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USING THE EFE MATRIX TO ASSESS THE FACTORS DETERMINING THE DEVELOPMENT OF ENERGY COOPERATIVES IN POLAND

Keywords: renewable energy sources, rural areas, energy cooperatives, PESTEL analysis, EFE matrix

ABSTRACT. This study aimed to identify the key factors influencing the development of energy cooperatives in Poland and assess their impact within the framework of the PESTEL analysis criteria. The research was conducted through a literature review and expert opinions gathered during the National Forum of Energy Cooperatives (2023-2024). A PESTEL analysis combined with a weighted scoring method using the EFE (External Factor Evaluation) matrix was applied to evaluate the driving forces and barriers affecting the growth of energy cooperatives. The average score obtained in the EFE matrix (2.95) suggests that the analyzed factors significantly influence the development of energy cooperatives in Poland. Legal and economic factors play the most substantial roles, highlighting the necessity for legislative changes and financial support for energy cooperatives and renewable energy initiatives. Additionally, modernizing energy infrastructure is crucial for fully harnessing the potential of renewable energy sources (RES). The relatively low importance of social and environmental factors underscores the need for enhanced education and public engagement in environmental protection.

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INTRODUCTION

The concept of energy cooperatives in Poland was implemented based on German experiences. In Germany, the establishment of the first electricity distribution cooperatives began in the late 19th century to build the infrastructure necessary for electrification. Following the nuclear disaster in Fukushima in 2011, German authorities decided to increase investments in renewable energy sources. As noted by Hartmann and Palm (2023), the term "citizen energy cooperatives" (ger. *Bürgerenergiegenossenschaften*) emerged around that time. The growth of German energy cooperatives serves as an excellent example of an energy transition aligned with sustainable development principles and accepted by society (Klagge, Meister, 2018). Moreover, the rationale for investments in energy independence and the development of stable, innovative infrastructure supporting economic growth and societal well-being is also reflected in the 2030 Agenda for Sustainable Development (Goal 9) (A/RES/70/1) (UN, 2015) and the "6 priorities of the European Commission for 2019-2024", which align with the European Green Deal. The strategy introduced in 2019 (EC, 2019), referred to as the "Green Deal", aims to achieve climate neutrality by 2050.

In the Polish legal system, the term "energy cooperative" has been in use since 2016. As Marzec (2021) notes, the push for creating legal frameworks for energy cooperatives in Poland was based on German solutions. The concept of energy cooperatives was implemented through the Renaldo Program by the Kuyavian-Pomeranian Agricultural Advisory Center. This program, approved in 2019, was a project of the Ministry of Agriculture and Rural Development, providing expert support in preparing for the establishment of pilot energy cooperatives in the Podlaskie and Kuyavian-Pomeranian regions. The project was 100% financed by the European Union under the Structural Reform Support Program and Germany's Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety. As Spiller (2023) notes, the experiences gained during this program helped establish best practices, support tools (such as the Renaldo Calculator), and recommendations for legislative changes. Another result of the Renaldo Program was the establishment of the National Forum of Energy Cooperatives. The Forum aims to diagnose conditions, barriers, and opportunities for the development of energy cooperatives in Poland, facilitate the exchange of experiences in founding and running energy cooperatives, and promote the idea of energy cooperatives.

The Forum brings together individuals and organizations continuously collaborating with the initiators and organizers of energy cooperatives. Regular members include energy cooperatives registered in the national registry maintained by the National Agricultural Support Center, as well as energy cooperatives in preparation (registered in the National Court Register or in the organizational stage). Supporting members are promoters of energy cooperatives, including individuals, companies, associations, foundations, local

governments, and other public entities actively collaborating with energy cooperative initiators and organizers (Wiśniewski, 2023). According to the definition provided in the Act of August 17, 2023 (Journal of Laws 2023, item 1762), an energy cooperative is defined as "a cooperative as understood under Article 1 § 1 of the Cooperative Law of September 16, 1982, or an agricultural cooperative as understood under Article 4 Section 1 of the Act on Agricultural Cooperatives of October 4, 2018, whose activities involve generating electricity, biogas, agricultural biogas, biomethane, or heat in renewable energy installations, their trade or storage, conducted solely for the benefit of the cooperative and its members". This definition implies that an energy cooperative is a cooperative or agricultural cooperative operating renewable energy installations to meet its own needs or those of its members. An energy cooperative member can be an entity whose installation is connected to the electricity or gas distribution network or district heating network, as well as an entity whose biogas, agricultural biogas, or biomethane produced by the energy cooperative or its members from renewable sources is delivered by means other than via the gas distribution network.

As Wiśniewski (2023) notes, the operational area of an energy cooperative is defined by the Act of July 19, 2019, as the territory of a rural or urban-rural municipality or an area encompassing up to three adjacent municipalities of this type. The operational area of an energy cooperative is determined based on the locations of energy production and consumption points of members connected to the specified electricity distribution network with a nominal voltage below 110 kV, district heating network, or gas distribution network. Additionally, the cooperative's facilities for biogas, agricultural biogas, or biomethane production and consumption must comply with these conditions (Wiśniewski, 2023). Importantly, the legislator has specified conditions for the production of electricity, heat, biogas, agricultural biogas, and biomethane by energy cooperatives. The total capacity of all installations must not exceed 10 MW, and their efficiency should meet at least 70% of the cooperative's and its members' own needs. A legislative amendment temporarily reduced this requirement from 70% to 40% from October 1, 2023, to December 31, 2025. In the case of heat production, the total capacity must not exceed 30 MW, biogas and agricultural biogas 40 million m^3, and biomethane 20 million m^3. An energy cooperative can commence operations only after its details are entered in the registry maintained by the National Agricultural Support Center. In Poland, the first energy cooperative was registered in December 2021. This cooperative comprised 19 members who owned 20 photovoltaic installations with a capacity of 0.181 MWe and consumed energy from 20 points of energy consumption. The establishment of additional energy cooperatives was recorded only in 2023. In the NASC Register in 2023, 19 new cooperatives were noted, bringing together 48 members who owned 92 photovoltaic installations with a total capacity of 3.564 MWe and consumed energy from 318 consumption points. The following year, 35 new energy cooperatives were established, comprising 117 members who consumed

energy from 281 points and owned 141 installations with a total capacity of 10.426 MWe. In total, by December 20, 2024, 55 energy cooperatives had been registered in Poland, bringing together 184 members who consumed energy from 619 points and owned 253 installations with a total capacity of 14.171 MWe. The activities of all energy cooperatives are based on the production of electricity using photovoltaic installations. Additionally, one cooperative operates a wind power plant, and another has an energy storage facility (KOWR, 2024).

MATERIALS AND RESEARCH METHODS

The methodology consists of two parts. The first part, based on literature review (desk research) supplemented with information gathered during the analysis of expert opinions shared at monthly stakeholder meetings at the National Forum of Energy Cooperatives between November 2023 and March 2024, outlines the legal-organizational foundations and factors influencing the functioning of energy cooperatives in Poland. In the second part, a weighted scoring method was applied using a matrix to assess external factors categorized according to the PESTEL analysis framework. These grouped factors were assigned ratings and weights based on inputs from six purposefully selected members of energy cooperatives. The use of the EFE matrix aims to evaluate the relative importance of political, economic, social, technological, environmental, and legal factors for the development of energy cooperatives in Poland.

RESEARCH RESULTS

PESTEL analysis is an extension of the PEST framework. According to Rahman and Mishra (2023), the first references to PEST analysis can be traced to Francis J. Aguilar's book Scanning the Business Environment (1967). Aguilar proposed four categories, ordered as ETPS: Economic, Technological, Political, and Social. Over the years, the analysis evolved, resulting in models such as STEPE (with the inclusion of environmental factors) and PESTEL/PESTLE. The PESTEL framework allows for the examination of barriers and enabling factors for the development of enterprises, organizations, and economic sectors, as noted by Kraj and Smol (2022). PESTEL analysis includes six categories of external factors:

- Political (P): Various forms of governmental and political influence, such as regulations or lobbying;
- Economic (E): Focused on macroeconomic conditions and seasonal or weather-related factors;

- Social (S): Concerned with cultural, societal, and demographic aspects;
- Technological (T): Involves changes in technology, technical infrastructure, and innovations (Cheng, 2023);
- Environmental (E): Considers natural environment requirements, climate change mitigation, and sustainable development;
- Legal (L): Includes legal regulations, market rules, and health protection laws.

Kozłowska (2020) highlights that both the basic PEST model and the extended PESTEL framework enable the identification of key phenomena affecting organizational development. This analysis also facilitates the assessment of the nature (positive, negative, or neutral), strength, and dynamics of the impact of factors. Jurevicius (2023) observes that PEST (PESTEL) analysis helps identify the key elements influencing a company's operations, which should then be evaluated, for instance, using the EFE matrix. The EFE matrix assesses external factors, enabling the identification of opportunities and potential threats to the organization (Talib, Hamid, Zulfakar and Ananda, 2014). To evaluate factors using the EFE matrix, the following steps are necessary:

1. Identify factors (compile a list of external factors).
2. Assign weights (each factor receives a weight ranging from 0 (insignificant) to 1 (most important). The total weights must equal 1.
3. Evaluate the factors (assign scores on a scale from 1 to 4, where 1 indicates low influence and 4 indicates high influence, (e.g., Vega, Balaria, 2019).
4. Calculate weighted scores (multiply the weight by the score for each factor).
5. Sum the scores (the total score can range from 1.0 (low) to 4.0 (high), with an average of 2.5.

According to the literature, a score below 2.5 indicates a weak position, while a score above 2.5 suggests a strong position. Suhendah, Angelina, Ricardo and Stevansyah (2022) propose the following scale for interpreting the total weighted score:

- 4.00-3.00 – high,
- 2.99-2.00 – medium,
- 1.99-1.00 – low.

Based on the literature, it can be concluded that the EFE matrix helps to understand the external environment, increasing stakeholder awareness, which can influence their business decisions (Zulkarnain, Wahyuningtias, Putranto, 2018). Its advantages include simplicity, but it does not provide comprehensive support for business strategy formulation. Additional strategic management tools are recommended to define appropriate action directions (Omodiaogbe, 2023).

The discussions and analyses conducted resulted in the list of external factors determining the development of energy cooperatives in Poland, grouped according to PESTEL criteria, as presented in Table 1. The significance of these factors was assessed using the EFE matrix by purposefully selected Forum stakeholders.

Table 1. Assessment of External Factors (EFE) for the Development of Energy Cooperatives in Poland by PESTEL Criteria

Category	Weight	Assessment	Score
Political			0.45
Drivers			0.23
Sustainable Development Goals – promotion of renewable energy sources	0.01	4	0.04
Political engagement in shaping programs related to renewable energy sources	0.01	4	0.04
Geopolitical challenges – independence from energy supply (e.g., from Russia)	0.05	3	0.15
Barriers			0.22
Time-consuming legislative processes	0.04	4	0.16
Centralized management	0.02	3	0.06
Economics			0.70
Drivers			0.49
Changes in energy prices	0.05	3	0.15
Rising emissions costs (EU ETS)	0.04	3	0.12
Financial support programs (e.g., "Energy for Rural Areas")	0.03	3	0.09
Inclusion of cooperatives in support programs under the Cohesion Policy 2021-2027	0.01	2	0.02
Exemption from licensing if energy trade is solely for cooperative needs	0.04	2	0.08
Energy purchase from the cooperative by its member is invoiced (VAT-based)	0.01	3	0.03
Barriers			0.21
High costs of renewable energy installations	0.05	3	0.15
Energy poverty	0.01	4	0.04
Accounting of cooperatives based on registration date with KOWR (data safeguards needed)	0.01	2	0.02
Social			0.23
Drivers			0.05
Concerns about climate change (climate anxiety)	0.01	2	0.02
Conscious energy use	0.01	2	0.02
Civil society – social engagement	0.01	1	0.01
Barriers			0.18
Social diversity (worldview, income)	0.03	2	0.06
Limited trust in institutions	0.02	3	0.06
Lack of sufficient knowledge about renewable energy sources	0.01	2	0.02
Society's mentality not conducive to integration	0.02	2	0.04

Table 1. Cont.

Category	Weight	Assessment	Score
Technological			0.57
Drivers			0.27
Availability of decarbonization technologies	0.03	2	0.06
Improved energy efficiency in buildings, goods, and services	0.03	2	0.06
Allowing energy storage for cooperative and member needs	0.05	3	0.15
Barriers			0.30
Existing energy transmission infrastructure (limits renewable energy production)	0.05	4	0.20
Time-consuming infrastructure investments.	0.05	2	0.10
Environmental			0.21
Drivers			0.13
Climate change (global warming, extreme weather conditions)	0.01	2	0.02
Limited resources	0.03	3	0.09
Air pollution	0.01	2	0.02
Barriers			0.08
Conflicts and challenges related to land use	0.03	2	0.06
Biodiversity protection	0.01	2	0.02
Legal			0.79
Drivers			0.24
Inclusion of expert recommendations in the legislative process	0.03	4	0.12
Implementation of legal provisions for connecting renewable installations for cooperatives	0.03	4	0.12
Barriers			0.55
Need to adapt public procurement laws to the specificities of energy cooperatives	0.05	4	0.20
Clarification of contracts between sellers and cooperatives, and reporting and network connection facilitation	0.05	3	0.15
Registration of small renewable energy producers (MIOZE) – frequent refusals by the Energy Regulatory Office	0.05	4	0.20
Total	1	-	2.95

Source: own study based on research results

According to the literature, the total weighted score should range from 1.0 (low) to 4.0 (high), with the average weighted score for the EFE matrix being 2.5. In the conducted study, the total weighted score was above average, reaching 2.95. This value indicates that the considered factors have a relatively strong influence on the development of energy cooperatives in Poland. The strength of the developmental factors (1.41) and barriers (1.54) is relatively similar, although the barriers have slightly greater significance.

An analysis of the results in Table 1 highlights the varied impact of different categories on the development of energy cooperatives. The key determinants influencing development were legal (0.79) and economic (0.70) factors. However, in both cases, the results reveal an inverse relationship between developmental factors and barriers. In the legal criterion, barriers (0.55) had twice the influence compared to developmental factors (0.24). Conversely, in the economic criterion, barriers scored 0.21, while developmental factors scored 0.49. It is worth emphasizing that legal barriers scored the highest among all factors determining the development of energy cooperatives in Poland. This underscores the necessity of further legislative work and simplification of procedures, particularly the need to: adjust Public Procurement Law (0.2), facilitate registrations in MIOZE (0.2), clarify agreements between energy sellers and cooperatives, and simplify reporting (0.15).

Economic factors also play a critical role. The main determinants are: high investment costs in renewable energy installations (0.15), energy price fluctuations (0.15), rising emission costs (0.12), and insufficient support within the cohesion policy framework (0.02). These findings indicate the need to reduce investment costs and enhance financial support.

Other criteria were less significant, although the range of scores is considerable. The next most important were technological factors (0.57), evaluated as relatively balanced in terms of their positive (0.27) and restrictive (0.30) significance. The limiting factors, particularly infrastructural constraints impeding renewable energy development (0.2), had a significant influence. This suggests the need for modernizing the energy infrastructure. A developmental factor worth noting is the allowance for energy storage for the cooperative's own needs and those of its members (0.15).

Political factors followed in significance, scoring 0.45, with developmental factors (0.23) and barriers (0.22) rated similarly. In this category, the time-consuming nature of legislative processes (0.16) and geopolitical challenges (0.15) were particularly significant.

Interestingly, social (0.23) and environmental (0.21) factors were the least significant. In the social category, barriers (0.18) significantly outweighed developmental factors (0.05), suggesting the need for public education on the benefits of energy cooperatives. Conversely, in environmental factors, developmental factors (0.13) were more significant than barriers (0.08).

The study results confirm that legal and economic factors are critical for the development of energy cooperatives in Poland. Legislative reforms aimed at removing legal barriers and supporting economic initiatives should be prioritized as growth accelerators. Meanwhile, the relatively low scores for social and environmental factors highlight the need to increase public awareness of the role of energy cooperatives in market transformation and environmental protection.

SUMMARY

Energy cooperatives can play a vital role in the energy transition process. Drawing inspiration from Germany's experience in citizen energy has led to the pilot project (Renaldo Program), which introduced best practices, regulations, and support mechanisms. These actions contribute to improving the conditions for establishing and operating energy cooperatives in Poland. The PESTEL analysis and EFE matrix evaluation indicate that legal and economic factors play the most significant roles in developing energy cooperatives in Poland. This finding highlights the need for legislative changes and financial support for cooperative and renewable energy initiatives. Modernizing energy infrastructure is also essential to fully harness the potential of renewable energy sources. The relatively low significance of social and environmental factors suggests a greater need for education and public engagement in environmental protection.

In conclusion, the distribution of results emphasizes an urgent need for intervention in legal, economic, and technological areas. Therefore, it is recommended to:

1. Implement further legislative changes to simplify administrative procedures related to the registration and operation of cooperatives.
2. Introduce financial support programs for renewable energy investments (including for cooperatives).
3. Conduct educational campaigns on the environmental and economic benefits of renewable energy investments, including those through cooperatives.
4. Support organizations that provide knowledge and best practices.
5. Promote not only photovoltaic installations but also wind energy, biogas, energy storage technologies, and renewable energy system integration.

Implementing these measures will contribute to the development of energy cooperatives in Poland and increase energy independence.

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WYKORZYSTANIE MATRYCY EFE DO OCENY CZYNNIKÓW DETERMINUJĄCYCH ROZWÓJ SPÓŁDZIELNI ENERGETYCZNYCH W POLSCE

Słowa kluczowe: odnawialne źródła energii, obszar wiejski, spółdzielnia energetyczna, analiza PESTEL, matryca EFE

ABSTRAKT. Celem badań było zidentyfikowanie kluczowych czynników wpływających na rozwój spółdzielni energetycznych w Polsce oraz ocena ich wpływu na funkcjonowanie tych podmiotów, w kontekście czynników zgodnych z kryteriami analizy PESTEL. Cel zrealizowano na podstawie literatury przedmiotu i analizy treści wypowiedzi ekspertów podczas Ogólnopolskiego Forum Spółdzielni Energetycznych (2023-2024). Do oceny sił napędowych i barier w rozwoju spółdzielni energetycznych zastosowano analizę PESTEL, w połączeniu z metodą punktacji ważonej za pomocą macierzy EFE. Średni wynik uzyskany w macierzy EFE (2,95) wskazuje, że wzięte pod uwagę czynniki mają relatywnie silny wpływ na rozwój spółdzielczości energetycznej w Polsce. Największą rolę w rozwoju spółdzielczości energetycznej w Polsce odgrywają czynniki prawne i ekonomiczne. To wskazuje na konieczność wprowadzania zmian legislacyjnych oraz wsparcia finansowego dla inicjatyw spółdzielni energetycznych i OZE. Istotna jest także modernizacja infrastruktury energetycznej, która umożliwi w pełni wykorzystanie możliwości wytworzenia energii z OZE. Relatywnie niskie znaczenie czynników społecznych i środowiskowych wskazuje na zwiększoną potrzebę w zakresie edukacji i zaangażowania społecznego w ochronę środowiska.

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