


Article

Economic Conditions for the Development of Energy Cooperatives in Poland

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Abstract: One of the important areas of the energy transformation is the citizens involvement in the energy production process. This is a prerequisite for maintaining the security of supply and price stabilization. In order for all citizens to have equal opportunities to use green energy, regardless of financial and housing opportunities, energy cooperatives are established in many countries. In Poland, the first renewable energy cooperatives emerged in 2021 but, unfortunately, their role in the energy transformation process will be rather limited in the near future. This is mainly due to the numerous legal, economic and social barriers that hinder their creation. This article adopts the hypothesis that there are too many barriers in Poland that discourage the creation of energy cooperatives or other forms of collective prosumption. The main obstacle is the limitations of installed power, coerced by the poor condition of the network infrastructure. The aim of the article is to answer the question of whether, given the current legal and economic conditions, a large-scale development of energy cooperatives is possible in Poland, or will the existing barriers make this development limited and not contribute to the country's energy transformation? To answer this question, primary and secondary sources were used. Primary research relied on interviews in all cooperatives operating in Poland. Based on the literature on the subject, reference was made to the experiences of other EU countries. The research shows that there are strong economic, legal and mental barriers to the development of cooperatives in Poland. Overcoming them requires changes in the law, in the energy policy including decentralization of the energy market and increased public confidence in collective forms of prosumption.

Keywords: development of energy cooperatives; economic barriers; energy cooperatives; energy policy; renewable resources



Citation: Kostecka-Jurczyk, D.; Marak, K.; Struś, M. Economic Conditions for the Development of Energy Cooperatives in Poland. *Energies* **2022**, *15*, 6831. <https://doi.org/10.3390/en15186831>

Academic Editors: Alessandro Burgio, Antonio Violi and David Borge-Diez

Received: 3 August 2022

Accepted: 14 September 2022

Published: 19 September 2022

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1. Introduction

Currently, we are faced with the need to reduce greenhouse gas emissions by at least 55% (from 1990 levels), and to ensure at least a 32% share of renewable energy in the energy mix [1]. It is estimated that over the next few decades, electrification will cause a six-fold increase in energy demand [2]. In order for all citizens to have equal opportunities to use green energy, regardless of financial and housing opportunities, energy cooperatives are established in many countries. This forces investments in energy from renewable sources and at the same time an increase in the number of prosumers and energy-self-sufficient households. The Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (Red II) [1] and the Directive (EU) 2019/944 on common rules for the internal market for electricity (IMED) [3] address these problems. They make it possible to create renewable energy communities (RES).

Renewable energy communities could play an important role in this transformation, in terms of the entity structure. In recent years, micro-installations on private properties

have developed dynamically in Poland, and they are currently dominant. In May 2020, out of 15 million households, almost 1,200,000 micro-installations were connected to the grid, which exceeds the assumed forecast many times over [4]. The vast majority of these are photovoltaic (PV) micro-installations, connected to the grid on the basis of a notification. If the current dynamics of connections are maintained, at the end of 2022 the total capacity of micro-installations may reach the value of about 10 GW [4].

However, the potential for a further increase in micro-installations created in households is limited. Due to the lack of appropriate network infrastructure, a significant number of such installations have a limited possibility of supplying energy to the grid from time to time. The grids are not able to receive the increased energy production, which causes temporary shutdowns of the installation and, consequently, reduces the profitability of the investment.

From 2015–2022, power grid operators in Poland refused to connect over 6000 installations. Moreover, most of the refusals concerned RES installations, the total capacity of which amounts to approx. 30 GW [4]. The lost potential accounts for approximately 50% of the current capacity of all Polish power plants. It is because of the bad condition of the power grids. In Poland, power grids were built many years ago and were designed for large conventional power plants. Currently, about 40% of overhead networks are over 40 years old [4]. They are heavily exploited and not well adapted to receive new RES capacities. Currently, the inability to connect to the grid is one of the most serious barriers to the development of not only renewable energy cooperatives but also other forms of prosumption in Poland. Unfortunately, power grid problems will continue to increase because of the lack of investments in remodeling them and there is a lack of regulations enabling the construction of direct grids that is strongly developing in many European countries. Only in 2021, the number of refusals to connect RES installations to the grid increase by 70% compared to 2020 and amounted to 3751 cases [4].

It is also important that the state deliberately limits the profitability of investing in PV micro-installations. First of all, from 1 April 2022, net billing was introduced instead of net metering. Such a solution significantly limited the profitability of investments in renewable energy in households. At the same time, it is not conducive to energy cooperatives or the use of other forms of citizen cooperation in the field of energy prosumption. As a result, it is not possible to use renewable energy for people living in blocks of flats. Despite the generally unfavorable conditions for installing micro-installations in Poland, it can be stated that people living in detached houses are privileged. The creation of energy cooperatives or other forms of cooperatives is necessary to enable different societal groups to use renewable energy sources.

Renewable energy consumer (co-)ownership is a key element for the overall success of the energy transition. However, little attention is paid to this in the literature. Many authors analyze the forms and structure of prosumption and point out that prosumption includes both production and consumption, and not production or consumption only [5]. Prosumers are recognized as citizens of social energy, i.e., potential agents supporting the energy transition. They play an important role in society in the process of energy transformation, mainly from the point of view of the development of local communities and benefits for residents [6]. Community-generated energy refers to a wide range of collective energy activities that involve citizens' participation in the energy system. Community energy projects have varying degrees of community involvement in decision-making and the sharing of benefits. They enable citizens to jointly own and manage renewable energy sources. Community members can invest in renewable energy generation by purchasing shares to finance the project and consume renewable energy [7–10]. The research on the propensity to invest in renewable energy communities indicates that the preferred organizational entity in such communities is a social non-governmental organization [11]. The belief that renewable energy creates jobs has a much stronger positive impact on community development than the belief that renewable energy improves the environment. Thus, the decisive motive for the formation of communities is economic benefits [11].

The literature indicates that local authorities play a decisive role in the development of the renewable energy community, although they often do not use their potential and are even unable to organize a renewable energy community [12]. In energy cooperatives, it is mainly PV farms and power-to-gas infrastructure. At the same time, there is a noticeable decline in interest in wind farms [13]. However, in Poland, only solar energy sources are developing. Investments in wind farms have been severely limited by the state. There are strong legislative barriers in this respect, which will be discussed later in this article. For this reason, mainly PV sources are currently being developed and cooperatives also use PV.

In the case of cooperatives, it should be noted many authors view renewable energy cooperatives as a tool for sustainable economic development without paying attention to the barriers that need to be overcome before such cooperatives are established [14].

When analyzing the benefits of participation in an energy cooperative, it should be noted that both individual benefits for members and broadly understood social benefits can be indicated. Social benefits are related primarily to the reduction in the so-called low emissions, which has a positive effect on the natural environment and the health of the inhabitants. It should be emphasized that, according to the regulations in force, at least 70% of the electricity demanded of both the cooperative and its members must come from renewable energy sources. This necessitates the investment of energy cooperatives that use renewable sources. However, these investments, and especially the construction of power plants, are capital intensive. Therefore, the energy cooperatives currently operating in Poland use PV.

In conclusion, the development of energy cooperatives is related to the development of renewable energy sources and, thus, contributes to the reduction in CO₂, which in turn has a positive effect on human health. This is especially true in Poland, which is still struggling with the problem of air quality and its negative effects. As the report, “Air quality in Europe—2020 report” [15], shows to the European Environment Agency, in 2018, 49,700 people died prematurely due to air pollution in Poland. The report also shows that Poland is one of the countries with the most polluted air [16–18].

At the same time, the development of renewable energy cooperatives is accompanied by activities related to improving the energy efficiency of buildings. It is easier to carry out costly investments related to the thermal modernization of buildings within a cooperative. The above statement is confirmed by the results of research carried out in the energy community, Nasza Energia.

The functioning of energy cooperatives can also positively affect local development and the standard of living of the inhabitants. As shown by the German experience, as a result of the increased activity of citizens, initiatives were created that not only improved the living conditions of the inhabitants but also influenced the development of innovative technologies and created permanent jobs. In addition, the activity of energy cooperatives, among others, thanks to covering energy needs, as well as generating additional income, has become an important factor in preventing energy poverty [19].

Energy cooperatives can also contribute to the development of rural areas. This applies especially to the circumstance in which energy cooperatives would obtain energy from biomass. The cooperation of energy cooperatives with local authorities and farmers could lead to achieving energy self-sufficiency in the commune. The direct beneficiaries of the benefits resulting from the functioning of the cooperative are its members. It should be emphasized that participation in an energy cooperative may be more advantageous than an individual investment in renewable energy. This is due to the lack of fees for the distribution service related to the energy generated and consumed within the cooperative, and the lack of some fees charged to the electricity producer [20].

The seller with whom the electricity purchase contract was concluded shall, with the energy cooperative, settle the amount of electricity introduced to the distribution network and the amount of electricity taken from this network for its own consumption by the energy cooperative and its members. The energy cooperative does not pay fees for the distribution and settlement services on the amount of electricity settled in the

above manner. At the same time, the amount of electricity generated in all installations of renewable energy sources of an energy cooperative and then consumed by all electricity consumers of the energy cooperative is not calculated and charged; RES charges, capacity fee [21], cogeneration fee [22] and excise duty, provided that the total installed capacity of all renewable energy installations of the energy cooperative does not exceed 1 MW. In addition, obligations to redeem green, blue and white certificates are not applied to the cooperative.

The aim of the article is to answer the question of whether, given the current legal and economic conditions, a large-scale development of energy cooperatives is possible in Poland, or will the existing barriers make this development limited and not contribute to the country's energy transformation?

The article identifies barriers to the development of energy cooperatives in Poland where such cooperatives are just beginning to emerge. The article is a contribution to the discussion on the limitations of establishing energy cooperatives and their significance for energy transformation. The conclusions were formulated on the basis of own research carried out in all cooperatives registered in Poland.

2. The Concept of Energy Cooperatives

A renewable energy cooperative is a prosumer that produces electricity exclusively from renewable energy sources for its own needs in a micro-installation or a small installation connected to the distribution network via the internal electrical installation of a multi-unit building, provided that it is a prosumer whose energy production is not the subject of his predominant economic activity if it is an undertaking. It is a framework that promotes local and rational use of energy resources and facilitates self-consumption [23]. It is a means to provide environmental, economic and social community benefits for its members (shareholders) but it acts not for profit (RED, Article 2) (16c) [2]. Next to the cooperative, we can distinguish citizen energy community (CEC), which means a legal entity for the purpose of providing environmental, economic and social community benefits to its members (shareholders), or local areas rather than generate financial profits (IMED, Article 2 (11b) [3]. Both are not intended to make a financial profit. The difference between them is that citizen energy communities can be the operator of the distribution system. In Poland, this is not yet possible [24]. Therefore, citizen energy communities do not operate in Poland. From a formal point of view, according to the regulations in force in Poland, only cooperatives operate.

The legal definition of an energy cooperative contained in Act. 2 point 33a of the Act of 20 February 2015 on renewable energy sources stated that it is a form of cooperation, the subject of which is the production of electricity, biogas or heat from renewable sources only for the needs of an energy cooperative and its members, connected to the distribution network in a specific area with a rated voltage lower than 110 kV or a gas distribution network or heating network [24,25].

Energy cooperatives are managed directly by their members on a "one member-one vote" basis and aim first at maximizing the benefits for the local environment and meeting the energy needs of their members, not for financial profit. Generating energy solely to meet the needs of its members means that an energy cooperative cannot sell the generated energy to a non-member entity. Thus, the energy cooperative does not participate in economic trade with external entities.

The activity of an energy cooperative has the so-called result-less character, which means that it does not aim to achieve profit in the form of financial gain. An energy cooperative aims to satisfy the energy needs of its members, just as a housing cooperative aims to satisfy housing needs. An energy cooperative may operate only in the area of a rural or urban-rural commune within the meaning of public statistics or in an area of no more than three such communes directly adjacent to each other. No more than 1000 legal or natural persons may operate under an energy cooperative. The act introduces numerous restrictions on the activities of such cooperatives. For example, if the object of its activity

is the production of electricity, the total installed electric capacity of all renewable energy installations must enable covering during the year no less than 70% of the energy cooperative's and its members' own needs and may not exceed 10 MW. If the object of its activity is the generation of heat, the total achievable thermal power cannot exceed 30 MW. In the case of biogas, the annual capacity of all installations must not exceed 40 million m³.

Other conditions for the operation of energy cooperatives:

- The area of one distribution system operator;
- Up to three rural or urban-rural communes directly adjacent to each other;
- Up to 999 members;
- Covering at least 70% of own needs;
- Maximum 10 MW of power of all sources;
- Registration by National Center for Agricultural Support;
- Already 3 companies may be founders and members of a cooperative;
- For members of the cooperative, a 0.6 discount (the cooperatives that were the subject of our research settle accounts in the net metering system, i.e., they will recover 60% of the energy produced and delivered to the grid. It is worth noting that as a result of legal changes, this rule was abolished on 30 April 2022 because the clearing system was changed to net billing);
- Exemption from the green energy fee (that is RES charges-these fees are related to ensuring the availability of energy from renewable sources in the national power system, i.e., covering the negative balance in the sale of electricity according to the new auction rules);
- Exemption from the capacity fee;
- Exemption from the cogeneration fee;
- Exemption from the distribution fee in the variable part;
- No obligation to deduct public aid;
- Compulsory comprehensive agreement, but it will be possible to choose a supplier with whom the distribution system operator must conclude an agreement within 21 days (a contract that contains provisions relating not only to the sale of electricity to a given customer but also the terms of the contract for the provision of electricity distribution services).

When defining an energy cooperative, its participatory nature should be emphasized. It can even be said that an energy cooperative is an organizational and business model in which citizens jointly conduct projects in the production, distribution, sale and storage of energy and heat from renewable energy. This leads to the conclusion that the development of energy cooperatives depends, inter alia, on the level of human capital and the associated confidence. Currently, there are no Polish studies linking the development of energy cooperatives directly with the level of human capital. However, as emphasized by Łabędzki and Struś [26], its low level is a general barrier inhibiting local development and innovation, especially in rural areas.

3. Methodology

Research on barriers to the development of energy cooperatives was carried out in Poland. Empirical research was carried out in two energy cooperatives officially registered in the National Center for Agricultural Support (KOWR) [27], i.e., Eisall Energy Cooperative in Raszyn and the Nasza Energia Energy Cooperative in Mszana. They are located in the central-eastern and southern part of the country (Figure 1)

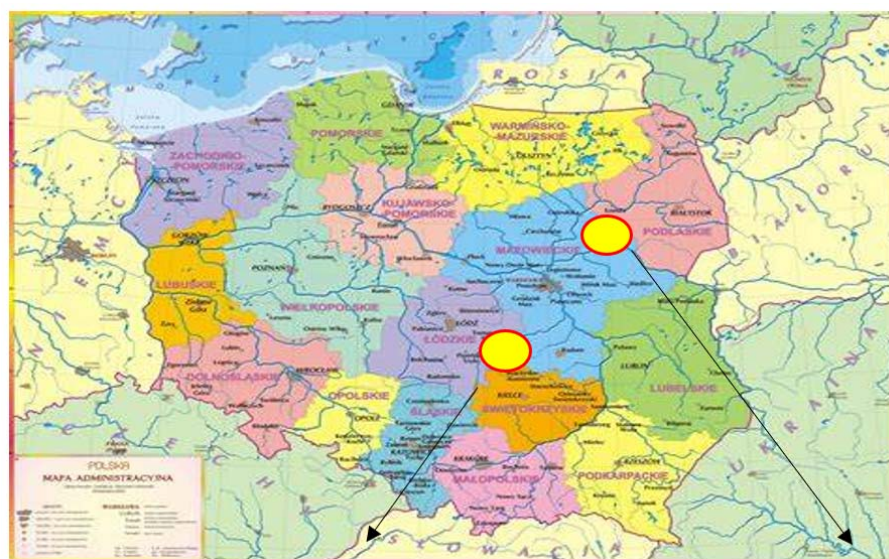


Figure 1. Location of a renewable energy cooperative in Poland. Energy Cooperative in Mszana Eisall Energy Cooperative in Raszyn. Source: own studies.

Due to the fact that there are only two energy cooperatives in Poland, the research used the method of expert interviews. The selection of respondents was deliberate. In both cases, they were the presidents of energy cooperatives. They were found to be very knowledgeable about the subject of the study. It was also assumed that thanks to their expertise and knowledge of the realities, they would also be able to propose realistic forecasts for the development of energy cooperatives in Poland. The interviews were direct with the use of the interview vestionary.

A questionnaire with 14 open-ended questions was used in the interviews. The aim of the questions was both to learn about the facts related to the functioning of energy cooperatives and, in particular, the barriers that inhibit their development, as well as an attempt to explain the current situation of the cooperative and diagnose the direction of their further development.

It was divided into two parts. The first part asked general questions about the organizational structure of the cooperative. Question 1 was particularly important: “who was the initiator of the establishment of the cooperative”. The answer to this question made it possible to determine whether the creation of cooperatives is of a bottom-up nature, or whether they were initiated by public authorities (top-down nature). The second part contained in-depth questions about the benefits, barriers and development prospects.

For obvious reasons (there are only two energy cooperatives in Poland and they have only been operating for a year), empirical research (interviews) is limited in scope. They are only of a qualitative nature. For this reason, statistical tools were not used to analyze the research results, and the obtained results do not allow for the assessment of the importance of cooperatives for the development of renewable energy sources and their impact on local communities. However, the obtained results make it possible to exemplify the state of the Polish prosumer energy sector and, most importantly, to identify barriers to the development of such entities in Poland. At the same time, based on the results obtained, it is possible to formulate recommendations for the energy policy. Additionally, the article was prepared on the basis of literature studies, an analysis of EU legal acts and reports on the renewable energy community. It should be emphasized that, in Poland, this problem is relatively new and therefore there are not many scientific studies. This applies in particular to works dealing with energy cooperatives from the economic point of view.

The methodology adopted in the article allowed for the following hypotheses:

H1. *In Poland there are too many economic, legal and mental barriers discouraging the creation of energy cooperatives or other forms of collective prosumption.*

H2. *Consumers, in their decisions, are primarily guided by the financial account. With the current energy prices and the costs associated with investing in renewable energy, the potential profits are too low to convince individuals to participate in an energy cooperative.*

4. Results and Discussion

Participation in an energy cooperative gives an opportunity to reduce the costs of energy production and consumption and to expand the role of consumers in the production and consumption of energy [28]. Research in Belgium and France shows that memberships in renewable energy communities also contribute to increased energy savings in households [24]. The above indicates that one should expect a dynamic development of energy cooperatives in Poland. However, in practice, it is completely different.

The explanation of the situation requires a broader analysis of the benefits resulting from participation in an energy cooperative and the barriers to the development of these cooperatives.

The development of energy cooperatives brings a number of benefits. It should be emphasized that both their members and the general public can benefit from the functioning of energy cooperatives.

Barriers to the Development of Energy Cooperatives

As shown in the literature on the subject, the development of energy cooperatives encounters numerous barriers. This situation is not only Polish-specific. This problem is also visible in other countries. The most important barriers that limits the development of energy cooperatives are: limited opportunities to obtain capital, restrictions in access to the energy market, unsatisfactory access to information on the establishment and operation of cooperatives, a privileged position of large market entities and difficulties in accessing real estate RES installations should be placed [29].

On the other hand, there are barriers to the development of energy cooperatives such as the relatively high costs associated with the investment, with the simultaneous reluctance to engage in projects of large private entities focused on profit. However, in this case, it is difficult to clearly assess the situation negatively (as a barrier). On the one hand, the lack of an economically strong partner undoubtedly hinders the investment process (especially in the construction of power plants) but on the other hand, the lack of a dominant profit-oriented entity means that the ideas of cooperatives do not lose their importance.

The Polish literature on the subject also emphasizes the importance of high investment costs as a barrier to the development of energy cooperatives, especially since the cooperative operating model adopted in Poland was based on settlements in the prosumer system [30]. As a result, entities with capital are not interested in these undertakings also in Poland (as in Germany). As a consequence, the energy cooperatives existing in Poland generate energy using only photovoltaics, but do not invest in the construction of their own power plant.

At the same time, the potential financial benefits from participation in an energy cooperative are relatively low, especially in the case of households, as shown in Table 1 below.

As it results from the simulation, a two-person household may gain approx. EUR 48.9 per year from participation in an energy cooperative. In the case of a three-person farm, it is EUR 65.2. A four-person farm can count on a financial benefit of approximately EUR 81.5.

Table 1. Simulation of the potential benefits of participating in a household energy cooperative (in Euro) *.

Without a Cooperative			Member of an Energy Cooperative			Benefit from Participation in an Energy Cooperative (Euro)
Energy Consumption in kWh (Annually)	Gross Energy Price ^{1,2} (Euro)	Annual Energy Purchase Cost (Euro)	Energy Consumption in kWh (Annually)	Gross Energy Price ^{1,3} (Euro)	Annual Energy Purchase Cost (Euro)	
A two-person household						
1500 ⁴	0.5039	755.8	1500	0.350	525.0	210.8
A three-person household						
2000 ⁴	0.5039	1007.8	2000	0.350	700.0	307.8
A four-person household						
15,000	0.1061	1581.3	15,000	0.073	1098.3	483.0

* Calculations according to the average EUR exchange rate published by the National Bank of Poland on 8 September 2022 (EUR 1 = PLN 4.7244). ¹ VAT 23%. ² Price according to the rate of the company Tauron S.A. as of 13 July 2022. ³ Price based on EISALL Energy Cooperative. First experiences. 3rd Distributed Energy Forum, 25 June 2021. ⁴ <https://optimalenergy.pl/aktualnosci/prad/ile-wynosi-srednie-zuzycie-pradu-na-osobe/> (accessed on 5 September 2022). Source: own study.

Another equally important barrier encountered in Polish literature is the adoption by the legislator of the requirement that the total installed capacity of all renewable energy installations operated by the cooperative should cover at least 70% of the energy cooperative's and its members' own needs within a year [30]. If this is not achieved, the cooperative cannot be registered. Such a strict provision raises doubts. On the one hand, it is to strengthen the development of renewable energy sources in Poland but on the other hand, it forces the need to use the support of specialized entities at the planning stage in the selection of renewable energy installations, and thus generates costs before starting operations. One should agree with T. Marzec's statement that such a strict requirement is dictated rather by the protection of the interests of network operators for whom an entity with unpredictable energy demand and unstable energy production would hinder balancing the power system.

The third barrier to the development of energy cooperatives is the mental barrier. Both the period of the centrally planned economy (1945–1989) and the period of systemic transformation were not conducive to building social capital. The level of trust in Poland is still low, and individualism and reluctance to cooperate prevail [31].

The fourth key barrier to the development of energy cooperatives and renewable energy, in general, is the maladjustment of the electro-energy infrastructure. To overcome this barrier, the existing 220 kV networks are gradually being replaced by 400 kV structures. A long-term program of transformer replacement with more effective ones is also implemented [32]. The cost of the planned investments is PLN 14 billion (approximately EUR 3 billion). In addition, major distribution system operators are investing in local microgrids. This makes it possible to reduce network losses and, at the same time, increase the installed RES capacity. In turn, these installations make it possible to replace energy from the nationwide grid, which is generated in high-emission fossil fuel power plants, and from local non-renewable sources. You will have to wait several years for the effects. It is estimated that the modernization of the existing grids will last until 2030. The development of energy cooperatives and other forms of collective prosumption is likely to continue if the condition of the infrastructure improves and limitations in terms of installed capacity are removed.

Although the barriers presented above are most often presented in the literature, there are more of them. Although the RES Act grants energy cooperatives certain privileges, e.g., exemption from some distribution fees, it also imposes restrictions. According to the act, an energy cooperative may operate in no more than three municipalities and may not have

more than 1000 members. The power of the installation is also limited. In addition, the cooperative, like prosumers, cannot sell electricity today, but only deliver it to the grid.

The development of energy cooperatives is also not conducive to legal solutions related to the functioning of cooperatives in Poland, designed mainly for housing cooperatives. These entities often have large, unused roof areas, ideal for the installation of photovoltaics. This is important, especially in the context of previous considerations related to the need for energy cooperatives to generate at least 70% of energy from RES. However, in practice, housing cooperatives and communities are not particularly interested in investments in renewable energy sources or membership in energy cooperatives. This is due to, *inter alia*, from the fact that in the current legal state, the energy obtained on the roofs can be used only for the common areas, i.e., lighting of staircases, powering elevators, gates and pumps. The energy produced in this way cannot be made available by a housing cooperative or a community to residents.

Błażejewska and Gostomczyk point out other barriers to the development of energy cooperatives [29]. In their opinion, a significant barrier to the development of new organizational solutions in the energy sector is the low activity of local and regional authorities. At the same time, it is worth emphasizing that the considerations conducted by these authors mainly concern rural areas and the possibility of farmers' participation in innovative energy initiatives.

When analyzing barriers to the development of energy cooperatives, one cannot limit oneself to literature studies only. Opinions expressed by representatives of already operating entities should also be taken into account. As already mentioned, there are two energy cooperatives operating in Poland, i.e., the EISALL Energy Cooperative operating in the Mazowieckie Voivodeship and the Energetyczna Cooperative-Nasza Energia operating in the Śląskie Voivodeship. Both cooperatives use photovoltaic installations.

The analysis of the available data [19] shows that, according to the representatives of EISALL Energy Cooperative, barriers to the development of energy cooperatives can be divided into critical and development barriers. Critical barriers significantly hinder the functioning of energy cooperatives or even make it impossible to perform certain tasks or duties. Development barriers pose a threat to the development of energy cooperatives and may be the basis for resigning from developing the project of establishing an energy cooperative. Details are provided in Table 2 below.

Table 2. Barriers to the development of energy cooperatives.

Critical Barriers	Development Barriers
<ul style="list-style-type: none"> • Lack of regulations explicitly obliging energy companies to conclude agreements with an energy cooperative; • Lack of agreed model contracts with energy companies; • Imprecise provisions regarding the exemption from the capacity fee for customers in the "G" tariff *; • Lack of precise rules with regard to prices set by the obligated seller regarding energy purchased by the SE cooperative and its members. 	<ul style="list-style-type: none"> • The 10 h rule with regard to the development of dispersed sources in the form of wind farms; • Lack of regulations with regard to determining the legal existence of contracts concluded by current members with energy companies; • Lack of clear regulations on the Public Procurement Law in correlation with the provisions on energy cooperatives.

Source: compiled on the basis of EISALL Energy Cooperative. First experiences. 3rd Distributed Energy Forum on 25 June 2021. * household tariff.

As the information contained in the table shows, the key problem is the lack of a developed model of cooperation between energy cooperatives and energy companies. Energy enterprises have a stronger bargaining position, which results not only from their dominant market position but also, as previously emphasized, from the legal solutions that are favorable to them. It is also worth paying attention to the barrier related to the 10 h rule.

The 10 h rule means that, currently, it is not possible to build windmills at a distance of less than 10 times the height of the windmill from buildings and forms of nature protection. This principle is one of the barriers to the development of renewable energy sources, which was also pointed out by the Supreme Audit Office [29]. It is worth noting that the solutions adopted in Poland are among the most restrictive in Europe.

As a result of the introduction of this rule, the possibility of locating new wind farms and initiating new wind farm projects has been limited. The development of housing in the vicinity of existing power plants was also blocked. As a result, there is no energy cooperative that uses this source of renewable energy (depending on the model, wind farms are 150 to 200 m high, which is also the value of the measure used in distance standards. The definition of the permissible distance in the statutory regulation is minimal. In practice, this means a distance of 1.5 to 2 km).

In addition, the interview with the President of the Eisall Cooperative shows that the barriers limiting the development of energy cooperatives include:

- The failure to adjust the provisions of the Public Procurement Act with regard to the functioning of communes in energy cooperatives (the need to announce a tender for the purchase of energy produced by a cooperative of which the commune is a member);
- Problems with the location of renewable energy sources resulting from the current provisions of local spatial development plans;
- Lack of a separate job position in the commune structure responsible for the commune's energy policy;
- Mental barriers, a lack of trust of potential members in the new form of activity.

In turn, according to the research (a structured interview) carried out at Spółdzielnia Energetyczna-Nasza Energia, the most important barriers to the development of energy cooperatives include:

- Different interpretations of legal regulations regarding energy balancing in an energy cooperative;
- Problems with concluding a contract for energy balancing;
- Lack of preparation of the Distribution System Operator and energy sellers for changes in the legal provisions, which entered into force on 1 April 2022.

The obtained results are consistent with the previous arguments and confirm the thesis that it is necessary to develop a model of cooperation with energy companies that is beneficial for energy cooperatives.

Additionally, the interview indicated that people do not trust the new legal form, which makes it difficult to recruit members. As mentioned before, this is a barrier related to the low level of social capital in Poland.

The confrontation of the results of literature studies with the empirical research conducted in energy cooperatives operating in Poland leads to several conclusions.

Firstly, the problem of access to the capital as a barrier to the development of energy cooperatives, raised in the literature on the subject (both domestic and foreign), was not reflected in the results of the interview. The reasons for such a situation include, *inter alia*, limited scale of investments carried out by cooperatives (only photovoltaics), not generating such high costs as wind farms or biogas plants and involvement of local authorities (municipalities) participating in the investments in the projects.

Secondly, involvement in municipal cooperatives is a *de facto* alternative to large private entities. This situation has its consequences. On the one hand, it solves the problem of the lack of interest in cooperatives of large private entities focused on profit but on the other hand, it creates the need for active actions by local authorities. Unfortunately, the current activity of these authorities is unsatisfactory, as shown by both literature research and interviews. This is due to the low level of knowledge of local authorities about the benefits of participation in an energy cooperative, the lack of prepared staff and the difficult budget situation resulting from the economic slowdown.

Thirdly, empirical research confirmed the views in the literature relating to the low level of human capital as a barrier to the development of energy cooperatives. The lack of trust is visible mainly among natural persons. As a result, they are not interested in membership in the cooperative, especially since, as shown by the financial simulations carried out in this article, the potential financial benefits are significant for people with relatively low electricity consumption per year.

The conducted interviews clearly indicated the barrier related to the relations between energy cooperatives and energy companies, and thus confirmed the views presented in the literature. Energy cooperatives have a weaker negotiating position, which is particularly important when interpreting imprecise legal rules.

Empirical research also confirmed previous findings regarding problems with locating RES investments. However, the research shows that the above-mentioned situation is influenced not only by the previously indicated unfavourable legal solutions (e.g., the 10 h rule), but also by delays in the preparation of local spatial development plans. The lack of such plan delays and, even in extreme cases, prevents the implementation of the investment.

Taking the above into account, it should be expected that the accelerated development of collective prosumer energy will take time. First, the network should be modernized so that the connection of subsequent collective prosumers does not cause excessive burdens and the necessity of switching on. At the same time, many other challenges will have to be met.

5. Conclusions

The conducted research shows that there are currently strong barriers limiting the development of energy cooperatives. These barriers are economic (high investment costs), legal and mental. At the same time, the financial benefits for individual members of the cooperative (natural persons) are relatively low over the year. On the other hand, environmental benefits are often perceived as something abstract and elusive.

The construction of the energy market is also not conducive to the development of small renewable energy sources in Poland. It is based on the principle of centralized generation and is subordinated to the functioning of large energy producers. For this reason, it will be necessary in the future to enable transactions on the energy market as part of blockchain mechanisms. These transactions are carried out between smaller energy producers, e.g., households, and consumers who can buy energy from them. Such solutions will undoubtedly contribute to the further fragmentation of the energy market.

Poland's energy transformation is slowed down by poor grid capacity and the inability to connect RES. Refusals to connect RES to the grid are becoming more frequent. This must be prevented by investing in networks. Otherwise, RES will not develop in Poland. From 2015–2022, grid operators refused to connect over 6000 installations. Moreover, most of the refusals concerned RES installations, the total capacity of which amounts to approx. 30 GW. The lost potential accounts for approximately 50% of the current capacity of all Polish power plants. Another barrier is the lack of direct networks. Already today, it is necessary to enable the construction of direct lines, as well as cable pooling and changes in the management of energy flows in the network by introducing a legal framework and incentives for distribution services.

The economic barriers also include the lack of adapted RES development plans. They are important for the assessment of the economic conditions of connecting to the grid. If the development plan does not provide for the expansion/modernization of the grid, the Operator may state that there are no economic conditions for the connection of the grid.

The condition for the development of energy cooperatives or other forms of collective prosumption is the elimination of economic barriers and the increase in the profitability of such investments. This requires, first of all, investments in the expansion of the network infrastructure. Currently, power grids are overloaded and do not provide opportunities for the development of energy from renewable sources. Investments are therefore needed

to improve the interconnection of national networks. It is also necessary to build direct power grids.

Legal changes will be very important as well, specifying the mutual relations between energy cooperatives and energy companies. This applies in particular to the procedure of concluding a contract between these entities. In the current legal regime, the position of energy cooperatives is too weak.

Investment conditions should also be simplified, e.g., through a flexible approach to the provisions of the local spatial development plan. The procedure of changing the spatial development plan is expensive and time-consuming in Polish conditions. At the same time, the energy policy of communes to date has often failed to take into account investments in renewable energy sources in their area, which negatively affects the current investment possibilities.

It is also advisable to take actions aimed at breaking mental barriers. For this purpose, study visits to operating cooperatives should be organized. The possibility of direct acquaintance with the activities of the cooperative and the benefits resulting from participation in it should positively influence the decisions of potential members.

The prerequisite for full market participation by consumers is the decentralization of electricity supply and trading. Decentralized trading systems that allow direct energy trading should be developed. In the long run, it must be tradable through futures trading options.

Taking into account the above, it should be stated that the most important challenge at present is to increase the available connection capacities and to quickly modernize the network. If the operator refuses to connect a micro or small RES installation, they should be automatically (through appropriate regulations) obliged to modernize the grid within a specified period. These challenges should be a priority in the current energy policy of the state.

Author Contributions: Conceptualization, D.K.-J. and M.S.; Methodology, D.K.-J. and M.S.; Software, D.K.-J., K.M. and M.S.; Validation, D.K.-J. and M.S.; Formal Analysis, D.K.-J., K.M. and M.S.; Investigation, D.K.-J. and M.S.; Resources, D.K.-J., M.S. and K.M.; Data Curation, M.S.; Writing—Original Draft Preparation, D.K.-J. and M.S.; Writing—Review and Editing, D.K.-J. and M.S.; Visualization, K.M.; Supervision, D.K.-J. and M.S.; Project Administration, D.K.-J. and M.S.; Funding Acquisition, D.K.-J., M.S. and K.M. All authors have read and agreed to the published version of the manuscript.

Funding: In part prepared by Katarzyna Marak: The project is financed by the Ministry of Education and Science in Poland under the programme “Regional Initiative of Excellence” 2019–2023 project number 015/RID/2018/19 total funding amount 10,721,040.00 PLN.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

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