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Innovative Concept for the Implementation of Renewable Energy Sources in the Low-Carbon Economy Model In the light of surveys - Case Study Poland*

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Abstract

The implementation of innovations in the area of renewable energy sources (RES) is crucial in the promoted model of low-carbon economy. These innovations include the development of new technologies, such as more efficient photovoltaic cells and wind turbines, as well as the improvement of existing solutions, such as energy storage and smart grids. Therefore, the aim of the research is to present the current challenges related to the implementation of this innovative concept in the field of the low-carbon economy model. On this basis, the article presents selected results of surveys in the field of public awareness of the changes taking place in this area of RES with the acceptance of the development of these technologies. For the currently promoted model of low-carbon economy. The presented research may contribute to the faster development of utilitarian solutions for the implementation of this concept by identifying areas that, in the opinion of stakeholders – citizens, require identification or expansion of knowledge on this subject. In addition, the presented and interpreted results may provide a basis for the authorities responsible for shaping development policy in the currently promoted model of low-carbon economy by state authorities in Poland and the European Union.

Keywords: innovation, renewable energy sources, development policy, economic models

Introduction

As indicated by the literature on the subject, renewable energy sources are presented as resources that do not run out in a short time (Borowski, 2022; Klimek, Jędrych, 2021; Coban, Lewicki, 2023; Demircan Çakar et al. 2022) .. This feature makes them a sustainable and sustainable choice for the development of any modern economy. For example, in the low-carbon economy model, the role of renewable energy sources is even greater (Niekurzak Lewicki, Wróbel, 2024). They contribute to the reduction of harmful substances into the environment, which is essential in the fight against climate change. Efficient use of energy in this model not only protects the environment, but also supports the ambitious climate goals set by both national and EU authorities (Walter et al. 2023). Promoting renewables enables more sustainable and resilient energy systems. It is the answer to the challenges of the modern world – from climate change to the growing demand for energy (Bellocchi et al. 2023). As the researchers emphasize, their role is crucial in reducing greenhouse gas emissions, in particular in improving air quality, which directly affects human health and the condition of the environment may prove crucial in the next few years. (Dawood, et al, 2020; Bhandari, Shah,.2021; Lebrouh et al., 2022). In addition, they make it possible to achieve ambitious climate goals, which are necessary to protect our planet. In the face of global challenges, such as the climate crisis, renewable energy sources are becoming the foundation of modern energy

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strategies. These are solutions that combine the promoted idea of ecology with innovation and respond to the needs of the 21st century (Rabiee et al. 2021; Oshiro, Fujimori 2022; Montanarella, L.; Panagos, 2021).

As emphasized in the literature on the subject, renewable energy sources are technologies that use natural processes that renew themselves in a short time (Murshed, et al. 2021; Ionescu, 2021; Lugo-Morin, 2021; Xu, Lin, 2021). Among them, we distinguish solar, wind, hydro, geothermal and biomass energy. Each of these methods has its own unique properties and applications, supporting sustainable development and environmental protection. This is the future of the energy sector, which allows for the reduction of greenhouse gas emissions and the reduction of dependence on fossil fuels. In recent years, both state authorities and industry leaders have launched many initiatives to implement the concept of a low-carbon economy. Examples of such activities include the Low-Carbon Economy Plan (LEEP), which aims to reduce greenhouse gas emissions in a given municipality. In mental simplification, it focuses on identifying areas with high energy consumption and developing solutions leading to increased energy efficiency and the use of renewable energy sources. It is renewable energy sources (RES): Replacing fossil fuels such as coal, gas or oil with energy from renewable sources such as the sun (photovoltaics, solar collectors), wind (wind turbines), water (hydroelectric power plants) can be the key to transformation processes. and practical.

An in-depth analysis of the literature on the subject has shown that it is limited in terms of research studies on the innovative concept of implementing renewable energy sources in the low-carbon economy model in relation to the stakeholder side, which is society (Słupik, et al.2021; Godzisz et al.2021); In particular, there are no publications referring to the analysis of the approach of the society of Central European cities, which will be forced to undergo the transformation process in the near future. The presented study outlines the political strategy of central authorities in this area. The aim of the article is to present selected research results concerning citizens' attitudes towards climate protection measures and the implementation of solutions conducive to a low-carbon economy.

Therefore, this article has many important economic and practical implications. Given that its aim of the research is to gain a broad knowledge of the current challenges related to the implementation of this innovative concept in the field of the low-carbon economy model, the article is organized as follows. Chapter 2 contains a detailed description of the purpose, scope and research method used in response to the research questions posed. Chapter 3 describes the results of experimental studies and their interpretation. Chapter 4 discusses the results achieved by the author and presents the conclusions

Material and Methods

The aim of the article was to present selected research results concerning citizens' attitudes towards climate protection measures and the implementation of solutions conducive to a low-carbon economy. RES concept on the way to a low-carbon economy model. The analysis concerned several postulates characteristic of this idea. It should be remembered that low-emission is perceived as a concept that assumes the reduction of greenhouse gas emissions, in particular carbon dioxide, into the atmosphere. This effect is achieved through: e.g. increasing energy efficiency, reducing energy consumption in various sectors of the economy. development of renewable energy sources (RES): More precisely understood as the use of wind, solar, water, biomass and other renewable sources that do not generate or generate minimal emissions in the energy generation process or Investments in low-emission technologies. Ultimately, the development and implementation of technologies that allow for energy production and industrial processes with lower greenhouse gas emissions and the achievement of measurable economic benefits.

Due to the diversity of respondents in terms of gender and age, one course was conducted using one communication channel – the Internet. During the research phase, 483 interviews were collected. The study used the CAWI method (interviews conducted via the Internet). The questionnaire to be completed was sent electronically to citizens living in the West Pomeranian Voivodeship and was made available on the relevant website of the university. The survey was an anonymous survey, which allowed the respondents to freely express their opinions.

In the course of the study, 483 completed answer sheets were obtained in electronic form via a questionnaire sent online. 450 were accepted for the study in connection with answering each question. The survey included 4 questions related to the innovative concept of implementing renewable energy sources in the low-carbon economy model. In the adopted scheme, the questions asked concerned, among others:

- The essence of the perceived changes in the area of energy efficiency,
- The essence of the perceived changes in the development of renewable energy sources (RES),
- The essence of perceived names in the area of investments in low-carbon technologies.,

- The essence of implementing a low-carbon economy model

The presented research consists of substantive comments and charts containing the results of answers to the questions included in the forms. After entering the answers into the spreadsheet, the obtained research data were subjected to statistical and substantive analysis. In order to improve the readability of the answers obtained, the results are presented in the simplest form (percentage) in individual figures from 1 to 4.

Results

At the first stage of the survey, respondents were asked to indicate whether they noticed changes in the area of increasing energy efficiency. (Fig.1).

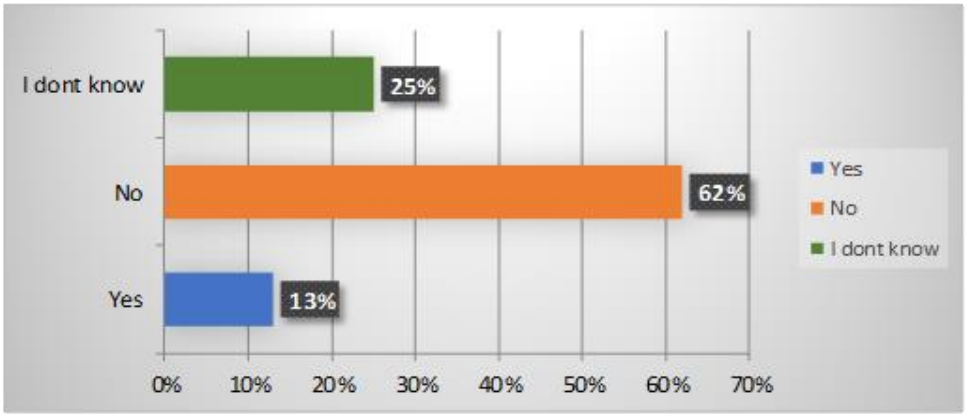

Fig. 1. Changes noticed by citizens in the area of increasing energy efficiency

The analysis of the results showed that over 62% of respondents do not see any changes in this area. In addition, 25% of respondents did not have their own opinion on this topic. It is worth noting that 13% indicated that they noticed changes in the area of energy efficiency In the next stage, respondents were asked to indicate whether they noticed changes in the area of the development of renewable energy sources (RES) (Fig. 2).

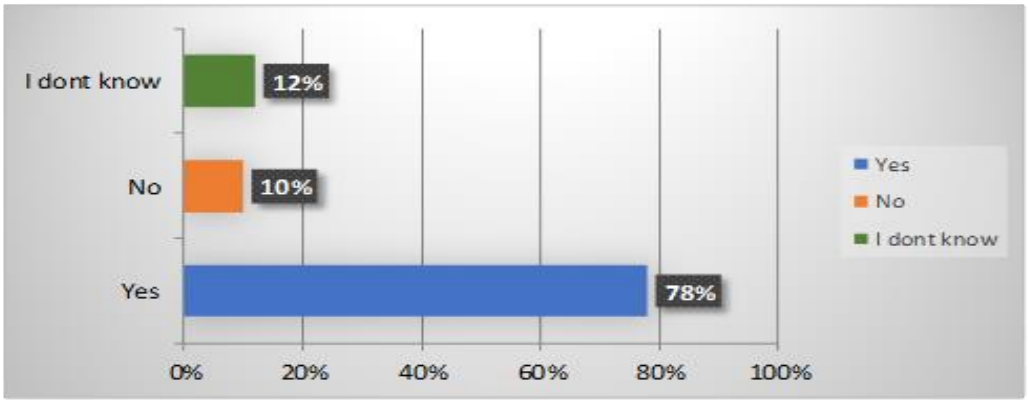

Fig. 2. Changes perceived by citizens in the area of the development of renewable energy sources (RES)

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The research shows that as many as 78% of respondents believe that changes in the introduction of renewable energy sources are noticed. It is worth noting that in this case only 10% of respondents indicated no noticeable changes in this area, and 12 have no opinion on this issue. In the next stage of the survey, respondents were asked to indicate whether they noticed changes in the area of technological innovation (Fig. 3).

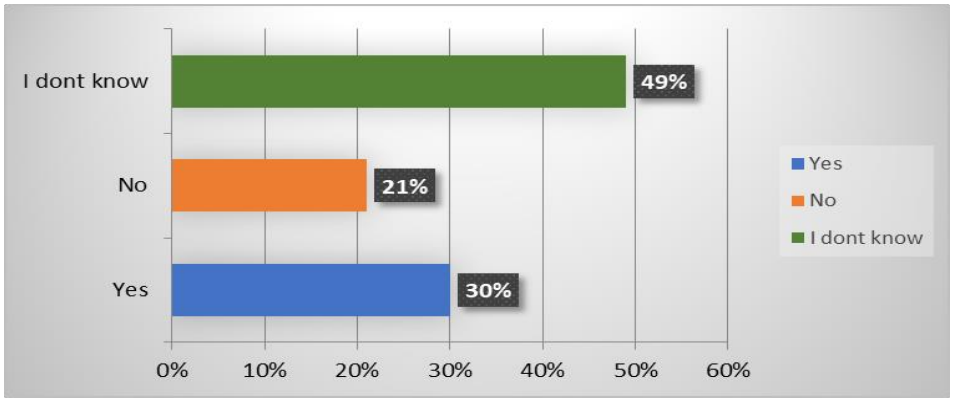

Fig. 3. Changes perceived by citizens in the area of technological innovation

The results of the answers indicate that as many as 30% of respondents noticed changes in the form of the emergence of technological innovations, on the other hand, 21% of respondents indicated that these changes were not at all. However, it is worth noting that 49% of respondents have no opinion on this issue. In the next and final stage of the research, it was necessary to define the possible impact of the low-carbon economy model in the economic and economic area (Fig. 4).

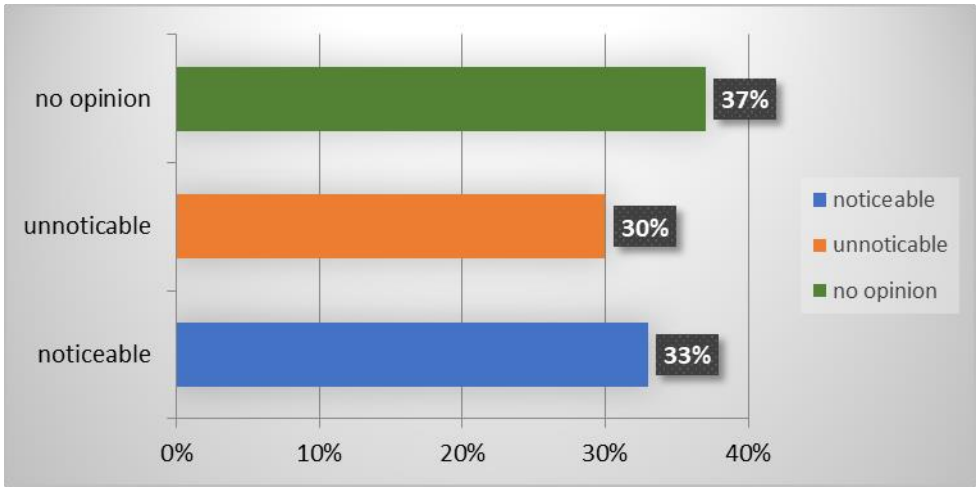

Fig. 4. Changes noticed by residents in the area of low-carbon economy

In this analysed case, the results obtained indicate similar percentages of answers given in relation to the analysed issue of the impact of the low-carbon economy model in the economic and economic area. On the other hand, 37% of respondents indicated that they did not have an opinion on this matter. However, it is worth noting that the division into those who notice the changes and do not notice them is only 3%.

Discussion and conclusions

A low-carbon economy is an economic model that seeks to minimize greenhouse gas emissions, particularly carbon dioxide, while promoting sustainability. This is achieved by increasing energy efficiency, developing renewable energy sources and implementing innovative technologies The development of modern cities is therefore not only a problem for today's residents, but in fact a challenge for the entire population and future generations. (Gamarra, et al.2021; Dzikuć, et al.2021). The researcher puts forward the thesis that the continuous development of renewable energy sources is the future of the global economy. The benefits of investing in renewable energy sources are multidimensional – from financial savings, through energy independence, to real support for environmental protection. Thanks to support systems, subsidies and modern technological solutions, investment in green energy is becoming available to both households and businesses Changing regulations, rising energy prices and the need to transform the energy sector make every investment in renewable energy sources a step towards financial stability based on a low-carbon model. In the era of climate and energy crisis, the choice of RES is not only a necessity, but above all a profitable strategic decision.

Although the presented results of research on the attitude of citizens from one of the regions of Polish do not always seem to confirm this. When it comes to changes in the area of increasing energy efficiency. However, the author shares the opinion of other researchers that this problem is systemic and may affect larger population groups (Abrar Farzaneh, 2021; Gambelli et al. 2017), where savings, e.g. on energy, are not noticed due to the fact that the housing substance of large cities, where large blocks of flats or old municipal housing predominate. Therefore, solving this problem requires systemic changes that go beyond the boundaries of the presented research. This does not change the fact that a noticeable increase in energy efficiency can be achieved in the long term in accordance with the idea of low-emission. However, appropriate financial outlays are needed in this matter, which is confirmed by other researchers. (Piwowar et al., 2016).

When it comes to noticeable changes in the area of the development of renewable energy sources, this process is already noticed, as indicated by over 78% of respondents. According to the author of the study, such a high rate was achieved by perceiving the benefits in the form of energy independence and potential financial savings. This thesis is also confirmed by research by other researchers, who clearly indicate that the greatest progress has been made in this area and has been made in recent years (Majewski et al., 2016). The high rate in this respect is also due to the large role of subsidies and government programs, which have once led to a change in social beliefs.

When it comes to changes in the area of innovation, this fact was indicated by about 50% of respondents. Therefore, according to the researcher, it seems to be an important process to indicate that innovations in renewable energy sources (RES) include both the development of new technologies and the improvement of existing ones in order to increase the efficiency and availability of renewable energy. Examples of innovation include m.in more efficient photovoltaic cells, energy storage (batteries, hydrogen), smart grids, as well as the use of artificial intelligence to optimise systems. In particular, it is important to expand public awareness of this issue, as also postulated by the authors of other studies on this matter. (Paska, Surma 2014; Ignatowicz, Dołęgowska, 2014).

As for the noticeable changes in the low-carbon economy, the results of the survey indicate that about 33% do not notice these changes and another 30% have no opinion on this issue. Therefore, the challenges in the area of the economy are related to the industrial and production aspect of the activities of the given areas. The first and often the biggest challenge is the significant upfront cost associated with investing in new technologies and upgrading existing infrastructures. The low-carbon economy plan itself and the price do not cost much, but the implementation of modern solutions may involve significant expenses. Another challenge is the need to adapt to dynamically changing environmental regulations, which may vary from region to region, which complicates the transformation process, as other researchers emphasize (Piwowar et al. 2017).

On the other hand, in dispute with other authors, there is the explanation of the most controversial topics that, in the opinion of the public, should be solved first (Grycan et. al 2018). It should be emphasized that in this survey, the largest number of respondents indicated problems related to changes in the area of energy intensity and the low-carbon economy model or aspects. The author puts forward the thesis that the current situation related to the ongoing problems with the adoption of legal regulations and the anti-EU attitude has led to the emphasis on these issues. Explaining and possibly solving them may prove extremely difficult in the long run. In addition, further announced tightening of the EU's climate policy and rising electricity prices may lead to another economic crisis, which in turn may lead to a change in sentiment in this area.

The analysis of the presented survey results shows that the innovative concept of implementing renewable energy sources in the low-carbon economy model is socially acceptable. At the same time, research has shown an imbalance between technological, social, economic and ecosystem factors. Against the background of academic considerations, it should be emphasized that the author puts forward the thesis that, despite many positive examples, the key determinant of the success of this concept may be the social acceptance of the proposed changes, and more specifically the approach of the residents themselves.

The presented research focused on the assessment of citizens' attitudes towards the innovative concept of implementing renewable energy sources in the low-carbon economy model Polish. According to the researcher, no. It should be remembered that the West Pomeranian Voivodeship is the leader in the production of electricity from renewable energy sources (RES) in Poland. This region produces practically as much renewable energy as it consumes. To sum up, the West Pomeranian Voivodeship is a leading region in the production and use of renewable energy, and its ambitions reach the development of offshore wind energy and hydrogen economy, whether other regions will follow the same path, this question remains unanswered.

The document uses data from a survey conducted on a specific research sample - 500 respondents from a given area located within a metropolis of 500,000 inhabitants. Certainly, much broader analyses are needed, in particular in the field of new technological solutions regarding renewable energy sources and the promoted model of low-carbon economy. In addition, further possible analyses in this area should focus on the aspects related to legal changes and the challenges related to the implementation of this ambitious plan that arise – after the implementation of these solutions in practice or socio-economic issues related to employment reduction, reindustrialization and other processes that are not yet fully identified.

To sum up, the presented research on the innovative concept of implementing renewable energy sources in the low-emission economy model certainly does not fully exhaust the topics discussed. They are only an encouragement for further research on this topic and will certainly be continued in the upcoming works on this subject.

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