

## Article

# Sustainable Energy Consumption and Prosumer Models in Polish Renewable-Energy Law

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## Abstract

This article asks a practical question: do current renewable-energy rules encourage end users to become prosumers, or do they mainly serve those already prepared to invest? This analysis maps recent Polish reforms, especially the shift from net metering to value-based net billing and later adjustments to settlements: the return to monthly average pricing for many early adopters, an optional hourly price model, and a strengthened prosumer deposit intended to reduce the sell–buy gap. It also examines the expanding catalogue of prosumer statuses, from the individual prosumer, through collective prosumption in multi-unit buildings, to the virtual prosumer, which may include people without a suitable roof or land. The article then considers civic forms of organisation—energy cooperatives, energy clusters and citizen energy communities—and the role of municipalities as conveners and intermediaries. It argues that regulatory responsiveness, even when market-oriented and technologically aware, is not enough. Uptake depends on whether the rules fit real constraints: finance, administrative effort, grid capacity and fair allocation of risk.

**Keywords:** renewable energy prosumers; net billing; energy communities; regulatory responsiveness; sustainable energy transition

## 1. Introduction

Poland’s energy transition is a process that effectively began around ten years ago. This period is commonly associated with the introduction of the renewable energy prosumer into the Polish legal framework. Over the past decade, numerous factors have either accelerated or slowed the pace of the energy transition [1].

Among them, the legal framework has played a particularly important role, as it establishes the conditions under which the entire process develops and largely determines its direction and pace. During this period, the Polish legal system has been significantly expanded to include new models of prosumer participation [2].

This article asks whether Polish renewable-energy law does more than provide a formal basis for prosumer participation. More specifically, it examines whether the existing framework offers a realistic route into prosumption for end users who lack substantial financial resources, technical knowledge or organisational support. To answer this question, the main prosumer and community-energy models available under Polish law are assessed against five criteria: access to finance, administrative simplicity, grid compatibility, settlement predictability and the allocation of risk. On this basis, the article distinguishes



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between rules that merely enable participation, those that provide a meaningful incentive to participate, and those that give a broader range of end users the practical capacity to do so.

To better understand the nature of the Polish prosumer models, it is first necessary to examine the development of the system over the last decade. Analysing statistical data from this period makes it possible to illustrate how Poland's energy transition has evolved and provides a broader perspective on both the current legal framework and the pace of the transformation. The table below presents the growth in the total number of prosumers in Poland over recent years.

As shown in Table 1, the number of prosumers in Poland increased approximately thirty-two-fold over a period of eight years. Such rapid growth brings with it a number of highly complex and serious consequences. First of all, attention should be paid to the technical limitations related to the electricity transmission infrastructure. In this respect, the problem is twofold. The first aspect concerns the age of the transmission infrastructure.

**Table 1.** Increase in the number of prosumers in individual years.

| Date | Number of Prosumers | Increase in % |
|------|---------------------|---------------|
| 2018 | 51,163              | -             |
| 2019 | 149,308             | 191.8%        |
| 2020 | 452,307             | 202.9%        |
| 2021 | 847,192             | 87.3%         |
| 2022 | 1,200,755           | 41.7%         |
| 2023 | 1,386,792           | 15.5%         |
| 2024 | 1,522,655           | 9.8%          |
| 2025 | 1,612,450           | 5.9%          |

Own elaboration based on the annual reports of the Energy Regulatory Office (URE) on electricity generated from renewable energy sources in micro-installations (2018–2025) [3].

The report of the Polish Supreme Audit Office (Najwyższa Izba Kontroli—NIK) revealed very alarming information regarding the age of Poland's electricity transmission infrastructure. According to the experts' analysis: *"The audit found that in 2021, a total of 46% of the 110 kV electricity lines were more than 40 years old, of which half were more than 50 years old. . . In 2021, 40% of the medium-voltage lines were more than 40 years old (15% were more than 50 years old). . . Low-voltage lines older than 40 years accounted for 30% of all low-voltage lines in 2021."* [4].

This means that a very significant part of Poland's electricity transmission infrastructure, at all voltage levels, still dates back to the period of Soviet influence.

The second issue concerns the diversification of electricity generation prior to the beginning of the energy transition process. At the time when the prosumer institution was introduced into Polish law in 2016, electricity generation from coal in Poland accounted for approximately 85% (53.6% from hard coal and 31.6% from lignite) [5].

Until that time, electricity generation in Poland was highly centralised. The introduction of approximately 1.6 million prosumers into this system over the past eight years has significantly altered the electricity transmission model, leading to difficulties in system balancing. Combined with the ageing nature of the transmission infrastructure, this creates a significant infrastructural challenge [6].

Non-market curtailment of renewable generation rose sharply from 2024 onwards (see Table 2). These figures should, however, be interpreted with caution. They relate to wind farms and commercial photovoltaic installations rather than household prosumers and cannot therefore be used to attribute curtailment to prosumer generation. Their relevance to this analysis is more limited: they illustrate the growing difficulty of accommodating variable renewable generation within the existing electricity network, which is also an important constraint on the further expansion of prosumption [7].

**Table 2.** Non-market curtailment of wind farms and non-prosumer PV installations.

| Date | Curtailment Energy |
|------|--------------------|
| 2023 | 0.1 TWh            |
| 2024 | 0.7 TWh            |
| 2025 | 1.4 TWh            |

Own elaboration based on Forum Energii [8].

These data raise a more general question that situates the article within a broader context: is the Polish electricity system prepared for new prosumers?

During the period covered in Table 1, a number of significant legal changes can be observed, which are described in the present article. These changes functioned as a tool used by the legislator to regulate the increase in the number of prosumers. Among other things, two new prosumer models were introduced and subsequently subject to significant legislative updates [2].

A key development was undoubtedly the change in the settlement system from net-metering to net-billing, which entered into force on 1 April 2022. Despite the introduction of new forms of prosumption, the pace of growth in the number of prosumers has begun to slow down. This is the result of a combination of many factors [9].

Polish scholarship has so far tended to consider particular aspects of prosumer regulation separately. Existing studies discuss, among other issues, the replacement of net metering with net billing, the profitability of household photovoltaic installations and the implementation of energy communities. What is still missing is a broader assessment of how the different forms of prosumption operate when examined from the same perspective. This article brings together individual, collective, virtual and community-based models and considers each of them in terms of access to finance, administrative requirements, grid conditions, the predictability of settlements and the distribution of risk. It does not seek to establish how households actually make investment decisions. Rather, it examines the incentives and obstacles created by the legal framework and considers them alongside the findings of existing empirical studies [10].

A very important role in the rapid growth of interest in individual prosumption until 2022 was played by support programmes and subsidies. It was precisely these instruments, in combination with the earlier net-metering settlement system, that constituted the main driver of the development of citizen energy. These programmes increased the profitability of prosumption, but did not remove the fundamental entry barriers. A condition for benefiting from the forms of support offered by the Polish state was the possession of adequate capital or a property suitable for the installation of a micro-installation.

Consequently, the main beneficiaries were primarily owners of single-family houses. This leads to the conclusion that the development of prosumption in Poland was based on the transfer of capital to groups that already possessed the relevant material, financial, or technical resources [11].

However, the question remains of how to include in the energy transition process those who do not possess such resources. Consequently, the Polish legal system has been expanded to include the collective prosumer model, as well as the so-called tenant prosumer (prosumient lokatorski) settlement system and the virtual prosumer model.

In principle, these measures were intended not only as a response to the selective and preferential nature of the individual prosumer model, but also as an extension of access to prosumption for a much broader group of citizens [2].

In this article, we analyse whether the introduction of new forms of prosumption constitutes a sufficiently strong incentive to become a prosumer, and to what extent these models reduce significant entry barriers. This is a particularly important issue in the context of the growing importance of energy democratisation and energy justice. Some of the

provisions constitute the implementation of Directive (EU) 2018/2001 of the European Parliament and of the Council (RED II). The analysis also addresses the issue of the adequacy of the legal framework in relation to the realities of the Polish energy market [12].

In the context of the extremely rapid development of renewable energy technologies, the timing and speed of legislative action are of crucial importance. Under the widely accepted assumption that law often lags behind technological and market developments, this article also examines the legislator's response time to the dynamically changing energy ecosystem.

## 2. Materials and Methods

This article adopts a multi-faceted methodological approach that integrates dogmatic and legal analysis with a functional approach and the perspective of public policies oriented towards the implementation of just energy transition goals. The described combination of methods is aimed at reconstructing the current legal status and capturing the practical consequences of the analyzed regulations and their ability to support structural changes in the energy sector.

Dogmatic and legal analysis is the basic component of the study and consists of the systematic restoration of legal norms regulating the status of energy prosumers in the Polish legal system. It includes both the identification of sources of law and the interpretation of their content using classic directives of legal interpretation. Particular emphasis was placed on the provisions defining individual categories of prosumers and the conditions for their participation in the energy market, including the scope of their rights and imposed obligations. This analysis takes into account rapidly advancing legislative changes, in particular in the implementation of European Union law and the adaptation of national regulations to new models of energy market functioning.

The dogmatic analysis is complemented by a functional approach, which allows the assessment of regulatory instruments not only through the scope of their normative construction but also, above all, in terms of their real impact on the behaviour of market participants and the economic and organisational efficiency of the system. In this context, the subject of the analysis is mechanisms for supporting prosumers, in particular electricity billing systems, solutions enabling energy aggregation and sharing, as well as instruments conducive to the integration of distributed renewable sources into the electricity system. The functional approach therefore allows the capture of the tensions between regulatory objectives and their implementation in market practice, including the identification of potential institutional and technical barriers.

The research material covers key normative acts shaping the legal framework of prosumer energy in Poland. In particular, the provisions of the Act on Renewable Energy Sources and the Energy Law Act, as well as executive and regulatory acts relating to the functioning of the net billing system as the basic mechanism of prosumer settlements, were analysed. In addition, regulations on diverse models of market participation, including individual, collective and virtual prosumers, are taken into account, the design of which reflects the increasing complexity of the relationship between generation, consumption and energy management.

The legal analysis reflects the law in force as of 18 July 2026. The study focuses on legislation and official materials that directly govern prosumer status, settlement arrangements, access to the electricity network and collective forms of energy activity. The sources examined include the Renewable Energy Sources Act, the Energy Law Act, the principal amendments adopted between 2016 and 2025, relevant implementing legislation, explanatory documents and guidance issued by the Energy Regulatory Office and the competent ministries. The secondary literature was selected for its relevance to the economic position

of Polish prosumers, collective energy initiatives, barriers to participation, grid integration and comparable arrangements in other EU Member States. Where the sources diverged, the analysis relied first on the applicable legislation, followed by regulatory data and official documents. Academic literature and sectoral reports were used to examine the practical implications of the rules and to identify areas in which their operation remains uncertain.

The conclusions drawn in this article differ according to the type of evidence on which they rest. Some follow directly from the legislation, particularly the provisions governing eligibility, rights and obligations, settlement methods and procedural requirements. Others rely on existing empirical research into investment profitability, barriers to participation, municipal involvement and the operation of energy communities. The broader assessment of whether the Polish framework is likely to encourage inclusive participation represents the authors' interpretation of these legal and empirical findings. Accordingly, the article does not present associations or plausible effects as evidence of causation.

The scope of the analysis is also broadened by taking into account the legal framework for new organisational forms in the energy sector, such as energy cooperatives, energy clusters and civic energy communities. These forms are part of a broader trend of decentralisation and democratisation of energy systems, and their regulation is an important element of the implementation of the EU concept of active participation of citizens in the energy market. The analysis of these institutions allows the assessment of the extent to which national law supports the development of cooperation models and local energy initiatives.

In order to ensure consistency and comparability of results, a proprietary regulatory evaluation grid was developed, embedded in the paradigm of sustainable development and regulatory effectiveness. This grid includes five interrelated analytical dimensions. The first is access to finance and economic incentives, understood as the ability of regulations to create stable and adequate investment incentives. The second dimension is the simplification of administrative procedures, which includes the transparency of the procedure, the level of formal burden and the ease of use of support instruments by different groups of recipients.

The third dimension concerns the compliance of regulations with the technical constraints of the electricity system, in particular the ability of the grid to receive energy from distributed renewable sources and the integration of data and energy flows in near real time. The fourth element is the predictability and stability of settlement mechanisms, which are crucial for mitigating regulatory risk and enabling rational investment planning by prosumers. The last, fifth dimension is the fair distribution of risks between market participants, system operators and the regulator, which includes both economic issues and responsibility for ensuring the safety and stability of the system.

The adopted analytical grid serves not only as a tool for organizing the research material, but also as an interpretative framework to assess the extent to which the applicable regulations contribute to the construction of an energy system that is at the same time efficient, publicly accessible and resistant to disruptions. Thus, it allows us to move from a description of legal norms to a more in-depth reflection on their significance for the energy transition process in the long term.

The five criteria are applied to each model in the synthesis table following the discussion of the different prosumer statuses. Access to finance is considered in terms of both the initial investment and the availability of grants, loans or collective funding. Administrative simplicity refers to the number of parties involved, the agreements that must be concluded and the procedures that participants are required to complete. Grid compatibility encompasses the possibility of connection, metering and data-exchange requirements, as well as the capacity of the distribution network to accommodate additional generation. Settlement predictability concerns whether participants can understand and reasonably anticipate

the economic outcome of a given model. Finally, fair risk allocation examines how price, regulatory, organisational and infrastructure risks are divided among participants and other actors. As the available evidence varies considerably between the models, particularly those that have only recently become operational, the assessment remains qualitative. The table therefore uses the categories “favourable”, “mixed” and “constrained” rather than numerical scores.

### 3. Prosumers and Sustainable Energy Consumption: Conceptual and EU Context

#### 3.1. Prosumer as an Element of the EU's Energy Transition

With the progress of the energy sector and the evolution of the end user, there was a natural need to identify and clarify a new term, which is “prosumer”. However, this is not a simple or one-dimensional concept, as its importance has developed in parallel with the transformation of the energy market, EU law and the practice of the functioning of the national energy system.

The Polish legal system, based largely on the transposition of European Union directives, shows that the concept of a prosumer should be understood more broadly than just through the prism of a single statutory meaning. Depending on the type of prosumer, its legal position and practical role in the energy system, we can talk about different characteristics of this entity. So the question arises, what is a prosumer today and what elements make up its contemporary importance?

A prosumer is no longer only a consumer who generates part of the energy for their own needs. It is also increasingly becoming a figure of energy decentralization, civic participation and the transition from passive energy consumption to active participation in the energy system. Exploring the full meaning of the prosumer allows you to better understand the broader idea behind the EU's energy transition. Since the European Union promotes an active recipient, the development of prosumers, energy communities and the participation of citizens in the transformation, it becomes reasonable to ask whether Polish prosumer instruments really implement this direction in practice.

The problem, however, is that there may be a practical gap between the idea of prosumerism and the real availability of instruments under EU and national law [13]. This is where the fundamental Polish prosumer problem is revealed: on the one hand, the national legal system takes over the European idea of an active recipient and civic participation in the energy transition, but on the other hand, the practical implementation of this idea depends on the availability of specific legal, technical and organizational instruments. Therefore, it is necessary to understand the contemporary complexity of the prosumer as an entity that not only consumes energy, but can also generate, store, share, sell and participate in local forms of energy organization. It is the citizens who ultimately verify the effectiveness of prosumer models, showing whether they are truly encouraging, accessible and feasible in practice.

A prosumer in the sense of civic participation is no longer only a person who generates energy for their own needs. He can be understood more broadly as an ordinary citizen who joins a large energy system and begins to play an active role in it. He is no longer just a passive consumer of energy, but a participant who, through his own production, consumption of energy on site, and in the long term also its storage or sharing, contributes a specific good to the energy system.

Such a good can be partial relief of the system, greater use of energy at the local level and participation in energy balancing within one's own household or local energy community. In this sense, a prosumer should not be seen solely as an entity acting out of a desire to save or make a profit. He can also be seen as a participant in the energy transition,

who, through his energy decisions, implements a certain act of good practice towards the energy sector and sustainable development. A new type of civic attitude is emerging here, consisting of co-responsibility for the functioning of the energy system [14]. Civic participation can therefore be understood not only as individual energy production by a prosumer, but also as joining smaller forms of energy organization, such as energy clusters, energy cooperatives, civic energy communities and various types of prosumer models.

The literature indicates that modern energy systems in many countries are moving from a centralized model to a distributed model [15]. In this context, the prosumer can be understood as one of the most visible manifestations of this decentralization, as it combines the functions of a consumer, a producer and an entity managing its own energy consumption. This is another example of the broader importance of prosumer matter, which is no longer limited to the mere fact of producing energy for one's own needs. Through its actions, as well as through the sheer scale of the phenomenon in question, it becomes a real element of the energy system. According to URE data, at the end of 2025 there were 1,612,450 renewable energy prosumers in Poland, including collective and virtual prosumers [16]. Such a large number of prosumers and their geographical dispersion reinforce the importance of this status and allow us to interpret prosumerism as the transfer of part of the functions of the energy system to the local level.

The dispersion of prosumers has turned the end user into an active participant in the energy transition. This is important for decentralization, as energy is no longer produced only in large, central units, but also in households, local installations and smaller energy structures. In practice, this can support the country's energy security, the development of local energy self-sufficiency, shorter energy transmission, reduction in grid losses, greater use of renewable energy sources and increased awareness of citizens in the management of their own energy consumption.

Comparing the above meanings, it can be concluded that the prosumer best reflects the transition from passive energy consumption to active participation in the energy system. At the same time, it is not a simple concept for the average consumer, because modern law and practice distinguish different types of prosumers and different forms of their participation in the energy market. A similar direction of change is indicated by the literature on local energy systems, which emphasizes that citizens are moving away from the role of passive consumers and are starting to act as active prosumers and co-owners of distributed energy systems [17]. Therefore, the prosumer is not limited to the role of an energy consumer, but also becomes a participant in a broader organizational, social and technological change in the energy sector.

In European Union law, several forms of active participation of consumers in the energy market can currently be indicated, which form a broader background for the understanding of the prosumer [12]. These include, *m.in.*, renewable energy prosumers, renewable energy prosumers working together, renewable energy communities, active consumers, civic energy communities and energy sharing mechanisms developed in recent years. This shows that the EU's approach to the energy transition is no longer limited to increasing the production of energy from renewable sources, but is increasingly shifting the emphasis to the active participation of citizens in the energy market.

For this reason, national regulations should be assessed not only in terms of their formal compliance with European Union law, but also in terms of their ability to remove real barriers to participation. This applies in particular to financial, premises, administrative and network barriers, which may limit the possibility of using prosumer instruments by various groups of recipients. Residents of multi-unit buildings, tenants and people who do not have the appropriate technical or financial facilities to generate energy on their own are of particular importance here.

In this context, the key question remains whether Polish legal instruments really translate the EU model of an active recipient into practical possibilities of action. It is not only a matter of introducing certain concepts and institutions into national law, but of whether they are actually accessible, understandable and sufficiently encouraging for citizens. Only then can prosumerism serve not only as a technical mechanism for self-generation, but also as a tool for sustainable development, supporting access to clean energy, the development of local communities and climate action. Prosumer models understood in this way show that the Member States of the European Union are facing a similar challenge: how to translate the general European framework into national solutions that will work in practice. Therefore, the Polish prosumer problem should be considered not only as a question of the implementation of EU law, but also as a question about the practical inclusiveness of the system. Ultimately, it is important whether national regulations allow different groups of consumers to actually enter the role of an active participant in the energy transition, and not only formally provide for such a possibility.

The RED II Directive can be understood as one of the key acts shaping the broader understanding of the prosumer in European Union law. It is not limited to promoting the production of energy from renewable sources, but also describes the framework for the active participation of final users in the energy market. To this end, the Directive defines, *inter alia*, a “renewable energy prosumer”, “a group renewable energy prosumer” and an “energy community active in the field of renewable energy”. points to the need to create a regulatory framework that allows them to generate, consume, store and sell electricity without imposing excessive and disproportionate burdens. The reason for this approach is quite clear. Citizens living in apartments should be able to enjoy a stronger position as a consumer to a similar extent as households living in single-family houses.

Therefore, RED II allows for a distinction between individual prosumers and prosumers operating in groups, and such a distinction should be proportionate and duly justified. This is of practical importance, as it allows the prosumer model to be opened also to entities such as tenants, residents of multi-unit buildings or other consumers who would not have a real opportunity to participate in such a system individually. More broadly, this can also support tackling energy exclusion and increasing energy efficiency at household level, especially for low-income or vulnerable customers.

RED II thus creates a background for the EU model of the prosumer, which can also participate in the implementation of climate and energy goals. The directive provides for the protection of prosumers from discriminatory or disproportionate fees, but at the same time allows for certain restrictions if they are justified by the financial stability of the electricity system. This means that the EU model of prosumption is based on a balance between supporting civic participation in the transition and the need to maintain the security and stability of the entire system.

For the purposes of this part, it is therefore necessary to distinguish the basic categories of prosumer participation provided for in RED II. The first is the “renewable energy prosumer”, i.e., an end user operating within its facilities, within certain limits, who generates renewable electricity for its own needs. It may also, if the law of a Member State so permits, operate on other installations and store or sell electricity generated by itself. However, an important condition is that in the case of a prosumer who is not a household, these activities cannot constitute his or her core commercial or professional activity.

The second category is “group prosumers of renewable energy”. They mean a group of at least two renewable energy prosumers who work together and are located in the same building or multi-apartment building. This construction is of particular importance for residents of multi-unit buildings, as it allows for a departure from the prosumer model understood only as the owner of a single-family house with its own RES installation.

The third relevant category is “renewable energy community”. It is not a classic individual prosumer, but a broader form of local and community participation in renewable energy. It is a legal entity based on open and voluntary participation, independent and effectively controlled by members or shareholders located at a short distance from renewable energy projects. Participants may include individuals, small and medium-sized enterprises and local authorities. Importantly, the primary goal of such a community is not to make a financial profit, but to bring environmental, economic or social benefits to its members or to the local areas in which it operates.

The practical significance of these constructions lies in the fact that RED II does not stop at just naming the prosumer but gives it a specific position in the energy system. A prosumer has the right not only to produce renewable energy for their own needs, but also to store it, sell surpluses, use appropriate remuneration mechanisms and retain their rights and obligations as an end user. It is also important that the Directive allows for more flexible forms of operation, including the use of concentrators, renewable power purchase agreements and twinning solutions.

At the same time, RED II shows that the development of prosumption cannot be based solely on the formal granting of rights. It is necessary to create such regulatory conditions that will allow citizens to make real use of the prosumer model. In practice, therefore, the point is that the possibility of participating in prosumption is not limited only to persons with adequate funds, their own real estate and technical conditions for independent investment. In this sense, the importance of the prosumer must be understood not only by the possibility of energy production itself, but also by the question of whether different groups of consumers can actually take advantage of this opportunity. This is where the most important problem of the practical availability of prosumption begins, which is of particular importance when assessing national legal instruments.

A similar function is played by the regulations concerning renewable energy communities. They allow you to transfer some of your energy activity from the individual level to the community level. In such a model, energy can be produced, consumed, stored, sold and shared within a local structure. RED II therefore treats prosumption as part of a broader change, consisting of greater involvement of citizens, local communities and end users in the energy transition. Therefore, national legal instruments should be assessed not only through the prism of the formal implementation of EU law, but above all by whether they actually enable active, accessible and non-discriminatory participation of different groups of consumers in the energy market.

### 3.2. Linking Prosumption to the SDGs

The analysis of a prosumer should not be limited only to energy law. If a prosumer is understood as an active customer participating in the local cycle of energy production, use and trading, then its importance is naturally also connected with the idea of sustainable development. It is therefore not only a matter of a technical change in the way energy is produced, but also of a change in the way citizens participate in the energy market. In this sense, the prosumer can be treated as a practical element of sustainable energy consumption, as it moves the consumer from passive use of energy to a more conscious and responsible participation in its production and use.

The most obvious link concerns SDG 7, which is access to affordable, reliable, sustainable and modern energy. Of course, prosumer models do not solve the entire problem of access to energy on their own, but they can support this direction by increasing the share of renewable energy sources, local energy use and increasing energy efficiency. A prosumer who produces energy for their own needs or participates in a collective or community model becomes part of a broader mechanism to increase the share of clean energy in the

system. That is why prosumption fits well into SDG 7, especially where it is combined with the real availability of instruments for different groups of recipients [18].

The second important point is SDG 11, which refers to sustainable cities and communities. In this context, local models are particularly important, i.e., prosumers operating in groups, energy communities, energy clusters or other forms of organizing energy closer to citizens. Energy then ceases to be only a matter of large producers and the central system and begins to be organized at the local level as well. This is not only important for energy, but also for society, as it can strengthen the cooperation of residents, local responsibility, acceptance of RES and greater awareness of how energy is used. From this perspective, the prosumer becomes not only a technical unit in the system, but also an element of the local community that participates in the energy transition.

The third link concerns SDG 13, i.e., climate action. Prosumption based on renewable energy sources can support reducing dependence on traditional, high-carbon energy sources, and thus fit into the broader direction of climate policy. However, this should not be reduced only to the production of green energy itself. It is also important that the prosumer can participate in changing the model of energy consumption through their energy decisions, increase climate awareness and strengthen the local dimension of the transformation. As a result, prosumer activities go beyond the technical dimension, also gaining civic and educational significance.

Comparing the prosumer with the objectives of SDG 7, SDG 11 and SDG 13 allows us to look at it more broadly than just by producing energy for self-consumption. This design combines cleaner energy, local commitment, better use of resources and climate responsibility. Therefore, national solutions concerning prosumers should be assessed not only formally, but also by their relevance to the local and sustainable energy transition.

### 3.3. Comparison Table of 5 EU Countries

The comparison covers Spain, France, Germany and Italy. These countries were not selected as a representative sample of EU Member States, but because their legal frameworks offer specific points of reference for the problems identified in Poland. Spain and France have developed arrangements for collective self-consumption and local energy sharing, while the German Mieterstrom scheme is specifically intended to facilitate access to locally generated electricity for tenants in multi-unit buildings. Italy, in turn, combines collective self-consumption and renewable energy communities with dedicated public incentives. Each of these systems therefore addresses an issue that remains important in the Polish context, such as access for tenants and apartment residents, the organisation of collective settlements or the financing of shared installations. The comparison is intended to identify possible lessons for Poland rather than to rank national regulatory systems, and it follows the same practical-accessibility criteria as the analysis of Polish law.

Such a combination is also of broader importance from the point of view of European integration. Since the European Union creates a common framework for prosumers, it is worth analysing how these assumptions are then implemented in different Member States. This allows us to see both similarities and differences in domestic prosumer models. In the longer term, such an analysis may be conducive to better ordering and approximation of legal solutions where justified, so that the European energy market is not just a set of separate national concepts. It should be a space for real cooperation, exchange of experience and joint acceleration of the energy transition (see Tables 3 and 4).

**Table 3.** Comparison of Prosumer Participation Models in Selected European Countries.

| Country | The Main Form of Prosumers' Participation                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Conclusion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Poland  | The model is based on several prosumer statuses: individual prosumer, collective prosumer and virtual prosumer. This system is complemented by net-billing of energy, in which the value of energy fed into the grid and the prosumer deposit mechanism are of fundamental importance [19].                                                                                                                                                                                                                           | The Polish model shows a gradual expansion of legal forms of prosumption. It is no longer limited to the owner of micro-installations on their own roof. It also includes multi-unit buildings and a model of generating energy in a place other than its consumption. However, the practical availability of these solutions remains a problem, especially for recipients without investment capital, organizational facilities or the ability to go through settlement and administrative procedures on their own [20]. |
| Spain   | A model of individual and collective self-consumption of electricity, developed on the basis of Real Decreto 244/2019. This regulation defines the administrative, technical and economic conditions of self-consumption, as well as the rules for accounting for energy in collective self-consumption or in the model linked to the installation through the network. Energy sharing coefficients and the mechanism for compensating for surpluses are important [21].                                              | The Spanish model shows prosumption as a practical billing mechanism, and not only as the status of a customer with a RES installation. Its advantage is the possibility of organizing the joint use of local energy production. However, the problem may be the need to correctly determine the configuration of self-consumption, the rules of energy distribution and the relationship between participants, the network operator and the energy seller.                                                               |
| France  | Collective self-consumption. One or more producers and one or more final users may be linked within a legal entity organising energy sharing [22]. The model can include the same building, including residential buildings, or a wider local area as part of extended collective self-consumption [23].                                                                                                                                                                                                              | The French model shows that collective self-consumption is based on the cooperation of producers and consumers coordinated by a specific organizational entity. This enables local energy sharing, but at the same time increases the importance of formal organization, settlement and management of relationships between participants. The problem may therefore not be the idea of sharing energy, but the practical complexity of its implementation.                                                                |
| Germany | The Mieterström model, i.e., the supply of electricity generated from a photovoltaic installation placed on a building directly to the tenants or residents of that building. The solution is linked to the Mieterstromzuschlag instrument, an add-on provided in the EEG system for specific forms of energy supply from solar installations to end users [24].                                                                                                                                                      | The Mieterstrom model shows that prosumption can be transferred from the level of the individual owner of the installation to the level of a multi-unit building. This also allows consumers who do not have their own roof or an independent RES installation to participate in local energy. However, the organizational and accounting complexity of the model remains a problem, as it requires reconciling the interests of the building owner, the installation operator and the final energy consumers.            |
| Italy   | A model based on distributed self-consumption configurations, including renewable energy communities, groups of self-consumers acting together, and remote self-consumers [21]. Of particular importance are the CACER and TIAD mechanisms, which define the rules for energy sharing, access to an incentive tariff and the possibility of using public support [25,26]. The Italian system also links self-consumption configurations to the area of the same cabina primaria and to the procedures handled by GSE. | The Italian model shows an institutionalized approach to collective prosumption. Its advantage is that it links local energy sharing with a system of public incentives. On the other hand, the weakness may be a high level of procedural complexity and dependence on the fulfilment of the conditions required for a given self-consumption configuration.                                                                                                                                                             |

**Table 4.** Comparative lessons for practical accessibility.

| Country | Access Route                                                            | Administrative Accessibility                             | Financial Accessibility                 | Lesson for Poland                                                     |
|---------|-------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------|
| Poland  | Broad statutory catalogue                                               | High for collective/virtual models                       | Mixed, individual grants dominate       | Develop integrated implementation support and stable settlements      |
| Spain   | Collective self-consumption and surplus compensation                    | Moderate, sharing coefficients require coordination      | Mixed                                   | Simplify collective allocation and standardise participant agreements |
| France  | Collective self-consumption through an organizing legal entity          | Moderate to high                                         | Mixed                                   | Use a clearly identified organising entity for local sharing          |
| Germany | Mieterstrom for tenants                                                 | Moderate, supplier and billing duties remain significant | Targeted at tenants                     | Tenant-focused models require operational simplification              |
| Italy   | Collective self-consumption and energy communities linked to incentives | Moderate, formal configuration and GSE procedures        | Relatively strong public incentive link | Combine collective participation with dedicated incentives            |

Note: The assessment is qualitative and functional. It compares how selected arrangements address access for tenants, residents of multi-unit buildings and persons without an individual installation; it does not rank national systems as a whole.

## 4. From Net Metering to Net Billing: Changing the Economic Logic of Prosumption

### 4.1. Net Metering as a Simple but Invasive Legislative Mechanism

For several years, the Polish prosumer model has been associated primarily with the discount system, usually referred to as net metering. Its importance did not lie only in the fact that it provided an economically advantageous mechanism for settling the energy fed into the grid. Equally important was its simplicity of communication. For the average end user, the regulatory message was relatively easy to understand: energy not used at the time of production could be fed into the grid and then partially received at another time, within the legally guaranteed settlement factor. Such a model built the image of the grid as a peculiar, albeit imperfect, energy storage. From the perspective of the investment decision, this was important because the potential prosumer did not have to follow current market prices, understand the mechanisms of the wholesale energy market or calculate the value of energy introduced and consumed in different periods. In this sense, net metering has acted not only as an economic instrument, but also as an instrument for reducing regulatory and cognitive uncertainty [9,27].

Simplicity understood in this way was of particular importance in the initial phase of the development of prosumer energy [28]. An end-user who considered investing in a micro-installation evaluated it not only through the prism of the mathematical rate of return, but also through the prism of confidence in the stability of the system and the predictability of energy bills. The system of discounts limited the number of variables that had to be considered in this decision. Of course, this did not mean that it was a neutral system for the market and the power system. On the contrary, its design led to shifting part of the costs of network operation and energy balancing away from the individual prosumer. From the point of view of public policy, this was the price for the rapid launch of civic renewable energy. That is why net metering can be interpreted as a model that is strongly encouraging, but at the same time poorly correlated with the actual value of energy at the time of its introduction into the system [10,27].

At this point, two levels of evaluation should be distinguished. At the individual level, the rebate system strengthened the attractiveness of the investment because it reduced settlement risk and made future benefits more intuitive. At the systemic level, however, it could weaken incentives for self-consumption and flexible energy management, as the prosumer was not sufficiently motivated to consume energy at the time of its production. The transition to a value model was therefore a response to a real systemic problem. However, it should not be discussed solely as a technical adjustment of settlements. It was a change in the economic logic of prosumption: from a model based on relatively simple quantitative balancing to a model in which the value of energy, the moment of its delivery to the grid, the price of subsequent purchase and the ability of the prosumer to increase self-consumption are essential [27,29].

#### 4.2. The 2021 Reform and the Introduction of Value-Based Net Billing

The amendment to the Renewable Energy Sources Act of 29 October 2021 introduced an amendment that covered new prosumers with the net-billing system from 1 April 2022. The legislator provided for the protection of acquired rights, i.e., existing prosumers and those who submitted an application for the connection of micro-installations by 31 March 2022 could continue to benefit from the discount system for the period specified by law. New participants, on the other hand, were included in the value model, in which the settlement is not the amount of energy delivered and consumed, but the value of the energy fed into the grid and the cost of energy consumed later from the seller [30,31].

From a regulatory perspective, net-billing was intended to adapt the prosumer billing model to the rules of the energy market and to the EU assumptions of active participation of consumers in the market. The assumption is that the prosumer should receive remuneration closer to the market value of energy, and at the same time bear part of the costs related to the use of the network. This is a direction consistent with the logic of transformation from a passive recipient to an active market participant. However, such systemic coherence does not determine the strength of the incentive. The more the settlements reflect the market value of energy, the greater the share of the risk of price, production time and consumption profile is transferred to the prosumer. As a result, the prosumer becomes a more market-based entity, but at the same time must have more knowledge, better energy management tools, and greater resilience to the volatility of economic conditions [15,29].

In practice, this change weakened one of the most important advantages of the previous model, i.e., its predictability, especially in relation to less specialized end users. In net-billing, the profitability of an installation depends not only on the volume of production and consumption, but also on the relationship between the price of energy fed into the grid and the price of energy purchased by a particular prosumer. The difference between these values is the central problem of the new system. The prosumer sells the surplus at the price linked to the wholesale market, but takes energy at the retail price, which also includes components not related to the value of the active energy itself. As a result, the simple assumption of “you will produce and receive later” has been replaced by a more complex calculation: “you will produce, sell at a certain value, record that value in a deposit, and then use it to cover part of the cost of purchasing energy”. Such a design may be economically more rational for the system, but it is less obvious to the end user [27,32].

Thus, it seems logical that the economic literature on Polish prosumer installations after the change in the billing system indicates the growing importance of self-consumption and energy storage [33,34]. Cost-effectiveness simulations show that the use of energy storage can significantly increase the share of energy consumed on-site and thus improve the economic result of the investment. At the same time, energy storage means an additional input cost. As a consequence, net-billing may strengthen the model of the “active”

prosumer, who invests not only in photovoltaic panels, but also in control devices, energy storage or changing the consumption profile. On the other hand, it may have a weaker impact on recipients who expect a simple, understandable and low-cost mechanism to reduce bills [9,29].

#### *4.3. Market Responsiveness and the Weakening of the Mass Incentive*

The transition between two regulatory mechanisms, i.e., from net metering to net billing, is a good example of the relationship between the responsiveness of regulation to the market and its ability to mobilize citizens en masse. On the one hand, the legislator reacted to the limitations of the previous model, i.e., the need for a more market-based valuation of energy, the need to increase self-consumption, the problem of network costs and the requirements resulting from EU energy market regulations. On the other hand, the same reaction increased the complexity of the system for the end user. The prosumer is no longer only a customer with their own source of production; they become a participant in a price mechanism, the outcome of which depends on factors that are partly beyond their control [15,31].

This shift is important for the main thesis of the article. If the evaluation criterion is only compliance with the market logic of energy, net-billing can be considered a more mature solution than net metering. However, if the criterion is the ability of the law to encourage new end-users to become prosumers, the assessment becomes less clear-cut. A customer who does not have capital, does not know the mechanisms of the energy market, does not have an energy storage facility and cannot easily change the consumption profile may perceive net-billing as less safe and more difficult to estimate, and thus also less profitable. As a consequence, the reform may select participants: it is easier for people who are more aware, better equipped with capital and more inclined to actively manage energy. On the other hand, it works less well for those who have yet to be encouraged to use the prosumer model [35,36].

The data on the dynamics of the connection of micro-installations do not in themselves prove the causal impact of net-billing on investment decisions, as the market was simultaneously influenced by other variables, which include, in particular, m.in: inflation, financing costs, installation prices, subsidy programs and network constraints. However, they are consistent with the thesis that the pace of expansion has weakened. According to PTPiREE, in record-breaking 2021, operators connected over 396 thousand new micro-installations, while in 2025 nearly 92 thousand. PTPiREE data also indicate that since October 2021, data have been presented monthly, and previous data quarterly; the organization emphasizes that the vast majority of micro-installations are photovoltaic installations, and the dominant majority are prosumer micro-installations. This means that the data on micro-installations can be treated as an approximation of the dynamics of prosumerism, although they should not be unreservedly equated with the exact number of prosumers in the legal sense [37].

#### *4.4. Subsequent Corrections: Monthly Pricing, Hourly Pricing and the Prosumer Deposit*

Successive amendments to the laws show that the legislator has noticed the limitations of the original structure of net-billing. The amendment of 27 November 2024, which entered into force on 27 December 2024, restored the settlement of energy fed into the grid according to the market monthly electricity price (RCEm) for many prosumers if they started generating energy before 1 July 2024. At the same time, the possibility of voluntary choice of settlement according to the market hourly price (RCE) is provided. In addition, a mechanism has been introduced to increase the value of the prosumer deposit by 23%, and for prosumers choosing hourly settlement, the possible return of the unused value of the deposit has been increased from 20% to 30% [20,38].

These adjustments are crucial for two reasons. First, the restoration of the monthly average price for a specific group of prosumers reduces exposure to short-term fluctuations in hourly prices. The monthly average price is less precise from the point of view of the market signal, but more predictable for the prosumer. Secondly, the hourly billing option retains the incentive for more active prosumers who are able to adapt production, consumption and storage to market conditions. The legislator is trying to reconcile two models of a stabilizing nature: stabilizing, important for a typical end user, and dynamic, appropriate for a more advanced market participant [20,33].

Increasing the value credited to the prosumer deposit by 23% improves, to some extent, the terms on which electricity fed into the grid is accounted for against electricity purchased at a later stage. The additional amount is credited to the prosumer account and may be used to cover the energy component of subsequent electricity purchases. This does not, however, place exported and imported electricity on an equal economic footing. The retail price includes charges that cannot be settled through the deposit, while the use and refund of the accumulated funds remain subject to statutory limitations. The amendment therefore reduces part of the difference between the value of electricity sold and the cost of electricity purchased, but it does not eliminate price risk, reproduce the simplicity of net metering or ensure a specific return on investment. Its significance lies primarily in improving the economic position of prosumers rather than making the settlement system more predictable [29,32].

#### 4.5. Assessment: From a Protective Incentive to Conditional Market Participation

The change in settlement systems from net metering to net billing can therefore be seen as a transition from a protective incentive model to a conditional market participation model. In the first model, the regulatory guarantee of simple recovery of part of the energy fed into the grid was crucial. In the second model, the key is the ability of the prosumer to optimize: increase self-consumption, shift consumption, use energy storage, understand prices and respond to market signals. Such a direction is rational from the point of view of the stability of the power system, but it does not have to be sufficient from the point of view of the inclusiveness of the transition. The more regulation, knowledge and capital are required, the greater the risk that prosumption will develop mainly among those who were already willing and capable of it [15,36].

It is in this sense that net-billing illustrates the limits of regulatory responsiveness. Regulation may be responsive to the market, technology and systemic costs, and yet not sufficiently responsive to the constraints of real prosumers—especially those less qualified. For some end users, it is not crucial whether the price of energy fed into the grid better reflects the market value. The key is whether the mechanism is understandable, predictable, financially accessible and resistant to frequent changes. If the answer is uncertain, the law may create a formally correct model of prosumption, but not necessarily an effective incentive to become a prosumer. Such a conclusion does not lead to the postulate of a simple return to net metering. Rather, it leads to the conclusion that net-billing needs to be supplemented with instruments that reduce the risk of entry, i.e., stable rules, clear information, support for investments in self-consumption, energy storage and simplified tools for calculating profitability [35,39].

From the perspective of this paper, the most important thing is that the change in the settlement system should not be assessed solely through the prism of compliance with the market. It should also be assessed through the prism of the question of whether the average end user can rationally, without excessive risk and excessive information burden, decide to enter into prosumption. Net-billing improves the market-based billing logic, but weakens the simplicity of the original incentive. Subsequent adjustments, especially the return to

RCEm for many prosumers and the strengthening of the deposit, partially alleviate this problem. However, they do not change the main conclusion: the current model allows for prosumption in market-justified conditions rather than on its own, and sufficiently encourages new end users to become prosumers (see Table 5).

**Table 5.** Comparison Analysis of the Net Metering and Net Billing Systems.

| ANALYTICAL DIMENSION                | NET METERING/DISCOUNT SYSTEM                                                         | NET BILLING                                                                                                   |
|-------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>SETTLEMENT RATIONALE</b>         | Quantitative offsetting of electricity exported to and later imported from the grid. | Value-based settlement of electricity exported to the grid and electricity later purchased from the supplier. |
| <b>MAIN USER-FACING ADVANTAGE</b>   | Simplicity and predictability of the regulatory guarantee.                           | Closer alignment between prosumer remuneration and the market value of electricity.                           |
| <b>PRIMARY REGULATORY CONCERN</b>   | Potential system costs and weaker incentives for real-time self-consumption.         | Greater price volatility, informational burden and economic risk shifted to the prosumer.                     |
| <b>BEST-FITTED PROSUMER PROFILE</b> | A user seeking a relatively simple mechanism for reducing electricity bills.         | An active user able to optimise consumption, self-consumption, storage and response to price signals.         |

## 5. The Expanding Catalogue of Prosumer Statuses

### 5.1. Entry

Currently, the Polish legal system provides for three models of renewable energy prosumers: the individual prosumer, the collective prosumer, and the virtual prosumer. These models were introduced into Polish law in a phased manner, which was not free from significant delays [19].

It should be noted that a considerable amount of time may elapse between the adoption of an act by the Sejm of the Republic of Poland and its actual entry into force. The prosumer models are, in principle, a response to the dynamically changing renewable energy market. Some of them constitute the implementation of EU regulations, in particular Directive (EU) 2018/2001 of the European Parliament and of the Council (RED II) [12].

The common intention behind their introduction was to broaden access to prosumption for a wider group of citizens. The models differ primarily in terms of requirements, but they are also addressed to different categories of final energy consumers who wish to actively participate in the electricity market through energy generation [2].

This chapter is devoted to analysing whether the prosumer models functioning in Polish energy law constitute a genuine broadening of access to prosumption for new groups of citizens, or whether they were introduced primarily as a consequence of the obligation to align national legislation with EU law, without a real impact on the development of prosumer-based energy generation.

### 5.2. Individual Electricity Prosumer

The oldest and, for a long time, the only functioning prosumer model in the Polish legal system is the renewable energy prosumer, often referred to as the individual prosumer. As a separate prosumer model, it was introduced into the legal system on 1 July 2016 through an amendment to the Renewable Energy Sources Act. It is based on the assumption that the final consumer owns their own renewable energy micro-installation. In most cases, this is a photovoltaic installation; however, the Act also allows other forms of renewable electricity generation [1].

These may include, for example, small-scale hydro installations, wind installations, or systems based on biomass or biogas. The electricity produced by such micro-installations is primarily intended to cover the electricity demand of the household. Any surplus generation is settled under mechanisms provided by law, which since 1 April 2022 has been based on the net-billing system [16].

At this point, a key economic aspect emerges. The previously described change in the settlement system from net-metering to net-billing fundamentally altered the perceived profitability of entering the prosumer system. Even the most inclusive model will not develop if it faces a significant financial barrier. The moment of this change in the settlement mechanism substantially affected the economic viability of investments in renewable energy sources. The reason for this shift was most likely the excessively rapid increase in the number of prosumers, which began to pose challenges for the electricity transmission infrastructure [16].

Among all available models, the individual prosumer is by far the most popular solution. At the end of 2025, the Energy Regulatory Office reported that there were 1,612,172 renewable energy prosumers operating in the Polish system. The installed capacity of all individual prosumers exceeded 13 GW. The popularity of this model results primarily from its relatively simple operating principles. The prosumer has full control over the micro-installation, independently makes investment decisions, and directly benefits in a clearly observable way from the economic effects in the form of reduced electricity bills [40].

Additionally, this model was significantly supported by the aforementioned support programmes and subsidies. The most important were the “Mój Prąd” programmes: Mój Prąd 1.0, Mój Prąd 2.0, and Mój Prąd 3.0, implemented in the years 2019–2021. The first edition of the programme offered funding for photovoltaic micro-installations with an installed capacity ranging from 2 kW to 10 kW. The level of funding could amount to a maximum of PLN 5000, covering up to 50% of the total installation and installation costs.

The second edition of the programme operated under unchanged rules. However, it achieved greater success mainly due to increased public awareness. An additional factor was the development of photovoltaic technologies combined with a decline in installation costs. In the third edition of the programme, the maximum level of funding was reduced from PLN 5000 to PLN 3000, while maintaining the rule of covering up to 50% of eligible installation and installation costs [11].

Another key programme is the thermal modernisation tax relief (*ulga termomodernizacyjna*), which could be combined with the “Mój Prąd” programmes. It allows owners of single-family houses to deduct expenses related to building thermal modernization, including photovoltaic installations, from personal income tax (PIT). The deduction limit is PLN 53,000. However, this solution favors individuals with a certain level of income, enabling them to effectively utilize the tax deduction [41].

The rapid growth of household photovoltaics was supported by several factors, including relatively straightforward support schemes, falling installation costs and favourable net-metering rules. The pace of new investment slowed after 2022, around the time net billing was introduced, but this sequence alone does not establish a causal relationship. Investment decisions during that period were also affected by inflation, rising financing costs, changes in subsidy programmes, equipment and electricity prices, and increasingly visible grid constraints. The available data should therefore be read as indicating that prosumer investment became less dynamic under conditions of greater uncertainty, rather than as evidence that net billing was principally responsible for the slowdown [9].

Unfortunately, due to its structure and nature, this model is highly selective. In order to become an individual prosumer, a number of conditions must be met that are not directly related to the willingness to participate in the energy transition itself. A potential renewable

energy prosumer must have an appropriate property enabling the installation of a micro-installation or a sufficiently large plot of land on which it can be installed. In addition, in the case of photovoltaic panels, factors such as the roof angle of the building or the orientation of the potential installation may play an important role. Another aspect is the material from which the roof is made [42].

For example, the installation of photovoltaic panels on a roof made of asbestos cement (eternit) is legally prohibited in Poland for safety reasons [43].

Another important aspect concerns the financial capacity of a potential prosumer. A prospective investor must have sufficient capital or creditworthiness to cover the project costs. The financial factor is widely recognised as one of the key barriers to the development of prosumption. The purchase and installation of a micro-installation, together with energy storage and a heat pump, often represents an expenditure reaching or exceeding PLN 100,000. Such an amount corresponds to almost 21 gross minimum wages in 2026. For the majority of citizens, this constitutes an unaffordable expense. In this regard, the previously described support programmes have played an important facilitating role [44].

The next highly significant issue relates to the limitations associated with connecting new generation sources to the electricity grid. The underlying causes of this problem were described in the introduction. Although Article 7(1) of the Energy Law provides for an obligation to connect installations that meet technical and economic conditions, in practice many prosumers face refusals to issue connection conditions. The broad wording of the criterion concerning the lack of technical conditions in Article 7(1) of the Energy Law leaves distribution system operators considerable interpretative discretion [45].

It was only in Information No. 15/2024 issued by the President of the Energy Regulatory Office (URE) that it was indicated that system operators should not abuse refusals based on the lack of technical conditions [46].

However, such a refusal is not definitive in nature. The system operator may indicate the possibility of connection following potential infrastructure expansion. In such cases, a prospective prosumer seeking to connect new capacity to the grid may be charged a connection fee, which includes the costs of potential modernisation or expansion of the network. In most cases, these costs effectively prevent new prosumers from entering the system, although in some instances such an investment may become economically viable over a longer time horizon. This structure leads to a situation in which the ability to connect may depend on the level of capital available to the prospective prosumer.

An interesting and often overlooked factor is the competence barrier, characterised by what may be described as a lack of energy-related competencies. Behind this seemingly abstract term lie basic abilities required to independently carry out thermal modernisation or an investment as such. An average citizen, who in most cases does not possess comprehensive knowledge of micro-installations, must choose the technology, assess the economic viability of the project, identify a potential contractor for the installation of the micro-installation, and also complete the grid connection procedure and understand the principles of the energy settlement system. In principle, the market already offers comprehensive services that help overcome these competence barriers; however, this also creates a significant risk of intentional misinformation. Fraud in this area has become sufficiently widespread that incorrect installation practices or the deliberate sale of low-quality equipment have even entered Polish popular culture [47].

The renewable energy prosumer model clearly illustrates the issue addressed in this article. It highlights the distinction between formal and actual access to prosumption. From a legal perspective, almost any final consumer has the possibility of becoming an individual prosumer. In practice, however, this possibility depends on financial, technical, and organisational factors. The individual prosumer model plays a key role in Poland's

energy transition. However, an analysis of its structure leads to the conclusion that the benefits associated with this option are primarily available to individuals possessing specific economic, financial, technical, or competence-related resources. The undeniable quantitative success, reflected in 1.6 million prosumers at the end of 2025, does not necessarily imply a high level of inclusiveness of this solution. Following the idea of a just transition, both the Polish state and the European Union have identified the above-mentioned issues and introduced new prosumer models. However, the question remains whether these new models have effectively reduced entry barriers for potential future citizens interested in prosumption.

### 5.3. Collective Electricity Prosumer

The date 1 April 2022 is a date that not only brought the change from the net-metering system to net-billing, but also introduced the concept of the collective prosumer into the legal system. This was the result of the implementation of the RED II Directive, on the basis of which the Renewable Energy Sources Act was amended [30].

This model was primarily designed with residents of multi-apartment buildings in mind, who had previously been excluded from the possibility of participating in prosumption. Until that point, generating renewable energy in apartment buildings was effectively impossible. The collective prosumer model was intended as a response to this problem. The legal construction allows for the use of energy produced by an installation located on the roof of a multi-family building by multiple consumers simultaneously. Theoretically, this assumption removes the fundamental barrier related to access to a roof or surface suitable for installing a micro-installation. Under the RED II Directive, residents of apartment blocks, housing communities, and housing cooperatives were finally given the opportunity to participate in the energy transition. From the perspective of the democratisation of prosumption, this represented a necessary step. Currently, the definition of a collective prosumer is set out in Article 2(27c) of the Renewable Energy Sources Act. According to this provision, a collective renewable energy prosumer is defined as “a final customer generating electricity solely from renewable energy sources for their own needs in a micro-installation or small installation connected to the distribution network via the internal electrical installation of a multi-unit building in which the electricity consumption point of that customer is located.” [19].

In terms of its structure, the collective prosumer model is based on the generation of electricity from a renewable energy installation located on a multi-unit residential building or within infrastructure associated with such a building. In the vast majority of cases, this is a photovoltaic installation mounted on the roof of a multi-unit building. The electricity generated in this way is then allocated to several final consumers located within the same building. The key assumption is that of a single generation source and multiple consumers [19].

The main problem, and one of the key entry barriers of the collective prosumer model, is the need to determine the shares of individual participants in the electricity generated by the renewable energy installation. The Act assumes that when more than one collective prosumer participates in the same installation, the prosumers must conclude an agreement specifying their share expressed in percentage terms with accuracy to four decimal places. The maximum installed capacity corresponding to each share must also be defined. This means that it is necessary to establish precise proportions according to which the electricity generated will be accounted for in the settlement process. In practice, such a solution generates a number of serious problems, which effectively constitute a key blocking barrier [19].

The success of citizen energy projects based on shared infrastructure depends not only on technical, economic, or legal conditions, but also to a large extent on the relationships between potential participants in such projects. In the case of the collective prosumer model, cooperation between participants is a key aspect. The implementation of an investment or project requires a series of fundamental decisions concerning its financing and the rules for distributing the benefits resulting from electricity generation in a micro-installation. There are several factors that may generate conflict [48].

One of the key dividing factors among residents is economic considerations. Potential problems may arise from divergent interests or project visions among residents. Some may be primarily interested in long-term reductions in energy costs, while others may focus mainly on initial investment costs. Some may be willing to invest significant personal capital, while others may not be able to afford it. Investment costs may be covered from the renovation fund, from additional contributions by residents, from a loan taken out by the housing community or cooperative, or from a combination of several sources. Each of these options generates different legal and social consequences due to differing preferences and opinions. There is also an increased risk of procurement-related fraud.

Another important issue is the potential for neighbour conflicts or a low level of trust between residents. The establishment of an energy investment and a collective prosumer arrangement requires long-term decision-making. In addition, it is necessary to obtain acceptance of specific rules concerning co-responsibility for the functioning of the installation. In cases where social relations are strained, obtaining the consent necessary for project implementation may become a critical barrier [2].

The Act also provides for the appointment of a prosumer representative, which may generate further conflicts among residents. Despite this, such a provision is highly beneficial from a practical point of view, as the representative is often a competent person responsible for communication with the grid operator, building manager, or other entities essential for the functioning of this model [19].

An additional aspect of the social barrier, particularly common in Poland, relates to ideological differences. In the context of widespread misinformation, renewable energy technologies are sometimes deliberately demonised by parts of the political discourse. This has a significant impact on trust in green technologies, which in Poland are often the subject of social resistance. In a hypothetical investment involving 100 people, the risk of ideological conflict is considerable.

Another very important barrier is the ownership structure of multi-unit residential buildings. This is because it is subject to continuous changes resulting, for example, from the sale of apartments, the inheritance of ownership rights, or the conclusion of tenancy agreements. Another issue may arise from the division of ownership shares in an apartment that was previously owned by a single person. These problems are highly complex and could certainly constitute the subject of separate academic articles. Any changes to the terms of the agreement, including changes in ownership shares and the rules governing the withdrawal of participants from the system, must be specified in advance in the collective prosumer agreement [2].

The structure of the collective prosumer model therefore assumes a relatively stable composition of participants and the shares assigned to them. As a result, this model generates significant organisational costs related to the need to update agreements, verify ownership shares, and adapt settlement rules to changing factual circumstances.

#### 5.4. Tenant Electricity Prosumer

A breakthrough change was intended to be the introduction of the tenant prosumer institution on 1 October 2023. Importantly, the tenant prosumer is not a separate prosumer model operating under Polish law, but rather an electricity settlement mechanism. Upon analysis, it is difficult to resist the impression that the legislator sought to address some of the problems that emerged during the functioning of the collective prosumer model [49].

Both solutions are addressed to residents of multi-unit residential buildings and, in principle, are intended to enable their participation in the energy transition. However, the manner in which these objectives are achieved is fundamentally different. The primary and most significant advantage of the tenant prosumer solution is the simplification of the organisational structure of the entire undertaking. Under the collective prosumer model, it is necessary to determine the shares of individual participants in the electricity generated and to update those shares on an ongoing basis. As previously indicated, this gives rise to a considerable number of administrative and financial problems. The tenant prosumer mechanism eliminates this issue because the beneficiary is the housing community or housing cooperative as the entity managing the building, rather than the individual residents, as is the case under the collective prosumer model. Such a solution mitigates the aforementioned problems and eliminates disputes concerning individual shares in electricity generation [50].

It should be noted, however, that this significant organisational simplification was achieved at the expense of the individual character of the benefits. This was, however, inevitable, since it was precisely this individual character that was responsible for the paralysis of the collective prosumer model. Under the tenant prosumer mechanism, the benefits are indirect in nature and relate primarily to the multi-unit residential building. Residents benefit from the investment through reduced building management costs or lower charges associated with the operation of the common areas. Unlike under the collective prosumer model, they do not receive an individual share of the electricity generated in proportion to their allocated shares. Another key change was the departure from the solution under which surplus electricity generated could only be used to reduce electricity bills. Under the tenant prosumer mechanism, the value of the electricity fed into the grid may be paid directly into the account of the tenant prosumer, for example, a housing cooperative. Such a solution allows the funds obtained to be allocated to purposes such as the renovation fund, reducing property-related costs, or covering expenses associated with the operation of the building [50].

From a purely axiological perspective and from the perspective of the democratisation of prosumption, the introduction of the collective prosumer model should be assessed positively. It is a solution that, for the first time, enabled residents of multi-unit residential buildings to genuinely become prosumers. From the perspective of a just energy transition, the collective prosumer model should be regarded as a necessity resulting from the low level of inclusiveness of the individual prosumer model. At the same time, the model is not without its shortcomings, which were recognised and subsequently addressed by the legislator through the introduction of the tenant prosumer mechanism.

However, when the above-mentioned requirements and entry barriers associated with the collective prosumer model are confronted with reality, the results are alarming. According to data published by the Energy Regulatory Office, by the end of 2025 only six collective prosumers were operating within the Polish electricity system. This is a catastrophic result and provides a clear answer to the research question posed in the introduction. It is not possible to demonstrate the practical advantages of this model, because apart from these six cases, the model simply does not exist in practice. This

example clearly illustrates the phenomenon of a dead legal provision—a regulation that formally exists within the legal system but, in reality, functions in only six cases [16].

#### 5.5. Virtual Electricity Prosumer

The third and final prosumer model in the Polish legal system is the virtual prosumer. Just as the collective prosumer model was intended to address the shortcomings and limitations of the individual prosumer model, the virtual prosumer model was designed to overcome the limitations of both of the earlier models. Among the three solutions, the virtual prosumer model is the most interesting and, at the same time, the most abstract. Whereas the individual prosumer and the collective prosumer remain, to varying degrees, linked to the physical place of electricity consumption and to the property where the electricity consumption point is located, the virtual prosumer model is based on the complete separation of the place where electricity is generated from the place where it is consumed. In this sense, it departs from the traditional understanding of a prosumer, who in most cases owns photovoltaic panels installed on the roof of their property [19].

The definition of the virtual prosumer was introduced into the Renewable Energy Sources Act by the amendment of 29 October 2021. It is currently set out in Article 2(27b), according to which a virtual renewable energy prosumer is a final customer generating electricity exclusively from renewable energy sources for their own needs in a renewable energy installation connected to the electricity distribution network at a location other than the place where electricity is supplied to that customer. As a result, the final customer may participate in electricity generation without the need to locate the renewable energy installation at their place of residence. At this point, it is once again worth acknowledging the legislator's attempt to overcome the barriers that affected the previous prosumer models [19].

In practice, the virtual prosumer model may involve a situation in which a final customer living in a multi-unit residential building, who does not own a roof or land, acquires a share in a renewable energy installation located outside their place of residence, while the electricity generated is settled against their electricity bill. The virtual prosumer therefore removes the spatial barrier and the need to own a suitable area for the installation. This solution also opens the way to prosumption for citizens who possess such resources but are unable to carry out the investment process themselves or simply do not wish to install renewable energy systems on their roofs or other suitable property [51].

From a technical perspective, this model is based on assigning a specific amount of electricity generated by an installation located elsewhere to a final customer at their point of electricity consumption. It should be noted that the legislator introduced certain limitations. The maximum generation capacity assigned to the electricity consumption point of a virtual prosumer may not exceed 50 kW and, moreover, may not exceed the contracted capacity assigned to that electricity consumption point. In addition, the virtual prosumer settles electricity under rules similar to the net-billing system. The prosumer pays the distribution charges for the electricity delivered to the consumption point, while the electricity generated by the remote installation is settled in accordance with the mechanism provided for prosumers [52].

Although the virtual prosumer model was introduced into the Renewable Energy Sources Act by the amendment of 29 October 2021, its actual entry into the Polish legal system did not take place until 2 July 2025. This date coincided with the entry into operation of the Central Energy Market Information System (CSIRE) [53].

The considerable time gap between the introduction of the model and its actual implementation may appear surprising. However, this resulted from several factors. From the outset, the legislator treated the virtual prosumer as a solution requiring substantially

greater preparation of the settlement system and a more complex implementation process on the part of system operators than the earlier prosumer models. In this respect, it is also worth recognising the extensive public consultation process and the fact that conclusions were drawn from the shortcomings of the previous models.

The legal changes concerning the virtual prosumer do not end there. From 20 October 2026, the provision requiring installations assigned to a virtual prosumer to be located within the service area of a single distribution system operator will be abolished. This is, of course, a beneficial change for the model itself [54].

The virtual prosumer model requires the creation of a settlement mechanism based on the relationship between an installation and a final customer located in different places. This solution requires the involvement of distribution system operators and the adaptation of IT systems to ensure the correct allocation of electricity shares and the proper settlement of prosumers who are not physically connected to the place where the electricity is generated. At the same time, when explaining the time required to develop these mechanisms, it should be noted that the previous absence of the virtual prosumer model effectively left citizens confined to a highly selective system.

In theory, the virtual prosumer is a highly inclusive solution, removing most, if not all, of the entry barriers described in this article. From the perspective of a just energy transition, it is also an outstanding solution. At the end of 2025, there were 272 virtual prosumers in Poland. At first glance, this may appear to be a very small number. However, it should be borne in mind that this model only became fully operational in the middle of 2025, while further liberalising legal changes are already on the horizon. Therefore, this figure should not lead to the same negative conclusions as in the case of the collective prosumer model [16].

### 5.6. Summary

The analysis carried out leads to the conclusion that successive amendments to the Renewable Energy Sources Act did not so much remove the barriers to entering or participating in presumption as gradually shift them to different areas. In the individual prosumer model, financial and property-related barriers predominated; in the collective prosumer model, the main obstacles were organisational, institutional, and administrative; whereas in the virtual prosumer model, issues related to market organisation have become of fundamental importance.

This means that expanding the catalogue of prosumer models does not automatically lead to an increase in the number of prosumers unless it is accompanied by the simultaneous removal of the actual barriers to entry. The best example is the collective prosumer model, which, after more than four years of operation, resulted in only six collective prosumers.

It should therefore be concluded that, until the virtual prosumer model became operational in practice, the Polish legal system remained highly selective and markedly non-inclusive. On paper, these models existed within the legal framework governing renewable energy, but this had virtually no impact on their actual uptake in practice.

The situation, however, remains dynamic and may change significantly as further amendments to the virtual prosumer model are introduced. There is little doubt that this model offers a substantial opportunity to resolve many of the key problems that have so far limited the development of presumption (see Table 6).

**Table 6.** Qualitative assessment of Polish prosumer and community-energy models.

| Model                    | Access to Finance                                                         | Administrative Simplicity                                   | Grid Compatibility                                    | Settlement Predictability                 | Risk Allocation                                              |
|--------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------|
| Individual prosumer      | Constrained by upfront capital; grants and tax relief partly mitigate     | Relatively favourable                                       | Mixed; connection and voltage limits                  | Mixed; net billing increases uncertainty  | Price and investment risk largely borne by prosumer          |
| Collective prosumer      | Mixed; shared investment possible                                         | Constrained by agreements, shares and representation        | Mixed; requires metering and DSO coordination         | Mixed                                     | Organisational risk shared among participants                |
| Virtual prosumer         | Potentially favourable for persons without a roof; capital still required | Constrained by allocation, contracts and data procedures    | Dependent on CSIRE and DSO systems                    | Mixed; net-billing logic applies          | Market and organisational risks remain with participants     |
| Energy cooperative       | Collective funding and preferential settlement may help                   | Constrained by formal establishment and governance          | Mixed; local balancing may help                       | Relatively predictable but model-specific | Risks pooled, but management burden is significant           |
| Energy cluster           | Project-specific; often institutionally financed                          | Constrained by coordination and formal cluster requirements | Potentially favourable for local balancing            | Dependent on support design               | Coordinator and members bear substantial implementation risk |
| Citizen energy community | Potentially inclusive, but finance mechanisms remain underdeveloped       | Constrained by legal form, registration and governance      | Mixed; depends on activities and network arrangements | Not yet established in practice           | Risk allocation depends heavily on governance design         |

Assessment basis: binding legal requirements, official implementation data and the secondary literature discussed in Sections 4–7. “Mixed” indicates that the model removes one barrier while creating or retaining another. The table does not represent an empirical ranking of user preferences.

## 6. Civic and Collective Forms of Organisation

### 6.1. Why Are Collective Forms Needed?

From the definitions and observations cited so far regarding the individual prosumer in the Polish energy system, one important conclusion can be drawn. Individual prosumption does not solve all the problems related to citizens’ participation in the energy transition. The answer to these limitations can be civic and collective forms of organization. In the Polish system, energy cooperatives, energy clusters and civic energy communities can be distinguished as forms that can compensate for the weaknesses of individual prosumption.

Not every customer has the infrastructure or budget to build a PV installation, wind installation, energy storage, generator or heat pump. Funds for the investment are not available to every citizen immediately. Often, the lack of appropriate technical knowledge that would allow you to go through the entire process on your own is also a problem. However, the quintessence of the problem is also the time that must be spent on various types of procedures or formalities.

The function of these forms is that they transfer prosumption from the level of a single person to the level of a local organization. They allow for connecting recipients, producers, local government units and local stakeholders within one organizational model. However, this does not mean that they are a simpler alternative to an individual prosumer. In practice, they transfer some of the problems from the level of the individual to the level of organization, management, financing and compliance with EU law, including state aid rules.

At this point, a research question can be asked: do energy cooperatives, energy clusters and citizen energy communities really increase citizens' access to the energy transition, or do they create more advanced instruments that can only be used by well-organized local actors?

## 6.2. Energy Cooperatives

Energy cooperatives appear to be one of the most civic forms of collective prosumption. Their meaning lies in the local production of energy and its consumption by the members of the cooperative. It is therefore a model based on cooperation, trust and common energy interest. Unlike an individual prosumer, this is not only about a single customer and his own installation, but about an organized group of people or entities who jointly try to respond to their energy needs [55].

In the Polish legal system, an energy cooperative has been linked to the structure of a cooperative within the meaning of the Cooperative Law or a farmers' cooperative. Its activity is primarily the production of electricity, biogas, agricultural biogas, biomethane or heat in renewable energy source installations, as well as their trading or storage. However, it is important that this activity be carried out for the benefit of the cooperative itself and its members [19]. So the essence of this model can be seen already here. An energy cooperative is not an ordinary energy company focused on selling energy externally, but a form of local organization that is primarily intended to serve its own members.

Such a structure may limit some of the obstacles typical of individual prosumption. A cooperative allows you to distribute the organizational and financial burden over a larger group. In this sense, it can increase access to the energy transition for people who would not be able to enter the prosumer model on their own. On the other hand, this does not mean that a cooperative is a simpler solution. It requires members, management, financing, settlement, relations with the distribution system operator and energy seller, as well as meeting registration requirements.

The territorial nature of the energy cooperative also remains a significant limitation. So far, this model has been strongly linked to rural and urban-rural areas and to local scope. This shows that the energy cooperative was designed as a tool for smaller local communities rather than as a universal instrument for all consumers. For this reason, the direction of changes aimed at extending the possibility of functioning of energy cooperatives also to urban municipalities is of particular importance. This could increase the importance of this form for residents of cities, multi-unit buildings and local housing communities. It should be noted, however, that the effectiveness of such a solution depends on the compliance of the support mechanism with the rules of state aid and on the assessment of the European Commission.

A practical barrier is also the fact that an energy cooperative must operate within a specific formal framework. It requires entry in the National Court Register, and then its data being included in the list of energy cooperatives kept by the competent authority. Only after meeting these conditions can it start the activity proper to an energy cooperative. It is therefore clear that the civic nature of this form does not exempt it from a fairly high level of formalization. For well-organized local entities, this may be passable, but for the average group of residents, it can be a significant barrier to entry.

The assessment of the attractiveness of a cooperative is also influenced by the settlement mechanism. The cooperative benefits from preferential rules, including certain exemptions from part of the fees, but at the same time it does not operate on the same principles as a classic individual prosumer. The literature points out that the settlement of energy in a quantitative ratio of 1 to 0.6 is less favourable than the previous system of discounts provided for some individual prosumers. In addition, the lack of free possibility

to sell energy to entities outside the group of members remains a limitation. If a cooperative wanted to conduct such sales, it could lose some of its preferences and be treated as an energy company.

For this reason, an energy cooperative is a form with great potential, but also with clear limitations. It can compensate for the weaknesses of individual presumption because it shifts the burden of investment and organization onto the group. At the same time, it itself requires a high level of local cooperation, knowledge, funding and efficient management. Its greatest advantage is its community character and the possibility of building local energy self-sufficiency. Its greatest weakness, however, is that not every citizen or group of residents will be able to create and maintain such a structure.

### 6.3. Energy Clusters

Energy clusters differ from energy cooperatives in that they are not a typical civic community form. Rather, they should be understood as a mechanism for coordinating local energy market stakeholders. Local governments, entrepreneurs, energy producers, consumers, public institutions, scientific units and other entities operating in a specific area can meet in a cluster. Therefore, the cluster is not a separate legal entity, but a form of cooperation based on a civil law agreement.

Its importance lies primarily in organizing cooperation between entities that could operate separately on their own, but together they can better respond to local energy needs. The cluster can be used to develop renewable energy sources, increase local self-consumption, better link energy production with local demand and support local balancing. In this sense, it has an organizational and coordinating function. It does not form a membership community in the sense that a cooperative does, but it can bring together different entities around a single energy goal.

It is worth noting that the wide design of the cluster can be both its advantage and weakness. On the one hand, it allows for the flexible inclusion of many different participants, including municipalities, entrepreneurs, consumers and energy producers. On the other hand, the lack of legal personality and the fact that the operation is based on agreement make the way the cluster is managed and the role of its coordinator of great importance. It is the coordinator who represents the cluster and is responsible for the practical arrangement of cooperation between its members. If the rules of this cooperation are unclear, the cluster may remain more of a formal agreement than a viable tool for local energy transition.

The territorial nature of the cluster is also important. According to the Renewable Energy Sources Act, its activity is linked to a specific local area, generally not exceeding the boundaries of one county or five municipalities. This shows that the cluster is to be a distributed energy instrument, operating close to the place where energy is produced and consumed. Such a solution fits well with the idea of local energy use, but it can also give rise to interpretation and organizational problems, especially when entities with a wider range of activities participate in the cluster.

Support for energy clusters, especially in the form of discounts or preferences for distribution fees, is not only a matter of national decisions of the legislator. Such instruments may need to be assessed from the perspective of energy market rules, the cost-effectiveness of distribution tariffs and state aid rules. This is an important legal issue as it shows the tension between the need to support local distributed energy and the obligation to comply with EU competition and energy market rules.

For this reason, an energy cluster can be assessed as a form with a high organizational potential, but less directly civic than an energy cooperative. It can support local balancing, the development of RES and the cooperation of many entities, but its effectiveness depends on the real activity of the participants, the position of the coordinator and the stability of

support mechanisms. In practice, a cluster can therefore be a good tool for local transformation, but it will not always be a simple instrument for the participation of the average citizen in the energy market.

#### 6.4. Citizen Energy Communities

Civic energy communities can be considered as the closest form to the EU idea of an active consumer and citizen participation in the energy market. Unlike the cluster, which is more of a coordinating and institutional nature, CECs were conceived as a model for the participation of citizens, local authorities and smaller actors in the energy system. Their importance lies not only in organizing energy production, but also in creating a space in which the end user can act more consciously and actively.

CECs are an attempt to transfer the EU concept of citizen energy community to the Polish legal system. In Polish law, they have been included in the Energy Law as an entity with legal capacity, based on voluntary and open participation. It is also important that decision-making and control powers are to belong to certain categories of participants, primarily natural persons, local government units and micro and small entrepreneurs, for whom activity in the energy sector is not their core business activity [56]. Already at this level, it is clear that the legislator wanted to distinguish CEC from typical energy companies.

The primary goal of a citizen energy community should not be to make a financial profit. Rather, its purpose is to provide environmental, economic or social benefits to the members, shareholders or local areas in which it operates. This is very important from the point of view of the entire analysis. CEC is therefore not just another form of doing business on the energy market. It is to be a structure that combines energy with local social and economic interests.

The range of possible activities of CEC is quite wide. It may include, *m.in.*, generation, consumption, distribution, sale, trading, aggregation and storage of electricity. It may also apply to energy efficiency projects, electric vehicle charging services and other energy services. In this sense, CEC has a wider potential than classically understood prosumption. It is not limited to the production of energy for own needs, but may include various elements of local energy management.

It is also important that the civic energy community can operate in various legal forms. It can be, *for m.in.*, a cooperative, a housing cooperative, a housing association, a specific partnership or a farmers' cooperative. This catalogue is closed. This is of practical importance, because CEC is not one rigid organizational form, but a model that can be embedded in different legal constructions. On the one hand, this increases flexibility. On the other hand, it requires good organization and a conscious choice of the form of action.

Compared to energy cooperatives and energy clusters, CECs seem to be more in line with the EU's thinking about civic participation in the energy sector. Existing forms, such as energy cooperatives and energy clusters, have not always fully corresponded to the model of local energy communities resulting from the European Union law. This was primarily due to subjective, geographical and organizational limitations. CECs are therefore intended to partially fill this gap and create a clearer framework for citizen participation in the energy market.

However, this does not mean that regulation alone is enough to develop this model. In practice, the importance of CECs depends on whether they will be used in reality by citizens and local entities. The key here is the simplicity of the establishment, access to financing, relations with the distribution system operator, the method of settlement, professional organizational support and clarity of formal obligations. Without these elements, the CEC may remain a legal structure that looks good in the regulations, but does not translate into mass participation of citizens in the energy transition.

The territorial scope of the CEC's operation is also a certain limitation. It may operate in the area of a single distribution system operator to whose network installations belonging to its members, shareholders or partners are connected. Compared to an energy cooperative, this model is broader and more flexible. At the same time, Poland has not decided to allow the cross-border operation of the CEC, despite the fact that Directive 2019/944 left this possibility to the Member States. This shows that the Polish regulation implements the basic EU model, but does not use all available instruments.

The obligation to enter the CEC in the list maintained by the President of the Energy Regulatory Office is also of significant importance. Only after such an entry can the civic energy community start operating in this formula. On the one hand, this allows the state to maintain control over new entities operating in the energy market. On the other hand, it means another procedure that needs to be undergone. This is where the problem of practical accessibility arises again. The more extensive the formal requirements, the greater the risk that CEC will be used mainly by well-prepared and professionally supported entities.

From the perspective of this article, the civic energy community is therefore a form of very high theoretical and systemic importance. It most fully reflects the idea of active participation of citizens, locality and joint action in the energy sector. At the same time, its practical significance depends on whether it is equipped with clear, useful and realistically accessible mechanisms of action. The CEC can be an important tool for a sustainable energy transition, but only if it does not remain just a formal legal construction.

## 7. Municipalities as Conveners and Intermediaries

The development of prosumer models should not be seen solely as a problem of statutory definitions, billing rules or the availability of RES technology. Even if the law formally recognizes an individual, collective or virtual prosumer, the transition from legal possibility to actual participation often requires an intermediary entity that can translate complex regulatory, technical and financial solutions into projects that can be applied locally. In this sense, municipalities can be of particular importance: not only as entities performing public tasks, but also as integrators, trust builders, entities providing reliable information and coordinators of local energy initiatives. The literature on energy communities emphasizes that local roots, multi-level governance and institutional support are conditions for the development of citizen forms of energy [39,57,58].

The importance of municipalities results primarily from the nature of barriers limiting the development of prosumption. Access to financing, lack of technical knowledge, complexity of procedures, uncertainty of settlements and difficulties in organizing joint decisions do not disappear only because the legislator creates new legal statuses. These barriers are particularly visible in multi-unit buildings, where the decision to invest depends not only on the will of one end user, but also on the principles of managing the community or housing cooperative, the method of sharing benefits and costs, the relationship with the distribution system operator and the energy seller. Research on community energy indicates that intermediaries are often necessary where bottom-up initiatives do not have sufficient legal, organizational or financial capacity to launch a project on their own [58–60].

Therefore, a commune may perform an enabling function, different from the one performed by the law itself. The legislator can create a collective or virtual prosumer structure, but it is the municipality that can help residents determine whether a given model is technically feasible, economically rational and organizationally feasible to carry out in specific local conditions. In this approach, the municipality reduces the distance between the abstract regulatory project and the practical participation of residents. The results of research on municipal support for energy cooperatives in Germany and Switzerland show

that local authorities can reduce some of the barriers to the development of such initiatives, especially when they are themselves a member or an active partner of the project [60].

The first dimension of this role is informative. Municipalities can provide neutral information about available RES technologies, billing rules, public support programs and the legal consequences of participation in a collective or community model. This is especially important after the transition from net metering to net billing, as the new model has increased the cognitive burden borne by the end user. A resident considering participating in a prosumer project must understand not only the cost of the installation, but also the expected level of self-consumption, the value of energy fed into the grid, the price of energy consumed later, the importance of energy storage and the risks associated with future changes in law and prices. In the literature, public intermediaries of the energy transition are described as entities that help potential users of technologies such as photovoltaics to go through the adoption process and reduce decision-making uncertainty [35,61].

The second dimension is organizational. A municipality may coordinate entities that would have a limited ability to cooperate without an external coordinator, e.g., residents, property managers, local entrepreneurs, energy cooperatives, cluster coordinators, municipal companies, network operators and energy sellers. Collective renewable energy projects are generally not individually feasible. They require a legal form, internal rules, data exchange, investment preparation, settlements and dispute resolution mechanisms. Research on local RES cooperatives indicates that local entities can perform managerial functions consisting in mobilizing residents, mediating between citizens and administration, providing contextual knowledge and initiating changes accepted locally [62,63].

The third dimension is advisory and technical. The municipality may create or support local energy advisory points, prepare model documentation, assist potential prosumers in assessing the feasibility of the investment, or indicate buildings suitable for the installation of photovoltaic installations. It can also aggregate demand by organising joint purchases or standardising procedures for residents and public buildings. Such activities are particularly important for less experienced entities, which formally can become prosumers, but are practically unable to go through the investment preparation process on their own. In the literature, the role of municipalities in the development of renewable energy communities is described as encompassing legal, technical, economic and social components, including co-management of projects and support for their implementation [64,65].

The fourth dimension is investment. Municipalities can use their own buildings, land or municipal companies to initiate local RES projects. The roofs of schools, offices, cultural institutions, sports facilities, water supply or heating infrastructure can become assets that support or even condition wider energy cooperation. This is especially important for people who do not have the technical capabilities to install the installation. It is precisely such groups that are to be covered by collective and virtual prosumer models. International analyses indicate that local energy communities can support the development of renewables, reduce bills, strengthen systemic resilience, generate local jobs and build more inclusive energy systems [57,65].

The fifth dimension is coordinating and strategic. Municipalities can combine prosumer initiatives with local climate plans, energy efficiency programs, anti-smog policies, building renovation strategies and measures to reduce energy poverty. This is important because prosumer law considered in isolation can in practice bring the greatest benefits to households that already have capital and knowledge. The municipality, on the other hand, can include prosumer and community instruments in a broader local transformation strategy. The literature indicates that the development of energy communities requires not only national and EU regulation, but also local rooting and multi-level coordination [57,66].

The importance of municipalities is also increasingly clearly noticed in Polish legislation. The amendment to the Renewable Energy Sources Act of 17 August 2023 modified the legal framework of energy clusters and formalised their functioning. In the amended model, the party to the energy cluster must be at least a local government unit, a capital company established by a local government unit or a company controlled by such a municipal company. This means that the participation of a local public entity is no longer only one of the possible organizational variants, but has become an element of the legal structure of the energy cluster [49].

The obligatory participation of a local government unit or a municipal entity can be assessed in two ways. On the one hand, it strengthens the public law rooting of the cluster and reduces the risk that the cluster becomes a purely private commercial agreement loosely linked to local needs. On the other hand, there is a risk that the development of the cluster will depend on the administrative capacity, financial condition and political priorities of the municipality. This is particularly important in Poland, where municipalities differ in human resources, investment experience, energy competence and project financing opportunities. Comparative studies on municipal support for energy cooperatives show that local support does not appear automatically, and its effectiveness depends, among m.in, on the real involvement of the municipality and national institutional conditions [58,60].

Such a legislative choice is significant. It suggests that the legislator recognizes the need for local roots of clusters and assumes that a municipality or municipal entity can increase the credibility, stability and public value of cooperation. The new definition of a cluster includes cooperation in the generation, storage, balancing of demand, distribution or trade in electricity or heat, and its aim is to achieve economic, social or environmental benefits or to increase the flexibility of the electricity system. Sources discussing the Polish amendment also point to the formalization of the cluster agreement, requirements for the coordinator, the area of operation and the points of consumption and introduction of energy into the grid [67].

However, the role of municipalities should not be idealized. Local governments may not have the specialized staff, legal knowledge, financial resources or data needed to run complex energy projects. They may also fear liability for projects exposed to regulatory changes, price fluctuations, network restrictions, and residents' dissatisfaction. Smaller municipalities may have more difficulties than large cities because they have weaker organizational facilities and less negotiating power. The literature on local energy transition strategies indicates that municipalities need tools, data, and institutional capacity to effectively manage the decentralized transition [57,68].

A separate limitation concerns the relationship between the activity of municipalities and market neutrality. If a municipality integrates residents, selects technology partners, supports joint purchasing or participates in a cluster, it must take into account the risks associated with public procurement, state aid, competition, accountability and transparency. Polish government announcements on energy clusters show that the design of financial support for clusters is sensitive to EU internal market law and tariff rules, especially when discounts in distribution fees are considered. The fact that, following the comments of the European Commission, work is being carried out on the modification of the cluster support system shows that local energy cooperation must be designed within both national and EU regulatory constraints [69].

Despite these limitations, municipalities remain one of the most likely bridges between formal prosumer models and real citizen participation. Their value does not consist in replacing individual initiative or private investment, but in reducing the transaction costs of entering into presumption. The municipality can create a local environment in which residents obtain information, identify reliable partners, understand the available models

and participate in projects whose management is not left solely to market actors. This is especially important when the goal is not only to increase the number of installations, but also to make prosumption more socially inclusive. Research on energy communities indicates that they can support a more just transition, but they face barriers related to the diversity of participants, the extent of national support and local roots [39,57].

From the perspective of this article, the role of municipalities supports a broader argument: regulatory responsiveness is not sufficient if it is not accompanied by institutional mediation. Polish law increasingly recognizes various forms of prosumption, including collective and virtual solutions, as well as civic forms of organizations such as clusters and energy communities. However, these models may remain virtually distant for many end users if no entity translates them into investable, understandable and locally manageable projects. Municipalities are not the only possible intermediaries, but they are in a special position because of their democratic legitimacy, knowledge of local conditions, access to public property and the ability to coordinate the various actors. The amended regulations on energy clusters, requiring the participation of local governments or a municipal entity, can therefore be read as confirmation that decentralised energy models need territorial public rooting [49,67].

The conclusion is not that every municipality should become a participant in the energy market in the strict sense. Rather, municipalities should be seen as institutional entities enabling practical and safe prosumerism. They can make legal models more useful by reducing information barriers, supporting collective organisation, making assets available or mobilising, helping with financing, and linking energy initiatives to local climate and social policies. Without such trusted intermediaries, many prosumer models may remain available in law, but difficult to achieve in practice. With the participation of municipalities, prosumer regulation is more likely to move from formally enabling to actually encouraging and, in some cases, empowering end-users in a sustainable energy transition.

## 8. Discussion: Why Regulatory Responsiveness May Not Be Enough

The analysis distinguishes between three functions that regulation may perform. At the most basic level, the law may enable participation by creating a legally recognised route into prosumption. It may go further by encouraging participation, particularly when it reduces the costs, uncertainty and procedural difficulties associated with an investment. Regulation can be described as empowering when it enables people who would otherwise lack the necessary financial, technical or organisational resources to make practical use of the available legal arrangements. This distinction provides the basis for assessing the Polish framework as a whole, rather than evaluating particular settlement mechanisms or prosumer categories in isolation.

Polish law has made considerable progress in opening different routes into distributed renewable-energy generation. In addition to the individual prosumer, the legislation now recognises collective and virtual prosumption, while energy cooperatives, clusters and citizen energy communities provide further forms of participation. This does not mean, however, that every model is equally accessible. As the qualitative assessment in Table 6 shows, each arrangement removes some barriers while retaining or creating others. The individual model is relatively straightforward but continues to depend heavily on property ownership and access to capital. Collective and virtual prosumption can include people without a suitable roof or installation site, but requires more complex coordination, data exchange and settlement arrangements. Community-based forms may spread costs and facilitate local balancing, yet their operation depends on effective governance and professional support.

A similar tension can be seen in the replacement of net metering with net billing. Net metering provided households with a comparatively simple and predictable incentive but offered limited encouragement to increase self-consumption and placed part of the resulting network and balancing costs on the wider system. Net billing was introduced partly in response to these concerns. By linking the value of exported electricity more closely to market prices, it favours active management of production, consumption and storage. At the same time, it leaves prosumers more exposed to price fluctuations and requires them to understand a considerably more complex settlement system. The reform is therefore better understood as an attempt to address system-level problems than as an unqualified improvement or deterioration in the position of prosumers. Its effects on accessibility are likely to differ between groups of end users.

The statistical evidence must be approached with similar caution. The number of new prosumer connections began to grow more slowly after the introduction of net billing, but the available data do not make it possible to isolate the effect of the settlement reform. During the same period, investment decisions were influenced by changes in subsidy programmes, inflation, interest rates, technology costs, electricity prices and the availability of grid capacity. Nor do the available curtailment figures establish a link between household prosumption and the reduction in renewable output. Those figures relate to wind farms and non-prosumer photovoltaic installations. Their relevance here is limited to showing the broader difficulties experienced by the electricity system in accommodating growing volumes of variable renewable generation.

The comparison with other Member States points to several possible ways of improving practical accessibility. The Spanish and French experience illustrates the value of clearly structured collective self-consumption arrangements and an identifiable entity responsible for organising cooperation between participants. The German Mieterstrom model creates a route for tenants to benefit from locally generated electricity, although its operation also demonstrates how supply and billing obligations can discourage participation. Italy not only shows that collective self-consumption and renewable-energy communities can be supported through dedicated financial incentives but also confirms that funding alone does not remove procedural complexity. None of these arrangements can simply be transferred to Poland. They nevertheless suggest that formal recognition is more likely to produce wider participation when it is accompanied by standardised governance arrangements, practical implementation support and financing adapted to collective projects.

Against this background, the assessment of the Polish framework is necessarily qualified. Polish renewable-energy law has responded to developments in EU law, electricity markets and energy technology, but it has been less consistent in addressing the circumstances of potential participants. Wider participation is unlikely to follow from the introduction of additional legal categories alone. It also requires affordable financing, manageable procedures, adequate grid access, reasonably stable settlement rules and a distribution of risk that does not place a disproportionate burden on individual end users. Unless these conditions are addressed together, the range of legally available models may continue to grow without substantially widening the group of people able to use them in practice.

### *Limitations*

Several limitations of the study should be noted. The article examines the legal framework and related policy choices on the basis of legislation, official documents and existing research. It does not include original survey or interview data, nor does it attempt to estimate the causal effects of particular reforms on prosumer uptake. References to how potential prosumers may respond to complexity, profitability or risk should therefore be understood as interpretations based on the structure of the law and the findings of

earlier empirical studies, rather than as direct evidence of household behaviour. A further limitation arises from the pace at which Polish prosumer law continues to change. The analysis reflects the legal position as of 18 July 2026, and later amendments may affect some of its findings. There is also still little operational evidence on collective and virtual prosumers or citizen energy communities. Finally, comparisons between Member States must be treated with caution because national systems differ in their electricity-market structures, tariff arrangements, housing patterns and forms of public support.

## 9. Policy Implications

The recommendations arising from the analysis can be grouped according to the five criteria used throughout the article. Some could be implemented through relatively limited legislative or regulatory changes, while others depend on longer-term investment in infrastructure and institutional capacity.

### 9.1. Access to Finance

Financial support should be better aligned with the circumstances of households that cannot cover the initial cost of an installation or make effective use of tax-based incentives. Possible measures include income-related grants, preferential loans, public guarantees and financing arrangements designed specifically for housing communities, energy cooperatives and virtual-prosumer projects. This would address a structural weakness of the Polish framework, which still tends to favour property owners with sufficient savings, borrowing capacity or taxable income. Over time, support should also move beyond subsidies for individual items of equipment. Financing generation together with storage, demand management and participation in collective projects would better reflect the way prosumer systems now operate.

### 9.2. Administrative Simplicity

Collective and virtual prosumption will remain difficult to use unless the procedures associated with these models become more straightforward. Standard agreements, model resolutions and uniform data requirements could reduce both legal uncertainty and the cost of preparing a project. Participants would also benefit from a single digital procedure covering registration, the allocation of generation shares and communication with sellers and distribution system operators. The respective responsibilities of prosumer representatives, coordinators, sellers and DSOs should be set out more clearly. Experience from other Member States also suggests that collective projects operate more effectively when one identifiable entity is responsible for organising the arrangement and communicating with market participants.

### 9.3. Grid Compatibility

Further prosumer growth will depend increasingly on the condition and capacity of the distribution network. In the short term, the connection process could be made more transparent. Applicants should receive clear reasons for a refusal, accessible information about available network capacity and predictable rules on the allocation of reinforcement costs. These matters can be addressed through changes in regulation and regulatory practice. They will not, however, remove the underlying infrastructure constraints. Investment in low- and medium-voltage networks, smart metering, energy storage and flexibility services will be necessary over a longer period. These measures extend beyond the scope of prosumer legislation, but without them the practical value of new participation models will remain limited.

#### 9.4. Settlement Predictability

Prosumer investment requires a reasonable degree of confidence that the applicable settlement rules will not change repeatedly during the expected lifetime of an installation. Future reforms should therefore provide adequate transitional arrangements and explain their likely economic and distributional consequences. Information supplied to prospective investors should be based on standardised calculators that present realistic ranges of possible outcomes rather than a single expected return. The function of the prosumer deposit also needs to be communicated more clearly. The deposit improves the value credited for electricity fed into the grid and reduces part of the difference between the value of electricity sold and the cost of electricity purchased, but it does not eliminate that difference or guarantee the profitability of an installation.

#### 9.5. Fair Risk Allocation and Institutional Support

The legal framework should avoid placing the full burden of price changes, data management, project coordination and network limitations on individual participants. This is particularly important in collective and virtual arrangements, where residents may have little control over the actions of coordinators, sellers, DSOs or other members of the project. The distribution of responsibilities and risks should therefore be made explicit in legislation and standard contractual documents.

Municipalities and other trusted intermediaries may help address some of these problems, but their involvement cannot be taken for granted. Local authorities need access to technical assistance, model documentation and funding if they are to organise collective projects, make municipal assets available or support groups with limited financial and organisational capacity. Polish legislation already recognises the importance of local-government involvement in the framework governing energy clusters. The experience discussed in this article indicates, however, that formal participation by a municipality is not enough. Effective intermediation requires dedicated staff, technical knowledge and stable institutional support.

Three measures appear particularly suitable for early implementation: standardising the procedures applicable to collective and virtual prosumers, improving access to finance for households and multi-unit buildings, and providing clear and stable information about settlement rules. Network modernisation, the development of flexibility markets and the strengthening of municipal capacity will necessarily take longer. Distinguishing between these two groups of measures would allow immediate legal shortcomings to be addressed without losing sight of the structural reforms needed to support broader participation in the future.

## 10. Conclusions

Polish renewable-energy law now provides considerably more opportunities for participation than the individual rooftop model on which prosumption initially developed. Alongside the individual prosumer, the legislation recognises collective and virtual prosumption and provides a framework for energy cooperatives, clusters and citizen energy communities. The expansion of these legal forms is important, but the assessment undertaken in this article shows that it has not removed the practical barriers to participation. The individual model remains most readily available to property owners with sufficient investment capacity. Collective and virtual arrangements can extend access to people without a suitable roof or installation site, but their operation depends on more demanding organisational, data-sharing and settlement procedures. Community-based forms may allow resources and risks to be shared, although their success requires stable governance and institutional support.

The replacement of net metering with net billing reflects the legislator's attempt to address genuine concerns relating to self-consumption, the allocation of system costs and the balancing of the electricity network. The new model nevertheless makes the economic outcome of an investment more dependent on market prices, consumption patterns, storage and the ability to manage energy actively. Subsequent amendments, particularly the restoration of monthly pricing for eligible prosumers and the increase in the value credited to the prosumer deposit, have partly improved the position of participants. These changes do not, however, restore the simplicity or predictability associated with the earlier settlement system.

The findings therefore suggest that Polish law has become more effective at creating legal routes into prosumption but has been less successful in making those routes equally usable by different groups of end users. The effectiveness of the framework should not be judged simply by the number of prosumer models recognised by statute. A more relevant question is whether participation is financially attainable, administratively manageable, compatible with existing grid conditions and supported by reasonably predictable settlements and a fair distribution of risk. In the short term, this requires simpler procedures for collective and virtual arrangements, better-targeted access to finance and clearer information on settlement rules. Over the longer term, wider participation will also depend on grid investment, stronger municipal capacity and institutions able to organise and support collective projects.

These conclusions must be read in light of the scope of the study. The article examines legal design and draws on existing empirical research, but it does not measure household investment decisions or establish the causal effect of net billing on prosumer uptake. Further research should therefore combine legal analysis with surveys, interviews and operational data from particular prosumer models. This is especially important for collective and virtual prosumption, where practical experience remains limited. Such evidence would make it possible to determine more precisely whether the broader formal availability of prosumer models is leading to wider participation in practice.

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