Generating Change Locally: Energy Communities as a Pillar of Energy Sovereignty and Civil Society in Poland

KATARZYNA CZEREWACZ-FILIPOWICZ[1,a,*], KATARZYNA IWIŃSKA[2,3,b], AGNIESZKA KONOPELKO[4,c], JUSTYNA KOZŁOWSKA[5,d]
[1]Director of the Institute of Management and Quality Science,
Bialystok University of Technology,
POLAND

[2]Łukasiewicz Research Network - ITECH,
Institute of Innovation and Technology,
POLAND

[3]Civitas University,
POLAND

[4]Department of Management, Economics and Finance,
Bialystok University of Technology,
POLAND

[5]International Department of Logistics and Service Engineering
Bialystok University of Technology
POLAND

[a]ORCiD: https://orcid.org/0000-0002-5987-2896
[b]ORCiD: https://orcid.org/0000-0002-7337-915X
[c]ORCiD: https://orcid.org/0000-0002-6454-087X
[d]ORCiD: https://orcid.org/0000-0001-5164-4023

**Corresponding Author*

Abstract: - This article explores the role of energy communities in Poland as a pillar of local energy transition, energy sovereignty, and civil society development. Against the backdrop of EU climate and energy policies—including RED II, RED III, and Electricity Directives—it analyses the legal, institutional, and socio-economic conditions shaping their formation. The study highlights challenges such as regulatory incoherence, infrastructural and cultural legacies, and limited citizen engagement. By reviewing energy transition indices and readiness frameworks, it identifies a research gap: the absence of context-sensitive tools for assessing the maturity and development needs of energy communities, which hampers the design of tailored interventions and policies. To address this, the paper proposes an original conceptual framework for assessing community energy maturity in Poland. The framework bridges the gap between EU strategic goals and local implementation needs, offering a practical foundation for diagnostic tools and policy recommendations adapted to post-socialist contexts.

Key-Words: - energy communities, energy transition, energy autonomy, energy resilience, energy citizenship, sustainable development, local governance, analytical tools, Poland.

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1 Introduction

The energy transition has become one of the key challenges facing contemporary Europe, driven by the necessity to combat climate change and ensure energy security amid growing geopolitical instability. The European Union (EU), through a series of strategic documents such as "A Competitiveness Compass for the EU" [1] and "The

European Preparedness Union Strategy" [2], emphasises that this process must be based on local engagement, diversification of energy sources, and the creation of enabling conditions for the development of energy communities (ECs).

In Poland, as in all EU countries, the energy transition is being implemented under the National Energy and Climate Plan (NECP), [3]. However, despite ambitious goals for emission reduction and the increased share of renewable energy sources (RES), the process faces numerous systemic, institutional, economic, and social barriers, [4], [5], [6], [7].

In response to the challenges of the transition, climate change, and the need to decentralise energy systems, the importance of ECs as new actors in the energy market is steadily growing. Energy communities represent a novel institutional framework within the European Union's energy transition strategy, allowing groups of energy users – such as households, local authorities or small and medium-sized enterprises – to collectively organise and manage energy generation, distribution, and consumption. These entities are designed to operate based on democratic participation and local ownership, with the primary objective of meeting the energy needs of their members in a manner that is both environmentally sustainable and reliant on RES. By fostering decentralised energy production and promoting community engagement, ECs contribute to enhancing energy security, reducing greenhouse gas emissions, and supporting socio-economic development at the local level, [1].

ECs are also gaining new relevance in the context of deglobalisation, disruptions in global supply chains, and the increasing frequency of energy-related crises, including large-scale blackouts in Europe. In such a volatile environment, locally anchored energy systems offer a resilient and flexible solution to ensure the energy security of communities. Their potential to enhance self-sufficiency and reduce external dependencies makes them a strategic energy and civil security policy component, [8].

Despite the growing recognition of their role and the increasing number of registered communities (for instance, energy cooperatives, Figure 1), the development of ECs in Poland faces significant obstacles. First, there is a visible shift of responsibility for achieving energy transition goals onto citizens and communities, who – given the state's ambiguous policy stance, fragmented legislative environment, and the burdens of historical cultural and infrastructural legacies – are facing considerable difficulties in establishing local energy initiatives. Second, the current legal and regulatory framework is incoherent: the provisions regarding ECs are fragmented, incomplete, and often inconsistent with other laws governing the energy sector and local government operations. Third, for years, many citizens have perceived that the energy transition results in more costs than benefits, negatively impacting their willingness to engage and participate in community energy projects.

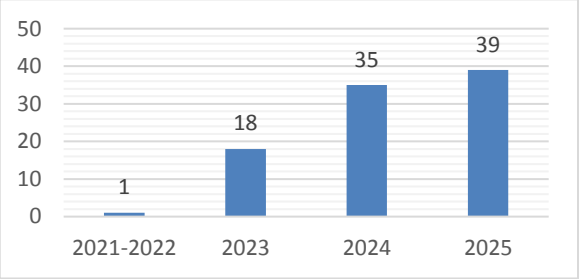

Fig. 1: The number of energy cooperatives in Poland
Data Source: [9]

This article examines the importance of ECs in Poland to support local energy transition, strengthen energy sovereignty, and foster civil society's development. Building upon policy and literature review, this article analyses the functions and potential of ECs, taking into account their legal, socio-economic, and institutional perspectives. Particular attention is given to identifying research gaps and deficiencies in the current indicators and measurement tools used to assess local energy maturity and the readiness of municipalities to establish and support ECs, as a form of contribution to building resilient, sustainable, and participatory local energy systems.

2 Legislative Provisions on Energy Communities

2.1 EU Regulations

Energy communities have become a key instrument for achieving the dual objectives of climate and social policy within the European Union. By promoting the collective generation, distribution, and consumption of renewable energy, they support the decarbonization targets of the European Green Deal and the Fit for 55 legislative package, [10]. Recognised in the Renewable Energy Directives (RED II, RED III) and the Electricity Directives, they form a core element of the EU's energy transition, supported by a regulatory framework

promoting the integration of RES and the decentralisation of energy production and management. These legal instruments impose specific obligations on Member States concerning developing RES and advancing energy communities.

Table 1. Evolution of the EU Legal Framework for Energy Communities

Aspect	RED II (2018/2001)	Electricity Directive (2019/944)	RED III (2023/2413)
Community Type	Renewable Energy Communities (RECs)	Citizen Energy Communities (CECs)	Renewable Energy Communities (RECs)
Legal Status	Legal entity	Legal entity	Legal entity
Participation	Voluntary and open	Voluntary and open	Voluntary and open
Control	Members or shareholders	Members or shareholders	Members or shareholders
Primary Objective	Environmental, economic or social	Environmental, economic or social	Environmental, economic or social
Market Access	Non-discriminatory access	Non-discriminatory access	Enhanced market integration
Grid Access	Right to be connected	Right to be connected	Promoted through simplified procedures
Ownership Rights	May own/establish/purchase/lease	May own/establish/purchase/lease	Encouraged through supportive frameworks
Consumer Protection	Not specified	Rights retained as consumers	Not specified
Admin. Support	Not specified	Not specified	Simplified procedures & increased targets

Source: Own elaboration based on [13], [14], [15]

The general provisions of Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action [11], as well as Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the Internal Market for Electricity [12], address the issue of ECs in the broader context of active energy consumers, prosumers, and policy measures aimed at facilitating the integration of RES and emerging technologies into the energy system. Although these legal acts do not provide an explicit definition of the term ‘energy communities’, their provisions may be interpreted as a legal foundation for developing and supporting such entities within the framework of the Energy Union. Specifically, concerning national planning and reporting obligations, the regulations refer to objectives and measures promoting the non-discriminatory participation of renewable energy, demand response, and energy storage, including via aggregation, across all segments of the energy market, as well as ensuring consumer engagement in the energy system and enabling the benefits associated with prosumption and innovative technologies.

The evolution from RED II [13] to RED III [14] demonstrates the EU’s commitment to empowering energy communities. While RED II laid the groundwork by defining Renewable Energy Communities (RECs) and ensuring their market access, the Electricity Directive (2019/944) [15] introduced a broader framework for Citizen Energy Communities (CECs), emphasising voluntary participation, local control, and non-commercial objectives. RED III builds upon these foundations by setting more ambitious renewable energy targets and simplifying administrative procedures to facilitate the creation and operation of energy communities. This progression reflects a holistic approach to integrating decentralised energy solutions into the EU’s energy landscape (Table 1).

2.2 Poland's Legislative Frameworks on Energy Communities

Poland’s legal framework on energy communities is fragmented and only partially aligned with EU directives. While RED II and the Electricity Directive introduced definitions of Renewable and Citizen Energy Communities, Polish law does not fully transpose these concepts, leading to legal ambiguities.

Energy communities in Poland may adopt various legal forms, including cooperatives, associations, or clusters, yet each operates under separate legal regimes (e.g., Energy Law [16], RES Act [17]), with inconsistent provisions. Energy cooperatives, for example, are limited to operating within specific geographic boundaries and a single DSO network. Energy clusters, although legally defined, lack integration into the national energy market mechanisms (Table 2).

Furthermore, there are no binding obligations on DSOs to cooperate with communities, and administrative procedures remain overly complex. The absence of a coherent support system – including financial incentives and simplified prosumer settlement rules – has significantly

hindered the growth of ECs. Surveys highlight that community members face legal uncertainty, financing difficulties, and a lack of administrative and technical capacity.

Table 2. Legal Frameworks and Operational Scope of Polish Energy Community Models

Form	Legal Basis	Participants	Scope of Activities	Key Limitations
Energy Cooperative	RES Act + Energy Law	≥10 individuals or ≥3 legal entities	Generation storage, trading of RES	Limited to 3 neighboring municipalities and one DSO
Citizen Energy Community	Civil and Energy Law	Natural persons, SMEs, LGUs	Energy services, RES generation	Not fully recognized in national law
Energy Cluster	Energy Law	At least one LGU or municipal company	RES, heat, electricity cooperation	Not integrated into energy market

Source: Own elaboration based on [16], [17], [18], [19]

These shortcomings underscore the urgency of systemic reform and the development of tailored diagnostic tools that address both legal and operational dimensions of energy communities in Poland.

3 The Role of Energy Communities in Strengthening Local Resilience, Autonomy and Civil Society

Currently, in the EU, ECs are recognised as mechanisms for fostering social inclusion, empowering citizens, and strengthening local governance. They reflect core principles of a just transition by aligning decarbonisation efforts with social equity, economic justice, and community resilience, [1], [20]. ECs can be seen as a manifestation of civil society, understood as the sphere in which citizens organise independently of the state and the market to collectively pursue social, economic, or environmental objectives. As such, ECs exemplify grassroots engagement in the energy transition, reflecting democratic participation, local empowerment, and community-driven sustainability efforts, [21]. Their primary aim is not profit maximisation but the production, distribution, and consumption of energy – typically from RES – for the benefit of their members. Participation in such initiatives fosters collaboration, mutual trust, and solidarity among local residents, strengthening the social fabric and contributing to the broader development of civil society, [22], [23]. Moreover, energy communities play a critical role in enhancing local energy autonomy and resilience. Through decentralised renewable energy production, they reduce dependence on centralised and often vulnerable supply chains, mitigating risks associated with geopolitical and market disruptions. Local energy initiatives are capable of adapting rapidly to changing conditions, including energy shortages, price volatility, or infrastructure failures. According to the European Preparedness Union Strategy [2], fostering local energy ecosystems is essential for building societal resilience against future crises, such as disruptions in energy supply, cyber-attacks, and climate-related disasters. In this context, energy communities are not merely tools for decarbonisation but act as strategic pillars of adaptive capacity and local self-reliance. From an economic and social perspective, ECs generate significant local benefits. They create multiplier effects within local economies by retaining energy expenditures locally, stimulating demand for regional services, and creating jobs in renewable energy sectors such as installation, maintenance, and management, [24]. At the same time, they enhance democratic participation by involving citizens directly in decision-making processes related to energy production and distribution, thus strengthening local governance and social cohesion. Furthermore, they contribute to combating energy poverty by offering more affordable and stable energy pricing, facilitating energy access for low-income households, and promoting solidarity-based financial models, [25]. The geopolitical context, particularly the Russian aggression against Ukraine in 2022, has profoundly reshaped Europe's energy landscape, [26]. The war exposed Europe's vulnerability to external energy suppliers and triggered a dramatic surge in fossil fuel prices, reinforcing the urgency of accelerating the energy transition, [27]. Simultaneously, global trends such as deglobalisation and the fragmentation of supply chains have prompted a reevaluation of energy strategies, with increasing emphasis on localised production and energy sovereignty. The recent blackouts and grid instabilities reported across Europe – such as the 2025 pan-European blackout incident [28] – highlight the risks associated with highly centralised, interconnected energy systems lacking adequate resilience measures. In this volatile environment, energy communities are emerging as crucial nodes for building robust, decentralised, and flexible energy infrastructures capable of withstanding geopolitical and systemic shocks.

3.1 Energy Citizenship as a Civil Society Manifestation in Energy Transition

One of the measurements for energy transition readiness and energy communities' development is the agency of citizens as central actors of an energy democracy, [29]. The concept of energy citizenship, introduced nearly two decades ago [30], captures the increasing role of civil society in the energy transition. This concept is predicted on the assumption that societal change relies on the active engagement of individuals who are well-informed and capable of influencing sustainable energy futures through their behaviours, rights, and responsibilities, [31].

Energy citizenship scholarship emphasises individual responsibility and motivation for action, promoting a shift from passive energy use to active participation in sustainable practices. This includes developing energy literacy, adopting efficient consumption behaviours, and embracing personal accountability in the energy system. A key dimension of the concept is its focus on behaviour and consciousness. It advocates for voluntary, self-regulated actions that foster energy awareness, often encouraged through public goods, individual contributions, and benefits, [32], [33], [34]. Participation is framed both as an individual and collective endeavour. While rooted in personal engagement, energy citizenship encompasses collaborative models such as energy communities and cooperatives, which support local prosumerism and democratic involvement in energy governance.

Collective energy citizenship is typically supported by one or more leaders and change-makers who influence the broader group. The dynamics and processes among various stakeholders, as well as the inclusive form of governance, are key social aspects that must be managed to effectively organise and stimulate the energy citizenship into action. For example, the concept was used in the context of grassroots mobilisation and anti-fracking activism in Żurawlów (Poland), which arose in response to proposed shale gas extraction. Researchers observed that the engagement of local actors with the production of lay expertise was shaped by residents' interactions with NGOs and public institutions, thereby fostering long-term environmental and energy engagement, [32]. On the other hand, other Polish case studies focus on energy citizenship built upon trust and willingness to act and benefit from energy production that leads to building renewable energy communities, [35]. Another example is the Denmark case that has a long-standing tradition of community ownership in wind energy projects, where citizen involvement has been crucial to the success and acceptance of renewable energy initiatives, [31]. According to recent research [36], the main factors encouraging individuals to act as active energy citizens encompass five interrelated dimensions. First, socio-political drivers play a crucial role, as active participation in decision-making, community engagement, and political involvement are key motivators. Empowerment is fostered through cooperation among citizens, civil society, and authorities, as well as through social networks and collective action, all of which support engagement and prosumerism. Second, economic drivers are significant, with financial incentives and economic benefits from participation in energy communities or prosumer activities serving as important motivators. However, economic barriers such as financial uncertainty and insufficient (public/institutional) support can limit participation, particularly among lower socio-economic groups. Third, environmental drivers, including heightened awareness of ecological crises, climate change, and a sense of responsibility to protect the environment for future generations, strongly motivate individuals to engage in renewable energy initiatives and complement economic considerations. Fourth, psychological drivers, such as altruism, openness to change, moral values, curiosity, interpersonal trust, and peer influence, shape pro-environmental attitudes and underpin the willingness to participate in energy citizenship. Finally, ethical drivers encompass social and moral norms related to energy sobriety, social acceptance, inclusiveness, and voluntary reductions in carbon footprints. Collectively, these dimensions provide a comprehensive framework for understanding the diverse motivations that drive active energy citizenship, illustrating that while economic incentives are important, they are substantially reinforced by environmental, psychological, socio-political, and ethical factors

These contexts emphasise energy democracy, participatory planning, co-ownership of renewable energy projects, and strong social trust and civil society as core elements of energy citizenship, which might be treated as a theoretical concept, but also an instrument (research tool) to measure, empower and scale-up the phenomena. To address the methodological expectations, a study [37] aimed to provide an empirically validated scale constructed upon understanding the psychological aspects of public engagement in energy transitions, [38]. This scale of nine factors relevant to energy transitions is divided into three social dimensions such as (1) beliefs about energy-related rights (e.g., the right to

affordable and renewable energy), (2) beliefs about energy-related responsibilities (e.g., the responsibility to participate in sustainable energy efforts), and (3) action motivation, (willingness to influence energy policy/system). Although this socio-psychological model is not without limitations, this is one of the few measurements that strengthens the position of social and psychological factors and analysis of the collective/individual contexts of energy transition.

4 How to Measure Energy Transition and Community Readiness? A Critical Review of Tools and Indexes

Energy transition models and indices are essential tools for guiding the shift toward sustainable energy systems and energy sovereignty. The energy transition is mostly assessed in a macroeconomic context, with the aim of evaluating countries' progress towards more sustainable energy transitions, [39], [40], [41], [42]. Some models or indexes for measuring the energy transition are developed for application in a specific economic sector [e.g. [43] or at the organisational level (business application, e.g. [44]). These indexes often include a range of indicators (environmental, economic, social, governance, and technological factors) to give a holistic view of the energy transition process and its supporting conditions, [42], [45], [46], [47].

The most known energy transition index is the World Economic Forum's Energy Transitions Index (ETI). This is a comprehensive tool for policymakers that provides a broad overview of the state and the path of energy transitions. It consists of two main sub-indices System Performance Index (SPI) and Transition Readiness Index (TRI). The first one measures the current state of the energy system, focusing on aspects like CO_2 emissions per capita, household electricity prices, renewable capacity buildout, and the innovative business environment. The second one assesses the enabling environment for future transitions, incorporating macroeconomic, institutional, social, and geopolitical factors, as well as governance structures and political dimensions, [41], [42], [48]. However, it is criticised for being unbalanced and including variables of marginal importance, [48]. Also, as it has been shown on the example of research conducted in China, its effectiveness can vary significantly across different cities and regions, [49]. This suggests that the ETI may not fully capture local characteristics, specific challenges and opportunities, and in this way, it can be less effective for local governments and energy communities. Quite similarly, World Energy Trilemma Index (WETI) is based on three dimensions: energy security, energy equity, and environmental sustainability. It is useful to monitor country's contribution in these three dimensions, [50]. However, it is calculated with an arithmetic averaging method, which may simplify complex interdependencies between the dimensions, [51]. It also applies a rather broad approach and may overlook specific local conditions and unique needs, such as the integration of RES and local energy storage solutions, [52]. So, the main weakness of these two indices (ETI and WETI) in relation to energy communities is the dominance of macroeconomic indicators and analysis of technologies at the national level. While energy communities, often local in range, rely mainly on small-scale solutions, e.g. in the field of RES. Nor do these indices measure the level of community involvement, democratic governance, or local economic and regulatory barriers (e.g., in relation to protected areas).

Among other indices and metrics used in the context of energy transition, it is worth mentioning City-Level ETI, Multicriteria Assessment Indexes, Smart Readiness Index, Technology Readiness Level (TRL), Smart Grid Readiness Indicator (SGR). City-Level ETI adapts the standard ETI for the municipal context, considering characteristics of city-level energy systems and socio-economic aspects, to track progress of energy transition across cities, [53]. Multicriteria Assessment Indexes use multicriteria analysis frameworks to assess energy transition readiness across several dimensions considering different evaluation criteria, e.g. innovation level of energy infrastructure, economic growth, societal compliance, [54], [55]. Smart Readiness Index is designed to assess how "smart-ready" the building is, considering a vast catalogue of smart-ready services defined by the European Commission Services, [56]. Energy Technology Readiness Index focuses on capacity and agility in organisation as two most important aspects of successful energy transitions. The two dimensions are broken into specific factors that are measured on a 4-point Likert scale (from very low to high) to rate each factor, [44] A summary of these indices, with the main components and metrics used, is presented in Table 2. Additionally, limitations to their application to energy communities are indicated. Most existing energy transition indicators are designed for assessment at the country or sector

level or for assessing the energy transition of enterprises.

Table 2. Energy transition indexes and metrics

Index/ Metric	Main components and criteria	Metrics used	Limitations in the context of energy communities
Energy Transition Index (ETI)	SPI (System Performance Index) – measures current energy system performance) TRI (Transition Readiness Index) – assesses future transition capacity; criteria are macroeconomic, social, institutional factors	CO_2 per capita, renewable capacity buildout, household electricity prices, innovative business environment,	country-level, it may miss local/community details
City-Level ETI	SPI (System Performance Index) TRI (Transition Readiness Index)	Local energy system structure, environmental sustainability economic development, capital and investment, technology capability, human capital	urban-level, it may generalise across diverse neighborhoods
World Energy Trilemma Index (WETI)	energy security, energy equity, environmental sustainability	access to electricity, electricity prices, gasoline and diesel prices, diversity of electricity generation, energy storage, import independence, CO2 emission per capita, final energy intensity, low-carbon electricity generation	broad approach, it may overlook specific local conditions and unique needs
Multicriteria Assessment Index	economic, social, technical, environmental, and legal aspects	Methods for Multicriteria analysis (e.g. PROMETHEE II with AHP)	Complex and data-intensive, less flexible in a small-scale, especially regarding social acceptance and local governance
Smart Readiness Index (SRI)	Set of over 50 "smart-ready" services that describe a smart building	9 technical domains evaluated in 7 impact criteria which are grouped in 3 functionalities (energy performance, flexibility, occupants needs)	designed for individual buildings and do not scale efficiently to larger clusters or entire communities e.g. in terms of collective energy management
TRL	Maturity of a particular technology,	Indicator based on a scale ranging from early-stage research to fully commercialized technology	Focused on technology and a country or sector, does not include other factors (social, legal or environmental)
Energy Transition Readiness Index	Capacity and agility	organisational	Energy Transition Readiness Index
Balanced Readiness Level (BRL)	Market Readiness Level (MRL), Regulatory Readiness Level (RRL), Acceptance Readiness Level (ARL), and Organisational Readiness Level (ORL)	e.g. market size and growth, competition, and market accessibility, analysis of law regulation, leadership commitment, internal capabilities, regulatory environment, financial resources	Tailored for energy community, not clear in terms of the communities created by individuals

Source: own elaboration based on the literature review, [41], [42], [44], [48], [49], [50], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61].

The unique, community-centred nature of energy communities require models that consider local energy dynamics and community involvement, and the cooperative nature of energy communities, where members must balance competition and cooperation, [62]. Therefore, these indexes and metrics usually cannot be directly applied to ECs, as they usually do not consider local aspects (social, economic or legal regulations) and need to be tailored to the local scale.

A promising assessment methodology might be the Balance Readiness Level. It was successfully applied for energy communities in Spain, [61]. However, one of its component – Organisational

Readiness Level – refers to companies and institutions. It is unclear then how it should be used within the energy community built by individual energy prosumers. Moreover, Polish energy transition cannot be considered equal to Spain's – which was faster, broader, strongly influenced by domestic policy initiatives, and may serve as role model for successful energy transition within EU, [63]. Also, Polish ECs face various challenges, e.g. financial constraints for renewable energy investments and the lack of real-time energy distribution monitoring [64] which may not exist in Spain. The availability and quality of some data for energy communities may be limited or even not available in Polish context, especially regarding digital transformation and innovation readiness, [65]. Thus, due to potential data limitations, local realities and regulations, organizational aspects and strategic priorities in assessment methodology still needs some adaptation for Polish energy communities. The most recent paper on energy transition modelling, based on the validation among 31 EU countries, clearly demonstrates that incorporating societal aspects, such as public acceptance, investment risk perceptions, and infrastructure lock-in, significantly improves the accuracy of modelling power sector transitions, [66]. Moreover, we know that these societal variables are not static; they evolve in response to emerging phenomena, locally driven "cultures" and geopolitical events that shape public opinion, responsibilities, and motivation to act.

4.1 Innovative Contribution and Added Value for the Future Research Direction

As stated above, existing evaluation frameworks, such as the Energy Transition Index (ETI) and the World Energy Trilemma Index (WETI), are designed for macro-level analyses and fail to capture local actors' specific needs, constraints, and potentials. This mismatch highlights the necessity for context-sensitive instruments that are adaptable to local conditions and integrate social, technological, economic, and institutional dimensions. This contribution is distinguished by its attention to the complex interplay of regulatory incoherence, post-socialist legacies, and low civic engagement—factors often overlooked in mainstream energy policy research. By reframing ECs not merely as technical or economic entities but as strategic platforms for civil society development, democratic participation, and local resilience, the article repositions them within a broader socio-political framework. It addresses a significant blind spot in comparative European energy transition studies, which tend to underrepresent or oversimplify the realities of Central and Eastern European member states. Grounded in Poland's unique historical and institutional context, the analysis offers academic insight and practical relevance for designing more inclusive energy transition policies. Building on these findings, future research should pursue several interrelated directions. Foremost is the development of locally adapted assessment tools capable of capturing community readiness, capacity, and needs. These tools should include indicators related to social capital, institutional barriers, technological infrastructure, digital literacy, and governance performance to support comprehensive local energy planning. This means not only interdisciplinary research but also comparative studies which are particularly crucial for examining how different EU member states – especially those in Central and Eastern Europe – interpret and implement RED II, RED III, and the Electricity Directives. This can help identify transferable best practices and contextual barriers shaped by post-socialist institutional legacies.

Equally important are behavioural and cultural studies exploring public perceptions of energy citizenship. Understanding psychological and cultural barriers, as well as the influence of narratives on energy justice and sovereignty, will shed light on the social dynamics that drive or inhibit collective engagement. Further research should explore innovative governance models for ECs, including cooperatives, municipal alliances, and legal mechanisms for local grid access and infrastructure sharing. These approaches may enable more democratic and participatory forms of local energy management. The economic feasibility of ECs also warrants attention. Future studies should examine financing models – including blended instruments such as grants, loans, and crowdfunding – and assess how public and EU funding mechanisms can support financial viability in rural or economically marginalised regions.

Given increasing risks from energy disruptions and climate extremes, research should also investigate the role of ECs in strengthening climate resilience. This includes assessing the contribution of microgrids, energy storage, and decentralised systems to local adaptation, emergency preparedness, and energy autonomy.

Effective implementation will depend on improved communication strategies and public engagement. Research should evaluate how trust is built in low-engagement communities, the influence

of media and civil society organisations, and the role of education in mobilising local actors.
Finally, longitudinal studies are needed to assess the long-term impacts of ECs on energy efficiency, local economic development, and civic participation. Such insights are essential for evaluating their structural contribution to sustainability and democratic transformation.

5 Discussion and Conclusions

Implementing RED II, RED III, and the Electricity Directive is central to enabling energy communities to function effectively within the European Union. These directives establish a strong legal foundation, aiming to integrate such entities into the broader energy system and contribute to long-term sustainability goals. However, divergent national interpretations and delays in transposition significantly impact the practical feasibility of energy communities across Member States, including Poland.

The regulatory Polish landscape concerning ECs remains fragmented and underdeveloped. The legislation still suffers from numerous legal ambiguities and procedural inefficiencies that hinder the growth of citizen energy initiatives. Energy communities – organisational entities that bring together local energy users to produce, manage, and consume RES – depend not only on favourable regulatory conditions but also on cultural, technological, and institutional readiness. Unfortunately, the prevailing neoliberal paradigm – emphasising competition and individualism – undermines communitarian values such as social trust, solidarity, cooperation, and local participation, which are fundamental to the success of citizen-led energy systems. The post-socialist legacy further complicates public trust and collective action in the energy domain.

The Polish regulatory framework requires comprehensive reform to align with EU directives and unlock the full potential of ECs. This includes revising foundational legal acts and the introduction of a unified, legally binding definition of ECs, the recognition of diverse organisational forms (e.g., cooperatives, associations, municipal partnerships), and the streamlining of administrative processes related to registration, licensing, and compliance.

Moreover, ECs must be granted clear legal rights to build and manage infrastructure, share energy storage, and operate local distribution systems. Financial instruments – such as targeted grants, low-interest loans, and tax incentives – are necessary to ensure economic viability, especially for grassroots-led initiatives. Regulatory measures like simplified access to grid infrastructure and support for local balancing should also be introduced. Complementary educational and promotional campaigns are needed to raise awareness among municipalities and local leaders regarding the strategic role and benefits of energy communities, [35], [62], [63].

While regulatory and institutional reforms are necessary, a critical gap remains in the analytical and methodological frameworks available to assess and support the development of energy communities. Existing indices and metrics – such as the Energy Transition Index (ETI) and the World Energy Trilemma Index (WETI) – were designed primarily for macroeconomic or national-level evaluations. They largely overlook key local-level dimensions, including community participation, governance practices, digital maturity, and technological capacity. Its modular structure allows for prospective cross-country application and benchmarking across post-socialist settings.

Although some adaptations, such as the City-Level ETI or the Balanced Readiness Level, aim to bridge this gap, they still require substantial modification to reflect the socio-economic diversity and regulatory specificities of Polish communities. In particular, there is a lack of adequate analytical and methodological tools that would enable a systematic assessment of the specific social, technological, economic, or institutional interventions required to enhance the energy autonomy, resilience, and flexibility of individual communities. Without such instruments, it becomes exceedingly difficult to design evidence-based development pathways that align with the local realities and priorities of community members.

Addressing this research gap is essential to unlocking the transformative potential of energy communities. Without accurate diagnostic tools, policy measures and funding schemes risk being misaligned with the needs of the communities they intend to support. In the Polish context - characterised by delayed energy transition progress and low levels of local empowerment – initiatives that build trust, stimulate civic engagement, and provide tailored support will be crucial for achieving climate targets. Energy communities, if properly supported, could become resilient and democratic pillars of Poland's energy future. Moreover, practical implementation is also hampered by regulatory ambiguities, the lack of detailed public support schemes, and the absence of simplified settlement mechanisms – such as prosumer tariffs – that could incentivise broader

community engagement. According to the Polish Green Network, members of ECs frequently report legal inconsistency, difficulties in obtaining external funding, and a shortage of technical or administrative support staff.

Further research should focus on the development of a tailored maturity assessment framework for energy communities, addressing their specific legal, social, and institutional conditions. Developing operational diagnostic tools, including self-assessment instruments and readiness indices, would significantly support local actors in identifying gaps, planning interventions, and monitoring progress. Future studies should also explore the transferability of such tools to other post-socialist or structurally disadvantaged regions in Europe.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

The authors wrote, reviewed and edited the content as needed and verifies that none utilised artificial intelligence (AI) tools were used. The authors take full responsibility for the content of the publication.

References:

[1] European Commission (2025). A Competitiveness Compass for the EU. Brussels: European Commission, [Online]. https://commission.europa.eu/topics/eu-competitiveness/competitiveness-compass_en (Accessed Date: February 2, 2025).

[2] European Commission, High Representative of the Union for Foreign Affairs and Security Policy (2025). Joint Communication to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions on the European Preparedness Union Strategy. JOIN(2025) 130 final. Brussels: European Commission, [Online]. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025JC0130 (Accessed Date: February 2, 2025).

[3] Ministry of Climate and Environment (2021). Poland's National Energy and Climate Plan for 2021–2030. Warsaw: Ministry of Climate and Environment. Available at: https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en (Accessed Date: February 7, 2025).

[4] Hebda, W. (2022). 'Energy Policy of Poland until 2040: The Challenges and Threats to Energy Security in the Next Two Decades', *Politeja,* 19(4), pp. 167–186. https://doi.org/10.12797/Politeja.19.2022.79.10.

[5] Szulecki, K. (2020). 'Securitization and State Encroachment on the Energy Sector: Politics of Exception in Poland's Energy Governance', *Energy Policy,* 136, 111066. https://doi.org/10.1016/j.enpol.2019.111066.

[6] Tarasova, E. (2024). 'Multiple just transitions? A study of how a just transition is envisioned in Poland', *Energy Policy,* 194, 114322.

[7] Nyga-Łukaszewska, H., Ruszel, M. and Szpor, A. (2023). 'Energy Transition – Example of Poland', In: *The Palgrave Handbook of Zero Carbon Energy Systems and Energy Transitions.* Cham: Springer International Publishing, pp. 1–17.

[8] Gianaroli, F., Preziosi, M., Ricci, M., Sdringola, P., Ancona, M.A. and Melino, F. (2024). 'Exploring the academic landscape of energy communities in Europe: A systematic literature review', *Journal of Cleaner Production,* 451, 141932. https://doi.org/10.1016/j.jclepro.2024.141932.

[9] Ministry of Agriculture and Rural Development, Register of Energy Cooperatives in Poland, 2015, [Online]. https://www.gov.pl/web/kowr/wykaz-spoldzielni-energetycznych (Accessed Date: February 2, 2025).

[10] European Commission (2021). Fit for 55: Delivering the EU's 2030 Climate Target on the Way to Climate Neutrality. COM(2021) 550 final. Brussels: European Commission, [Online]. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0550 (Accessed Date: October 11, 2024).

[11] European Parliament and Council (2018). Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action. *Official Journal of the European Union,* L 328/1, [Online]. https://eur-lex.europa.eu/eli/reg/2018/1999/oj/eng (Accessed Date: October 11, 2024).

[12] European Parliament and Council (2019). Regulation (EU) 2019/943 on the Internal Market for Electricity. *Official Journal of the European Union,* L 158/54, [Online]. https://eur-lex.europa.eu/eli/reg/2019/943/oj/eng (Accessed Date: October 11, 2024).

[13] European Parliament and Council (2018). Directive (EU) 2018/2001 on the Promotion of the Use of Energy from Renewable Sources (RED II). *Official Journal of the European Union,* L 328/82, [Online]. https://eur-lex.europa.eu/eli/dir/2018/2001/oj/eng (Accessed Date: October 15, 2024).

[14] European Parliament and Council (2023). Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources (RED III). *Official Journal of the European Union,* L, [Online]. https://eur-lex.europa.eu/eli/dir/2023/2413/oj/eng (Accessed Date: October 15, 2024).

[15] European Parliament and Council (2019). Directive (EU) 2019/944 on Common Rules for the Internal Market for Electricity and Amending Directive 2012/27/EU (Electricity Directive). *Official Journal of the European Union,* L 158/125, [Online]. https://eur-lex.europa.eu/eli/dir/2019/944/oj/eng (Accessed Date: October 15, 2024).

[16] The Republic of Poland (2024). The Energy Law Act of 10 April 1997. Journal of Laws, Items 266, 834, 859, 1847, 1881.

[17] The Republic of Poland (2024). The Act of 20 February 2015 on Renewable Energy Sources. Journal of Laws, Items 1361, 1847, 1881.

[18] Witkowska, A. (2024). National guidelines for energy communities in Poland. Warsaw: WiseEuropa. (Krajowe wytyczne dotyczące wspólnot energetycznych w Polsce). Warsaw: WiseEuropa.

[19] Polish Green Network (2024). Elektryzujące Wspólnoty: Transformacja Polskiego Sektora Elektroenergetycznego Przez Lokalne Źródła Odnawialne, [Online]. https://zielonasiec.pl/wp-content/uploads/2024/05/energising-communities-pl.pdf (Accessed Date: December 28, 2024).

[20] Caramizaru, E. and Uihlein, A. (2020). Energy communities: an overview of energy and social innovation. EUR 30083 EN. Luxembourg: Publications Office of the European Union.

[21] Dudka, A. and Magnani, N. (2023). 'Do energy communities need to be local? A comparative study of two energy cooperatives in Europe', *Zeitschrift für Vergleichende Politikwissenschaft.* https://doi.org/10.1007/s12286-023-00576-3.

[22] Böll Stiftung (2023). Energy communities and the legacy of post-socialism. *Heinrich Böll Stiftung*, [Online]. https://pl.boell.org/sites/default/files/2025-03/energy_communities_report.pdf (Accessed Date: December 28, 2024).

[23] Nagaj, R. and Gajdzik, B. (2024). 'Energy and climate policy as a determinant of fuel poverty in Poland', Scientific Papers of Silesian University of Technology – Organization and Management Series, (198), pp. 328–343. https://doi.org/10.29119/1641-3466.2024.198.18.

[24] REScoop.eu (2022). The Potential of Citizen Energy Communities for Europe's Energy Transition. Brussels: European Federation of Citizen Energy Cooperatives, [Online]. https://www.rescoop.eu/uploads/REScoop-Annual-Report-2022_final.pdf (Accessed Date: October 15, 2024).

[25] European Commission (2023). Recommendation on Energy Poverty and Action Plan. COM(2023) 326 final. Brussels: European Commission, [Online]. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023DC0326 (Accessed Date: October 15, 2024).

[26] Konopelko, A., Kostecka-Tomaszewska, L. and Czerewacz-Filipowicz, K. (2023). 'Rethinking EU countries' energy security policy resulting from the ongoing energy crisis: Polish and German standpoints', *Energies,* 16(13), 5132. https://doi.org/10.3390/en16135132.

[27] International Energy Agency (2022). World Energy Outlook 2022. Paris: IEA, [Online]. https://www.iea.org/reports/world-energy-outlook-2022 (Accessed Date: October 29, 2024).

[28] Jones, S. (2025). 'Spain and Portugal hit by massive blackout as grid suffers unexplained collapse', The Guardian, [Online]. https://www.theguardian.com/world/live/2025/apr/28/ukraine-russia-zelenskyy-putin-trump-crimea-germany-europe-news-live-updates (Accessed Date: April 29, 2025).

[29] Szulecki, K. and Overland, I. (2020). 'Energy democracy as a process, an outcome and a goal: A conceptual review', *Energy Research & Social Science,* 69, 101768. https://doi.org/10.1016/j.erss.2020.101768.

[30] Devine-Wright, P. (2007). 'Energy citizenship: Psychological aspects of evolution in sustainable energy technologies', In: Murphy, J. (ed.) Governing Technology

for Sustainability. London: Earthscan, pp. 63–88.

[31] Wahlund, M. and Palm, J. (2022). 'The role of energy democracy and energy citizenship for participatory energy transitions: A comprehensive review', *Energy Research & Social Science,* 87, 102482. https://doi.org/10.1016/j.erss.2021.102482.

[32] Cantoni, R., Lis, A. and Stasik, A. (2018). 'Creating and debating energy citizenship: The case of shale gas in Poland', In: Szolucha, A. (ed.) Energy, Resource Extraction and Society. London: Routledge, pp. 53–69. https://doi.org/10.4324/9781351213943-4.

[33] Debourdeau, A., Schäfer, M., Pel, B., Kemp, R. and Vadovics, E. (2024). 'A conceptual typology of energy citizenship', *Energy Research & Social Science,* 117, 103720. https://doi.org/10.1016/j.erss.2024.103720.

[34] Laakso, S., Eranti, V. and Lukkarinen, J. (2023). 'Practices and acts of energy citizenship', *Journal of Environmental Policy & Planning,* 25(6), pp. 690–702. https://doi.org/10.1080/1523908X.2023.2251915.

[35] Orłowska, J., Suchacka, M., Trembaczowski, Ł. and Ulewicz, R. (2024). 'Social aspects of establishing energy cooperatives', *Energies,* 17(22), 5709. https://doi.org/10.3390/en17225709.

[36] Biresselioglu, M.E., Demir, M.H., Solak, B., Savas, Z.F., Kollmann, A. and Kirchler, B. et al. (2024). 'Empowering energy citizenship: Exploring dimensions and drivers in citizen engagement during the energy transition', *Energy Reports,* 11, pp. 1894–1909. https://doi.org/10.1016/j.egyr.2024.01.040.

[37] Held, J., Hamann, K.R.S., Jans, L., Masson, T., Fritsche, I. and Goedkoop, F. et al. (2024). 'Energy citizenship as people's perceived (collective) rights and responsibilities in a just and sustainable energy transition – scale development and validation', *Journal of Environmental Psychology,* 96, 102310. https://doi.org/10.1016/j.jenvp.2024.102310.

[38] Hamann, K.R.S., Bertel, M.P., Ryszawska, B., Lurger, B., Szymański, P. and Rozwadowska, M. et al. (2023). 'An interdisciplinary understanding of energy citizenship: Integrating psychological, legal, and economic perspectives on a citizen-centred sustainable energy transition', *Energy Research & Social Science,* 97, 102959. https://doi.org/10.1016/j.erss.2023.102959.

[39] Li, F., Pye, S. and Strachan, N. (2016). 'Regional winners and losers in future UK energy system transitions', *Energy Strategy Reviews,* 10, pp. 53–65. https://doi.org/10.1016/j.esr.2016.08.002.

[40] Szép, T., Pálvölgyi, T. and Kármán-Tamus, É. (2022). 'Indicator-based assessment of sustainable energy performance in the European Union', *International Journal of Sustainable Energy Planning and Management,* 34, pp. 107–124. https://doi.org/10.54337/ijsepm.7055.

[41] Singh, H., Bocca, R., Gómez, P., Dahlke, S. and Bazilian, M. (2019). 'The energy transitions index: An analytic framework for understanding the evolving global energy system', *Energy Strategy Reviews,* 26, 100382. https://doi.org/10.1016/j.esr.2019.100382.

[42] Owjimehr, S. and Samadi, A. (2023). 'Energy transition determinants in the European Union: threshold effects', *Environmental Science and Pollution Research International,* 30(20), pp. 22159–22175. https://doi.org/10.1007/s11356-022-23743-w.

[43] Lehtveer, M., Göransson, L., Heinisch, V., Johnsson, F., Karlsson, I. and Nyholm, E. et al. (2021). 'Actuating the European Energy System Transition: Indicators for Translating Energy Systems Modelling Results into Policy-Making', *Frontiers in Energy Research,* 9, 677208. https://doi.org/10.3389/fenrg.2021.677208.

[44] Sabidussi, A. and Wasser, J. (2024). 'Energy Transition Readiness: A Practical Guide', *International Journal of Sustainable Energy Planning and Management,* 34, pp. 125–138. https://doi.org/10.54337/ijsepm.7992.

[45] Dialga, I. (2021). 'Evaluating Normandy's sustainable development and energy transition policies', *Journal of Cleaner Production,* 279, 127096. https://doi.org/10.1016/j.jclepro.2021.127096.

[46] Gnansounou, E. (2008). 'Assessing the energy vulnerability: Case of industrialised countries', *Energy Policy,* 36(10), pp. 3734–3744. https://doi.org/10.1016/j.enpol.2008.07.004.

[47] Waleed, K. and Mirza, F. (2023). 'Examining fuel choice patterns through household energy transition index: an alternative to traditional energy ladder and stacking models', *Environment, Development and Sustainability,* 25(3), pp. 6449–6501. https://doi.org/10.1007/s10668-022-02312-8.

[48] Kuc-Czarnecka, M., Olczyk, M. and Zinecker, M. (2021). 'Improvements and Spatial Dependencies in Energy Transition Measures', *Energies,* 14(13), 3802. https://doi.org/10.3390/en14133802.

[49] Shen, Y., Shi, X., Zhao, Z. and Sun, Y. et al. (2023). 'Measuring the low-carbon energy transition in Chinese cities', *iScience,* 26(1), 105803. https://doi.org/10.1016/j.isci.2022.105803.

[50] Sobik, B. (2023). 'Energy Transition Index and World Energy Trilemma Index as an energy transition's pace measure for policy-making using the example of Poland', *Energy Policy Studies,* 1(12), pp. 13–20. https://doi.org/10.62316/HROS2997.

[51] Fu, Y., Lu, Y., Yu, C. and Lai, K. (2022). 'Inter-country comparisons of energy system performance with the energy trilemma index: An ensemble ranking methodology based on the half-quadratic theory', *Energy,* 254, 125048. https://doi.org/10.1016/j.energy.2022.125048.

[52] Mohammed, M., Alhawsawi, A. and Soliman, A. (2021). 'An Integrated Approach to the Realization of Saudi Arabia's Energy Sustainability', *Sustainability,* 13(1), 205. https://doi.org/10.3390/su13010205.

[53] Shen, Y., Shi, X., Zhao, Z., Xu, J., Sun, Y., Liao, Z. et al. (2023). 'A dataset of low-carbon energy transition index for Chinese cities 2003–2019', *Scientific Data,* 10(1), 28. https://doi.org/10.1038/s41597-023-02815-7.

[54] Neofytou, H., Nikas, A. and Doukas, H. (2020). 'Sustainable energy transition readiness: A multicriteria assessment index', *Renewable and Sustainable Energy Reviews,* 131, 109988. https://doi.org/10.1016/j.rser.2020.109988.

[55] Alpagut, B., Romo, A., Hernández, P., Tabanoğlu, O. and Martinez, N. (2021). 'A GIS-Based Multicriteria Assessment for Identification of Positive Energy Districts Boundary in Cities', *Energies,* 14(22), 7517. https://doi.org/10.3390/en14227517.

[56] Garzia, F., Pernigotto, G., Menegon, D., Finozzi, L., Klammsteiner, U. and Gasparella, A. (2024). 'Assessment of the potential correlation between Smart Readiness Indicator and energy performance in a dataset of buildings in South Tyrol', *Energy and Buildings,* 283, 114623. https://doi.org/10.1016/j.enbuild.2024.114623

[57] Avendano, I., Andersen, K., Erba, S., Moazami, A., Aghaei, M. and Najafi, B. (2024). 'A novel framework for assessing the smartness and the smart readiness level in highly electrified non-residential buildings: A Norwegian case study', *Energy and Buildings,* 282, 114234. https://doi.org/10.1016/j.enbuild.2024.114234

[58] Chatzikonstantinidis, K., Giama, E., Fokaides, P. and Papadopoulos, A. (2024). 'Smart Readiness Indicator (SRI) as a Decision-Making Tool for Low Carbon Buildings', *Energies,* 17(6), 1406. https://doi.org/10.3390/en17061406.

[59] Bukar, A.M. and Asif, M. (2024). 'Technology readiness level assessment of carbon capture and storage technologies', *Renewable and Sustainable Energy Reviews,* 200, 114578. https://doi.org/10.1016/j.rser.2024.114578.

[60] Wijaya, E.P. and Asif, M. (2025). 'Technology readiness level assessment on digital technologies for energy efficiency', *Transportation Research Procedia,* 84, pp. 512–519. https://doi.org/10.1016/j.trpro.2025.03.103.

[61] Eisele, P., Carrilho, F., Bojja, D., Pelote, P. and Valderrama, C. (2024). 'Readiness of demand response technology for Spanish Energy Communities', *Energy Strategy Reviews,* 44, 101477. https://doi.org/10.1016/j.esr.2024.101477.

[62] Mucha-Kuś, K., Sołtysik, M., Zamasz, K. and Szczepańska-Woszczyna, K. (2021). 'Coopetitive Nature of Energy Communities—The Energy Transition Context', *Energies,* 14(4), 931. https://doi.org/10.3390/en14040931.

[63] Jorge-Vazquez, J., Kaczmarek, J., Knop, L., Kolegowicz, K., Alonso, S.L.N. and Szymla, W. (2024). 'Energy transition in Poland and Spain against changes in the EU energy and climate policy', *Journal of Cleaner Production,* 468, 143018. https://doi.org/10.1016/j.jclepro.2024.143018.

[64] Gajdzik, B., Jaciow, M., Wolniak, R., Wolny, R. and Grebski, W.W. (2024). 'Diagnosis of the Development of Energy Cooperatives in Poland—A Case Study of a Renewable Energy Cooperative in the Upper Silesian Region', *Energies,* 17(3), 647. https://doi.org/10.3390/en17030647.

[65] Czemiel-Grzybowska, W., Bąkowski, M. and Forfa, M. (2024). 'Overcoming the Challenge of Exploration: Organizational Readiness of Technology Entrepreneurship on the Background of Energy Climate Nexus',

Energies, 17(23), 5999. https://doi.org/10.3390/en17235999.

[66] Fisch-Romito, V., Jaxa-Rozen, M., Wen, X. and Trutnevyte, E. (2025). 'Multi-country evidence on societal factors to include in energy transition modelling', *Nature Energy*, 10, pp. 460–469. https://doi.org/10.1038/s41560-025-01719-7.

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