasizes that social awareness is an important factor in the development of renewable energy sources (RES). Its impact is realised through complex cognitive, institutional and psychosocial mechanisms that determine both the level of acceptance of technology and the actual readiness to participate in the energy transformation.

One of the key aspects is knowledge and education. Understanding the principles, benefits and limitations of renewable technologies translates into a higher level of trust and openness towards energy innovations (Tomaszewski, Sekściński, 2020). As noted by Cichowska, Mreła

and Sokolov (2021), education in the field of renewable energy not only serves an informative function, but also shapes values, beliefs and pro-environmental attitudes among citizens, especially the younger generation, who will co-create the national energy policy in the future.

Trust also plays a significant role in the process of shaping social acceptance – both in the technologies themselves and in the institutions responsible for their implementation. Institutional and technological trust reduces the perceived threat, promotes the legitimacy of public actions and strengthens the willingness to participate in energy projects (Dworska, 2023). Empirical research confirms that the level of trust is positively related to the level of knowledge and willingness to learn, which indicates a close relationship between cognitive competences and attitudes towards innovation (Żywiołek et al., 2022).

Another factor determining readiness to implement RES is pro-environmental attitudes and social norms. The value system and normative behaviour patterns within a given community shape individual decisions regarding participation in the energy transition (Ruszkowski et al., 2024). Research by Fazal et al. (2023) conducted in developing countries shows that positive social norms, pro-environmental attitudes and aspirations related to improving the quality of life are important factors motivating the use of renewable energy.

Equally important is the sense of social agency, understood as the belief in the possibility of real influence of individuals and local communities on the development directions of energy policy (Neves et al., 2024). Increasing awareness of one's own role in decision-making processes fosters citizens' involvement in energy communities and infrastructure co-management projects. A high level of civic agency enhances the sustainability and effectiveness of implemented renewable energy solutions (Bögel et al., 2023).

Consequently, social awareness is not only a cognitive component of attitudes towards RES, but also plays an integrating role – combining knowledge, trust, social norms and a sense of agency into one coherent system of factors promoting social acceptance and active participation in the energy transformation.

A higher level of social awareness and acceptance of RES translates directly into their development by increasing private and community investments, reducing implementation barriers and shaping a pro-ecological energy culture (Oksman et al., 2021). Social acceptance thus becomes not only a condition for technical progress, but also a catalyst for a mental transformation in which citizens perceive themselves as active participants in the energy system, not just its recipients (Batel et al., 2013).

3. Research methodology

In the first quarter of 2025, a study was conducted to determine the level of social awareness and acceptance of renewable energy sources (RES) and hydrogen technologies in Poland. The survey was conducted on a sample of 315 respondents using the CAWI (Computer-Assisted Web Interview) technique, which allows for remote data acquisition while maintaining high quality of responses.

The gender structure of the sample was almost balanced: women constituted 50.96% of the respondents and men 49.04%. In terms of education level, the majority were people with higher education (35.8%) and secondary education (34.8%). The analysis of the age structure showed that the largest group consisted of respondents aged 36-45 (28.8%), followed by people aged 46-55 (26.5%). This means that the majority of participants represented a professionally active population with a stable life and economic situation. Younger people, under 25 years of age, constituted approximately 10% of the sample. In terms of the place of residence, inhabitants of urban communes dominated (61.5%), while 24.1% of participants came from urban-rural communes, and 14.4% from rural communes. Detailed characteristics of the respondents are presented in Table 1.

Table 1.
Characteristics of the study sample

Gender	Male	49.04%
	Female	50.96%
Education	Primary	9.03%
	Vocational	20.32%
	Secondary	34.84%
	Higher	35.81%
Age	Under 18	4.15%
	18-25	5.75%
	26-35	15.02%
	36-45	28.75%
	46-55	26.52%
	56-65	12.14%
	Over 65	7.67%
Place of residence	urban commune	61.54%
	urban-rural commune	24.08%
	rural commune	14.38%

Source: own study.

The research questionnaire covered issues related to attitudes towards replacing fossil fuels with renewable sources, assessment of their efficiency, environmental friendliness and profitability, as well as willingness to bear higher energy costs in exchange for environmental benefits. A separate block of questions was devoted to hydrogen technology – its perceived safety, commercialisation prospects in the five- and ten-year horizon, implementation barriers, infrastructure assessment and educational needs in this area.

4. Findings

The first question aimed to assess respondents' attitudes toward replacing fossil fuels with renewable energy sources. The responses are presented in Figure 1.

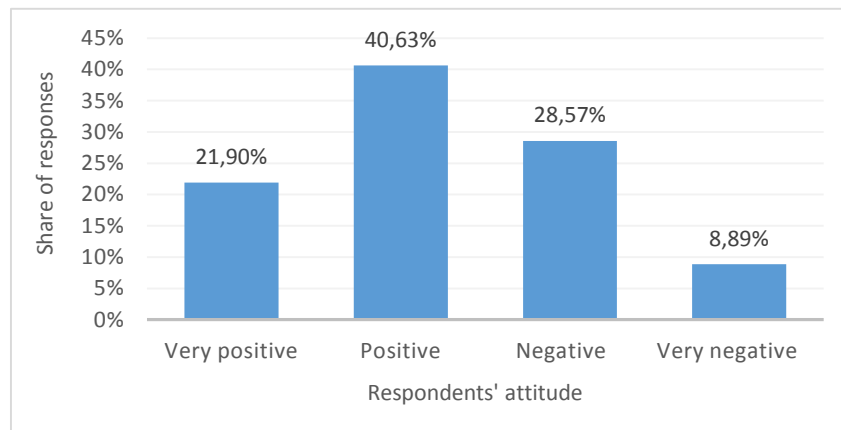


Figure 1. Respondents' attitude towards replacing fossil fuels with energy from renewable energy sources.

Source: own study.

The analysis of the obtained results indicates that the general attitude of society to energy transformation towards renewable energy sources (RES) is mostly positive. Replacing fossil fuels with energy from renewable sources was assessed positively or very positively by a total of 62.5% of respondents (40.63% and 21.90%, respectively). In turn, 37.46% of the study participants expressed a negative (28.57%) or very negative (8.89%) attitude. These results confirm that support for energy transformation in Poland is moderately high, but heterogeneous.

These results are confirmed by the research of Żywiołek et al. (2022), according to which social acceptance for renewable energy sources is strongly correlated with the level of knowledge, trust in public institutions and transparency of decision-making processes in the field of energy. This means that scepticism towards RES does not necessarily have to result from a negative attitude towards the idea of sustainable development, but rather from a deficit of information and trust in the entities responsible for implementing changes. In a broader context, it can be stated that social acceptance for renewable energy sources in Poland is in the stage of gradual consolidation – most citizens understand the need for transformation and notice its benefits, but some still perceive it through the prism of uncertainty and risk.

The next question concerned the selection of one of the individual energy sources that the respondent considers to be the most efficient, cost-effective and ecological. The summary of responses is presented in Figure 2.

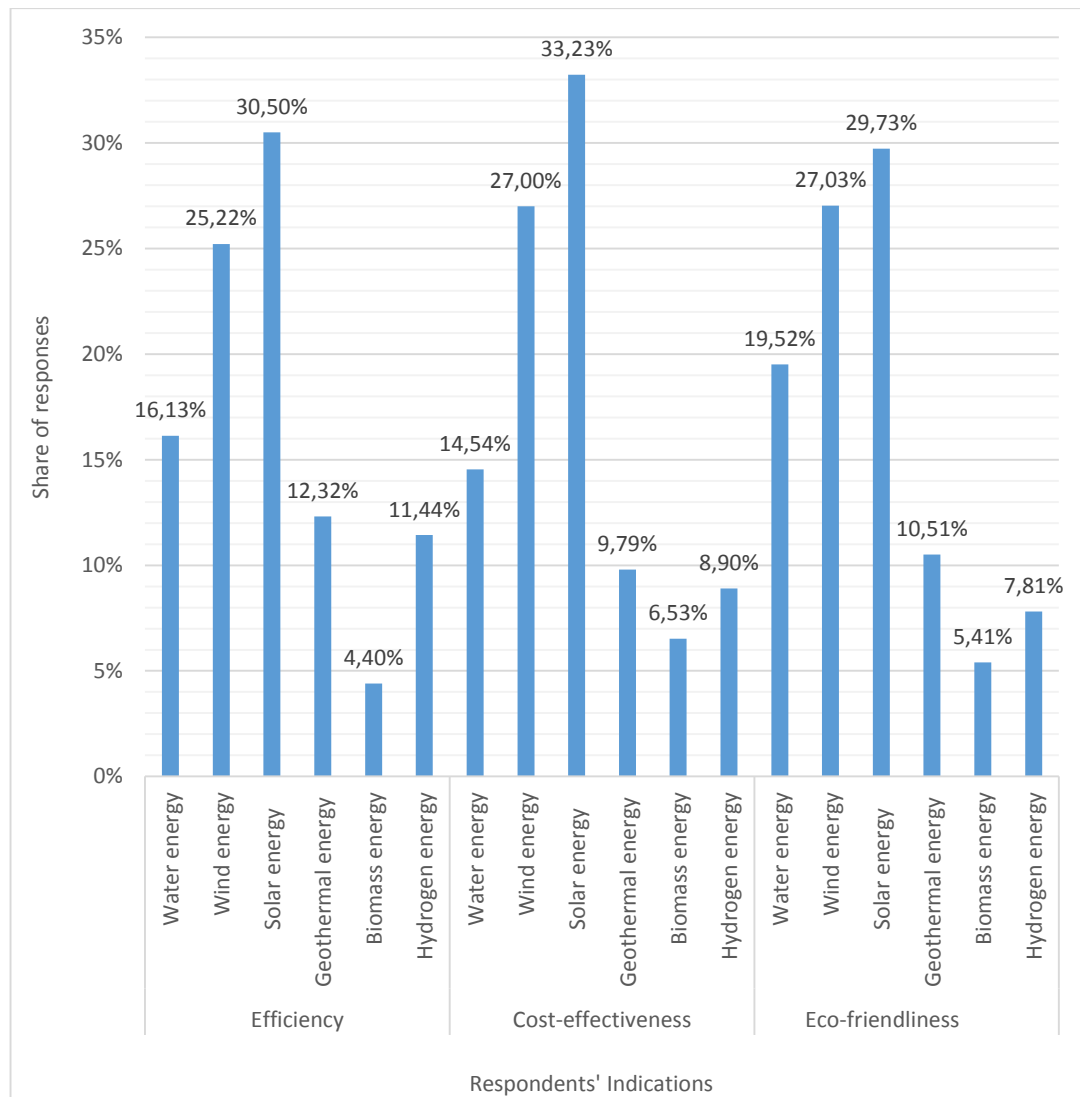


Figure 2. Indications of the most efficient, cost-effective and ecological energy source.

Source: own study.

Solar energy (30.50%) and wind energy (25.22%) were considered the most efficient energy sources, which implies that society identifies these technologies as the most effective in converting natural resources into useful energy. Hydropower (16.13%) came third, followed by geothermal energy (12.32%), while biomass (4.40%) and hydrogen energy (11.44%) received the lowest ratings. This distribution of opinions reflects the widespread recognition of solar and wind technologies, which are most visible in public spaces (e.g. wind farms or photovoltaic installations on residential buildings). On the other hand, lower assessments of biomass and hydrogen may result from limited public knowledge about their functioning and possibilities of use.

In terms of perceived profitability, i.e. cost-effectiveness, the results are similar. Solar energy (33.23%) and wind energy (27.00%) were considered the most profitable energy sources, while hydropower (14.54%) and geothermal energy (9.79%) were rated as moderately cost-effective. Only 8.90% of respondents considered hydrogen energy to be an economically

advantageous solution. These results confirm the established belief in the economic advantages of photovoltaics and wind energy, supported by numerous financial programmes (e.g. „My Electricity”, „Clean Air”) and the development of the prosumer model. The high ratings of these sources result from their availability, scalability and relatively short payback period. The public perception of the high cost of producing hydrogen (especially green hydrogen) may further reinforce scepticism towards this technology.

With regard to the ecological criterion, similar trends prevail. Solar energy (29.73%) and wind energy (27.03%) were considered the most environmentally friendly, followed by hydropower (19.52%) and geothermal energy (10.51%). The least ecological in the opinion of respondents were biomass (5.41%) and hydrogen energy (7.81%). The high ratings of solar and wind energy result from their symbolic status as "clean energy", perpetuated in media coverage and public discourse.

The juxtaposition of three categories – efficiency, profitability and environmental friendliness – reveals a coherent structure of social perception. Solar and wind energy occupy the highest positions in all analysed dimensions, which confirms their dominant status in the social awareness of Poles as future sources. On the other hand, biomass and hydrogen remain marginal technologies in public perception.

The purpose of the third question was to indicate the greatest benefit of using renewable energy sources out of 5 options. The summary of responses is presented in Figure 3.

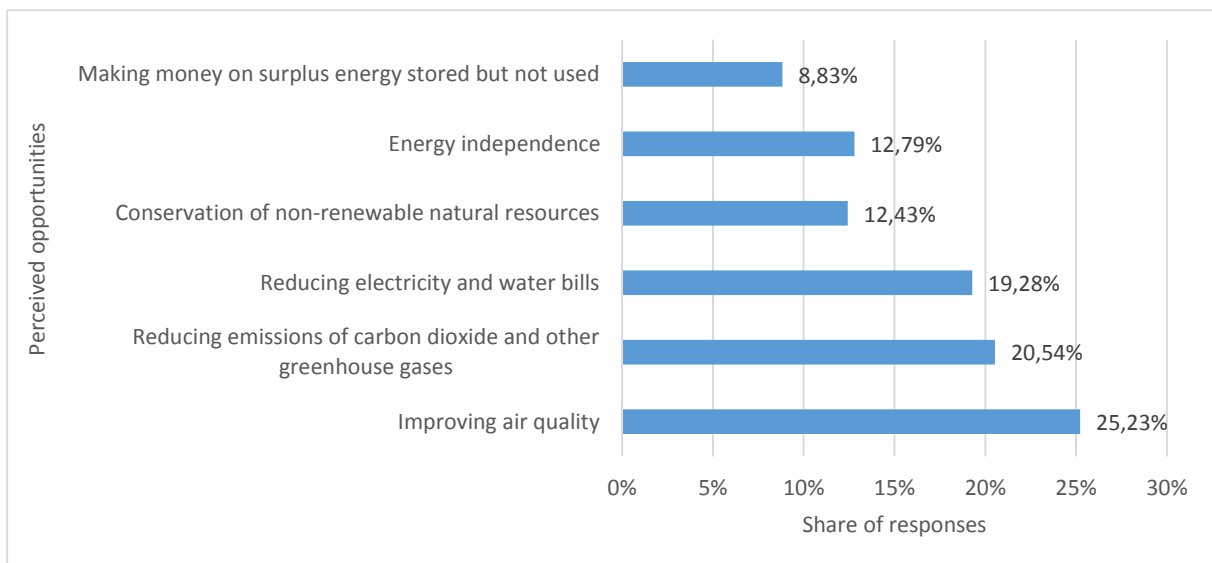


Figure 3. Perceived opportunities related to renewable energy sources.

Source: own study.

The analysis of responses regarding perceived opportunities arising from the development of renewable energy sources (RES) indicates that environmental and health-related motives dominate the social awareness of Poles. The most frequently indicated benefits were: improved air quality (25.23%) and reduced greenhouse gas emissions (20.54%). Subsequently, respondents mentioned reducing energy bills (19.28%) and increasing energy independence

(12.79%). The possibility of obtaining income from energy surpluses was indicated much less frequently (8.83%), which suggests limited knowledge of prosumer mechanisms and economic aspects of energy transformation.

The relatively low percentage of responses indicating the possibility of earning money from surplus energy proves that the potential of RES remains insufficiently recognised and utilised. This may be due to limited knowledge about the functioning of net-billing systems, complicated legal regulations or lack of a sense of real influence on the energy market. According to the research by Mirowski and Sornek (2015), awareness in Poland is still fragmented, and for many households, investment in RES is not perceived as a source of income, but rather as an ecological activity or a symbolic gesture of social responsibility.

Similarly, it was decided to examine public opinion on the threats associated with the use of renewable energy sources. Respondents' responses are presented in Figure 4.

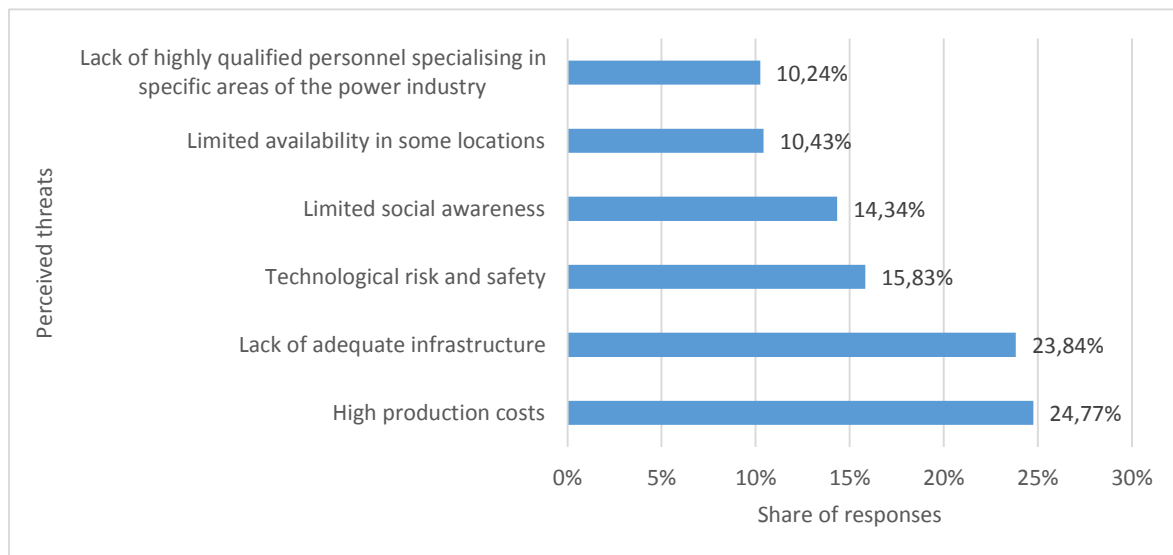


Figure 4. Perceived threats to the implementation and use of renewable energy sources.

Source: own study.

In the opinion of respondents, the greatest threats to the development of renewable energy sources (RES) are economic and infrastructural factors. The most frequently indicated factors were high energy production costs (24.77%) and insufficient technical infrastructure (23.84%). Other barriers included technological risk (15.83%) and limited social awareness (14.34%). The structure of the responses clearly indicates that public concerns primarily relate to the practical aspects of implementing the energy transformation.

The high position of the factor related to the lack of infrastructure can be interpreted as a manifestation of the growing social understanding of the complexity of the energy transformation process. Respondents realise that renewable energy production itself is not sufficient without an appropriate storage, transmission and distribution system. This observation is confirmed by research conducted by the European Environment Agency (2022), which indicates that confidence in the development of RES increases where citizens see

specific infrastructure investments – e.g. modernisation of energy networks, local energy storage projects or the development of hydrogen transport.

High indications of technological risk and limited social awareness confirm that energy transformation is perceived not only as a technical process, but also as a cognitive and communication challenge. Lack of understanding of how new technologies work, especially hydrogen ones, may increase the fear of their failure or the danger of operation.

The next part of the study focused on examining opinions on the level of public knowledge and educational needs in the field of renewable energy sources. The results are presented in Figure 5.

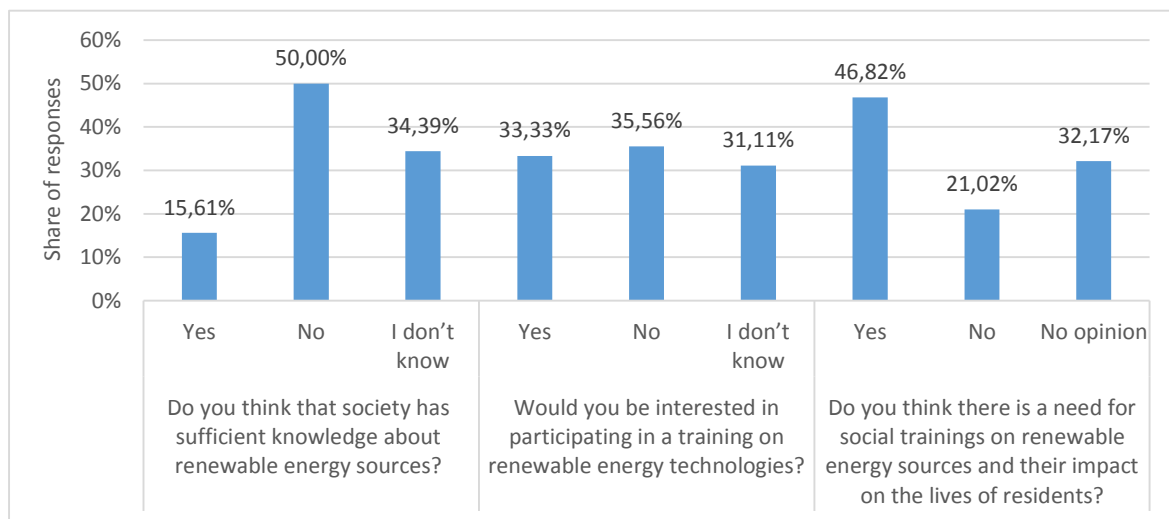


Figure 5. Knowledge and educational needs of society regarding renewable energy sources.

Source: own study.

The analysis of respondents' answers regarding the level of public knowledge about renewable energy sources reveals a significant cognitive gap, which constitutes a potential barrier to the further development of energy transformation. Half of the respondents (50%) stated that society does not have sufficient knowledge about RES, while only 15.61% assessed this level positively. This means that despite the growing presence of energy topics in the public debate and media, Poles' knowledge in this area remains superficial and fragmented.

The lack of in-depth technical and ecological awareness is also confirmed by earlier analyses by Yüksel Köseoğlu (2016) and Żywiołek et al. (2022), indicating that insufficient social knowledge is one of the main factors limiting the acceptance and willingness to participate in the energy transformation. The literature emphasises that knowledge about the principles of operation of technologies, their safety and environmental effects is the foundation of social trust in innovation (Devine-Wright, 2020). Thus, the educational gap not only slows down the process of implementing RES but also increases the susceptibility of society to disinformation and stereotypes regarding renewable energy sources.

The results regarding interest in RES trainings confirm this diagnosis. One-third of respondents (33.33%) declared willingness to participate in such trainings, 35.56% expressed disinterest, and 31.11% had no opinion.

At the same time, the results of the question regarding the need to conduct social training in the field of RES (46.82% of "yes" indications) prove that respondents recognise the social importance of energy education, even if they themselves do not declare their willingness to participate in such a training. This can be interpreted as a manifestation of the so-called *normative consciousness* – the belief that environmental education is needed for the common good, regardless of individual participation plans.

The comparison of the three analysed indicators (knowledge assessment, readiness to participate in trainings, need for social education) allows us to indicate that in Poland there is a significant deficit of knowledge about renewable energy sources, but at the same time there is a growing demand for education in this area. This indicates the need to develop integrated educational programmes – both formal (in schools and universities) and informal (local workshops, information campaigns).

5. Summary

The conducted research shows that society has a predominantly positive attitude towards energy transformation and replacing fossil fuels with renewable energy sources. Both in the sphere of perception of environmental friendliness and profitability, beliefs about the advantage of solar and wind energy dominate, which confirms their established position in the public consciousness as modern, effective and environmentally friendly technologies.

On the other hand, development barriers are still noticeable – primarily high investment costs, lack of infrastructure and limited social awareness. More than half of the respondents admitted that the level of knowledge about renewable energy sources is insufficient, and at the same time almost half of them see the need for social training in this area. This indicates the need to intensify educational and information activities that can actually increase the level of acceptance and participation of citizens in the energy transformation processes.

Based on the conducted research and literature review, it can be concluded that social awareness (including knowledge, attitudes, trust and sense of empowerment) is an important element supporting the development of renewable energy sources. At the same time, there is a need for further research, including, among other things, how specific educational campaigns raise awareness and influence decisions regarding renewable energy sources, and how demographic, cultural and geographic differences affect the relationship between public awareness and renewable energy adoption. Beyond quantitative research, it appears essential to

employ qualitative methods (such as in-depth interviews) to better understand psychological barriers, as well as behavioral experiments to test the effectiveness of various communication strategies (e.g., those based on financial vs. environmental benefits) in the decision-making process regarding renewable energy sources investments. Additionally, it should be noted that the issue of trust in sources and exposure to misinformation were not directly measured in this study; therefore, these claims represent an inference that requires further empirical confirmation.

In summary, the collected data confirm that the energy transformation in Poland is at the stage of gradual social acceptance, the further development of which requires parallel strengthening of educational competences, building trust in institutions implementing climate policy and ensuring a coherent technical infrastructure enabling the wide use of renewable energy sources.

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