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RECEIVED 22 September 2024

ACCEPTED 07 July 2025

PUBLISHED 25 August 2025

## CITATION

Bielecki M, Neska E and Kowalska-Pyzalska A (2025) “Why would I bother?” Understanding prosumer motivations and engagement in renewable energy communities: a qualitative study of polish photovoltaic installation owners.

*Front. Energy Res.* 13:1500038.

doi: 10.3389/fenrg.2025.1500038

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# “Why would I bother?” Understanding prosumer motivations and engagement in renewable energy communities: a qualitative study of polish photovoltaic installation owners

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Renewable Energy Communities (RECs) play a vital role in promoting decentralized, sustainable energy systems by enabling local stakeholders to collectively generate, share, and manage renewable energy resources. This enhances community resilience and environmental stewardship. The development and efficient functioning of RECs depend not only on technical or economic factors but also on numerous socio-psychological variables deeply rooted in local historical, political, economic, and cultural contexts. Our study aimed to understand the motivations and barriers to participation in RECs through thematic analysis of qualitative data obtained from in-depth interviews with current and prospective prosumers in Poland. The study's findings are twofold. First, they offer a deeper understanding of the mechanisms shaping perceptions of RECs and the factors contributing to the success of future implementations and policies, structured according to Bronfenbrenner's socio-ecological model. Second, the findings have broader methodological implications, highlighting the necessity of accounting for socio-cultural heterogeneity, embedding research practices in the local context, and promoting interdisciplinarity as the foundation for effectively shaping future policies.

## KEYWORDS

renewable energy community, prosumers, Poland, drivers, barriers, in-depth interviews, Bronfenbrenner's socio-ecological model

## 1 Introduction

Climate change stands as one of the most significant global challenges. To mitigate its adverse and lasting consequences, an energy transition is essential, in which renewable energy sources and energy efficiency play a crucial role (Koirala et al., 2018; Gielen et al., 2019). Furthermore, recently, due to the complex geopolitical situation in Eastern Europe, energy security and affordability have received special attention from EU countries, which relate their increase in energy independence to, among

others, renewable energy technologies such as photovoltaics (PV), wind turbines, and green hydrogen (Zhang et al., 2023).

Among the proposed solutions, the idea of the Renewable Energy Community (REC) emerged as one of the responses. REC applies the latest digital technologies to unlock the potential of renewables and create an environmentally friendly ecosystem, in which the community can produce, store and consume energy locally (European Union, 2019; European Union, 2018).

As a nascent entity, REC has the potential to reshape prevailing electricity market models by transitioning passive consumers into active prosumers with substantial societal impact (Caramizaru and Uihlein, 2020; Otamendi-Irizar et al., 2022; Brummer, 2018). However, this transformation cannot occur without significant social engagement, thus extending far beyond purely technological or economic aspects. This very complexity will be the primary focus of our study.

Through our comprehensive literature review and identified research gaps, particularly in the Central and Eastern European context, our study addresses the following key research questions:

1. What was the decision-making process associated with purchasing PV, and how is it influencing the perception of REC?
2. How is the concept of REC understood by existing prosumers?
3. What are the key barriers and motivations of potential future REC participants?
4. What are the potential implications concerning the optimal way to introduce REC, warranting attention, interest, and acceptance?
5. What are the methodological implications of the obtained results, and what kind of framework could facilitate the recognition of the contextual factors in further research on energy transition?

To address these questions, we employed a qualitative methodological approach using semi-structured interviews with Polish current and future prosumers. The data was analyzed using thematic analysis and interpreted through Bronfenbrenner's socio-ecological model, as introduced in Section 1.1. This methodology allows us to systematically explore the multi-layered factors influencing REC participation decisions while acknowledging the unique historical, social, and economic context of Poland.

Our study makes several key contributions to the expanding literature on renewable energy communities. First, it extends the understanding of RECs to the understudied Central and Eastern European context, specifically Poland, where the energy transition dynamics differ significantly from Western European models. Second, it provides empirical insights into how prior experience with individual renewable installations shapes perceptions of and willingness to engage in communal energy approaches. Third, it offers a methodological framework for analyzing energy transition factors that explicitly accounts for contextual dimensions that are often overlooked in generalized studies. Finally, it provides policy-relevant insights for effective REC implementation in contexts similar to Poland, where individual prosumership has preceded community-based approaches. The paper is structured as follows: Section 1.1 reviews existing studies on REC participation and identifies factors influencing acceptance. Section 1.2 describes the specificity of the Polish energy context,

essential for understanding our findings. Section 2 presents our methodology and data collection approach, followed by Section 3 which details our findings. Finally, Section 4 discusses policy implications and propose a framework for contextually-grounded energy transition research.

## 1.1 Existing studies on REC participation

Participation in RECs is the subject of numerous studies from various perspectives (Neska and Kowalska-Pyzalska, 2022). Both actual citizen involvement and stated intentions to participate are analyzed. Most of the studies focus on initiatives that already exist (González et al., 2022; REScoop, 2020; GridFlex, 2020; Milchram et al., 2020; Van Summeren et al., 2021; Vernay and Sebi, 2020; Reijnders et al., 2020) or theoretical concepts of REC (Busch et al., 2021; van Bommel and Höffken, 2021; Impram et al., 2020; Parag and Sovacool, 2016; Koirala et al., 2016; Caramizaru and Uihlein, 2020; Coenen and Hoppe, 2021; Hamann et al., 2023). Until now, a long list of incentives and barriers impacting the decision on participation in REC has been identified. One of the key aspects is social trust and a sense of control over activities. Research indicates that trust in other community members and belief in one's own ability to influence REC activities significantly increase intention to participate (Neves et al., 2024; Koirala et al., 2018). In addition, expected financial benefits, altruism and innovation are important determinants of citizen involvement in local energy communities (Neves et al., 2024; Ahmed et al., 2024). Among incentives financial profitability (Soeiro and Ferreira-Dias, 2020; Fina et al., 2022), real time data access (Vallecha et al., 2021), increase of energy independence (Brummer, 2018), and social factors (Soeiro and Ferreira-Dias, 2020; Botelho et al., 2021) prevail. On the other hand novelty and complexity (Milchram et al., 2020; Cielo et al., 2021), legal uncertainty (Soeiro and Ferreira-Dias, 2020), and lack of trust (Koirala et al., 2016) are mentioned as the most significant shortcomings of REC. Additionally various REC business models offer community members the opportunity to actively participate in decision-making, investment and ownership of energy infrastructure (Neska and Kowalska-Pyzalska, 2022; Cielo et al., 2021; Botelho et al., 2021). This approach not only promotes sustainable development, but also strengthens social ties and a sense of community.

We summarized the incentives and barriers to participation in REC projects in Figure 1, organized according to Bronfenbrenner's socio-ecological model. This approach allowed us to order the factors from a systemic perspective: from the individual to the macrosystem level. We will revisit this model again, first by describing the methodological assumptions (Section 2.1 Data Collection and Analysis) and later by summarizing the results.

The perception of barriers and incentives to participation in the REC depends, *inter alia*, on the setup of the REC market. Establishing an arrangement of an electricity supplier, consumer, and third-party entity that fits the goals and constraints of the community is crucial when building a community. The study of Neska and Kowalska-Pyzalska (2022) summarizes different possible REC setups. It seems that peer-to-peer models (P2P), aggregator models, and those based on collective prosumer installation are the most common (Parag and Sovacool, 2016; Botelho et al., 2021;

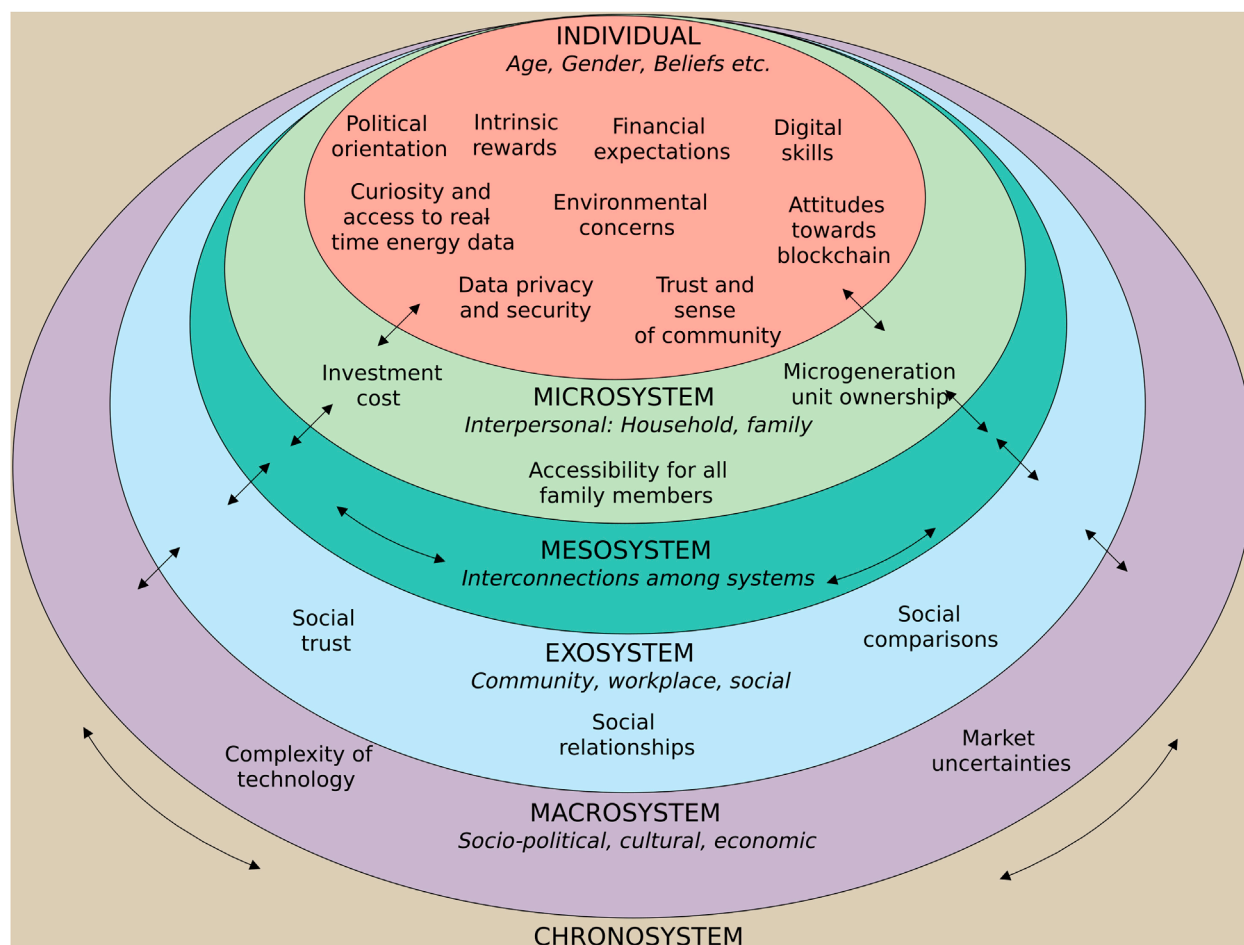


FIGURE 1  
Mapping of literature-supported factors influencing REC acceptance onto Bronfenbrenner's socio-ecological model.

Cielo et al., 2021; Norbu et al., 2021; Botelho et al., 2021). Thus, for the purposes of this study, three main operational variants have been identified which can operate independently or in combination:

- Peer to Peer Energy Trading: a portion of the renewable energy generated (e.g., from PV installations) within a household can be transferred to other households, public institutions, or private organizations. These transactions occur within predefined administrative boundaries (such as neighborhoods, villages, cities, or counties), with or without prearranged benefits based on specific agreements. In comparison with the two other variants, in the P2P model a community may value a greater sense of independence and control over home energy management;
- Shared renewable energy source (RES) installation: households using shared RES facilities for local energy production and/or storage for their own consumption. Examples of these installations include photovoltaic farms, wind farms, hydrogen energy production facilities, and energy storage systems. Within this model, a community may emphasize considerations related to investment costs. Although the initial investment is high, a shared RES installation can be perceived

as more cost-effective than multiple individual installations. Furthermore, in the case of a model based on a shared installation, the equitable distribution of benefits derived from the use of this shared RES installation may be a particularly important aspect for a community;

- Demand Side Response (DSR) model with an aggregator: enabling a management entity to remotely regulate a household's electricity consumption (e.g., electric heating or air conditioning) within predetermined limits and time frames. In return, the household typically receives a benefit established in advance. This variant appears to be the most complex and difficult to comprehend. Some community members may perceive a restriction of their freedom and control, along with what they view as excessive conditions imposed on their energy management practices. In contrast, other community members may value the positive impact on their electricity costs without the need to invest in an individual or shared RES installation, since a third party can assume that responsibility. Additionally, respondents emphasize that maintaining thermal comfort at home is more important than financial gain, which may limit the practicality of this variant

or suggest that it would only be viable with a larger pool of participants (Neska et al., 2024).

Although the above mentioned REC models can operate in various ways and under different governance structures, they share the characteristic of utilizing energy generated from renewable sources. This approach enables RECs to contribute both to an increased share of renewables and to distributed energy generation in the overall energy mix, while also promoting more efficient energy use by ensuring that consumption occurs close to the site of generation. In this way, RECs play an important role in the broader energy transition aimed at expanding the role of RES (Caramizaru and Uihlein, 2020; Hicks and Ison, 2018).

## 1.2 The specificity of the Polish context

Even though there is a vast literature on various aspects of REC in Western and Northern European countries (Bonfert, 2024; Van Summeren et al., 2021; Milchram et al., 2020), as well as outside Europe (Vallecha et al., 2021; Williamson, 2022), the issue of consumer approaches to REC in Central and Eastern Europe seems to be understudied (Jasinski et al., 2021). At the same time, studies show that the formative experiences, understanding, and awareness of the need for the energy transition, as well as needs and motivations, can vary greatly both between and within countries—even if we limit our considerations to the area of the European Union (Janik et al., 2021).

In the case of Poland, the largest country in the region, its distinguishing characteristics are numerous and result from diverse temporal-scale processes. Some factors, such as the symbolic heritage dating back to the times of communism or the vivid memory of the “wild capitalism” of the early years of transformation, remain perceptible even after multiple decades (Kubow, 2013; Kwiatkowski, 2008). Some others are relatively recent phenomena, such as highly skeptical discourse towards the European Union introduced during the previous right-wing coalition government, direct experience of the migration crisis caused by the war in Ukraine unfolding just beyond Poland's borders, or the exceptional intensification of political polarization translating, among other things, into attitudes towards climate issues (Zuk and Szulecki, 2020; Huber et al., 2021).

Regardless of all other factors, Poland witnessed one more fundamental change in the last 5 years which is of high relevance in the context of the studied topic: an unprecedented increase in rooftop photovoltaic panels (Igliński et al., 2023; Dzikuć et al., 2022). This growth rate is unique in Europe (Rataj et al., 2021). Photovoltaics have been the main growth engine in Poland's renewable energy sector since 2019, according to IEO research agency (IEO, 2022a; IEO, 2022b). At the end of 2022, installed PV capacity exceeded 12.4 GW, up from 7.7 GW in 2021, marking a record increase of more than 4.7 GW and a 61% market growth. In 2023, consumer-owned micro-installations reached 1,275,736, with 14,739.4 MW capacity (IEO, 2022a).

The rapid development of photovoltaic microinstallations in Poland was primarily driven by a series of strategic financial incentives and regulatory changes implemented between 2019

and 2023 (for a comprehensive review, see Błaszczuk et al. (2024)). This growth trajectory was initiated on 1 January 2019, with the introduction of “thermal modernization relief”, which amended the Personal Income Tax Act and established favorable tax conditions for individual investors. However, the most significant catalyst was the launch of the “My Electricity” subsidy program by the National Fund for Environmental Protection and Water Management in August 2019. The initial regulatory framework employed a net-metering system that allowed prosumers with installations up to 10 kWp to receive 0.8 kWh for each 1 kWh sent to the grid, while installations between 10 and 50 kWp received 0.7 kWh. This settlement approach, combined with the removal of administrative barriers such as the 50 kWp threshold for installations without building permits under the RES Act and Construction Law, accelerated market growth until April 2022 (Łuszczuk et al., 2023), when the system transitioned to less favorable net-billing terms that reflected actual market conditions and price fluctuations. Additional market-shaping events included the September 2020 introduction of fire protection requirements for installations above 6.5 kWp, the 2023 amendments to the RES Act, which exempted installations up to 150 kWp from building permits and promoted energy clusters, and the Energy Law amendment that introduced hourly billing starting in 2024. Despite fluctuating energy market conditions and the government's introduction of energy price caps in late 2022, Polish investors continue to choose PV installations to hedge against rising electricity prices and ensure supply during potential blackouts or technical issues (Dzikuć et al., 2022).

The experience of being a prosumer modifies user behavior and increases awareness regarding electricity use (Zuk and Zuk, 2022). However, Poles have limited experience with RECs, which are mostly restricted to cooperatives and clusters involving small and medium companies and housing associations, not individual consumers (Jasinski et al., 2021; Dragan, 2020). Therefore, understanding the barriers and motivations within this population, crucial for the successful introduction of RECs are essential for shaping future energy transformation policies.

## 2 Materials and methods

### 2.1 Data collection and analysis

The study involved two main steps. First, the authors conducted 16 semi-structured, in-depth interviews with current or prospective prosumers (lasting between 50 and 75 min) between May and June 2023. The interview structure closely matched the scope of the research questions. During the interviews, respondents were presented with a concise description of the REC, which outlined three main variants previously mentioned in the introduction of this publication: (1) P2P energy trading, (2) a shared RES installation, and (3) a DSR variant with an aggregator (the full interview script is available in the [Supplementary Appendix](#)). All interviews were transcribed and submitted for reflexive thematic analysis (Braun and Clarke, 2021) using MAXQDA software (Maxqda, 2021). The authors collaboratively developed an initial two-level coding scheme to identify key themes, refining it iteratively during the coding process.



The empirical material was interpreted within a framework considering historical, socio-cultural, economic, and psychological factors, organized using a taxonomy based on Bronfenbrenner's Ecological Systems Theory (EST, (Bronfenbrenner, 1979)). EST describes the environment as a set of embedded systems ranging from individual characteristics through immediate settings like family or neighborhood to broader societal and cultural contexts (see Section 1.1, Figure 1). This approach has proven fruitful in organizing knowledge about various social phenomena, including renewable energy issues (Vigurs et al., 2021).

## 2.2 Sample description

Drawing on Robinson's framework for qualitative research based on interviews (Robinson, 2014), we used purposive sampling using the status of the purchase of PV (long-term users, recent adopters and prospective users) as a factor differentiating cells. The participants invited to the study were (co) decision-makers about their investments in renewable energy sources and varied in sociodemographic characteristics (age, gender, place of residence, level of education). They were typical PV users residing in detached or semi-detached houses. The sample included three groups to capture diverse experiences related to PV ownership.

1. Prosumers for at least 2 years, using the net-metering system (interview codes L1–L5).
2. Prosumers for less than 2 years, with four respondents using net billing (interview codes S1–S5).
3. Future prosumers planning to purchase PV installations within weeks of the interviews (interview codes P1–P6).

All owned or planned PV systems were micro-installations intended solely for household energy needs, with power ranging from 3 to 8 kW and annual energy consumption of 2–3 MWh. Participants' household characteristics and PV installations were representative of future REC members. Table 1 provides detailed information on respondents and their households.

## 3 Results

The research findings are organized as follows: first, we discuss issues related to experiences and decisions associated with PV installations. Next, we examine the understanding of the REC concept, mainly focusing on the role of entities involved in their creation and the level of trust in them. Finally, we explore the motivating factors and barriers to participation in RECs. These findings address the first four research questions posed at the beginning of this study. The final research question, which involves contextualizing these findings within a systematized model, will be discussed in the paper's final part.

### 3.1 Experiences with the PVs

We summarize these experiences by describing four main meta-themes: the drivers and barriers within the decision-making process, post-purchase satisfaction among PV owners, and sources

of knowledge concerning PV operation. Importantly, all these experiences are discussed primarily as a significant context shaping the perception of RECs.

#### 3.1.1 The decision-making process regarding PV installations - drivers

Economic incentives have emerged as the primary drivers for the purchase of PV installations. State-subsidized programs significantly influenced decisions, often encouraging action. The steady increase in energy prices played a crucial role, prompting homeowners to view PV installations as a viable long-term investment. The anticipation of further price increases, driven by EU policies, highlighted the importance of these investments. Thus, the decision to adopt PV technology was based on immediate financial relief and strategic forecasting of energy costs.

Social factors also played a significant role. The rapid local development of PV installations created momentum, where geographic and social proximity led to concurrent decisions among community members. This social proof phenomenon, where their peers' choices influenced individuals, greatly impacted decision-making (Cialdini and Jacobson, 2021). Additionally, proactive sales strategies by installation companies simplified the purchase process. These companies facilitated technical and administrative aspects, providing comprehensive services that made PV technology more accessible to average consumers.

Importantly, environmental considerations, while present, were not primary motivators. Only three respondents cited ecological reasons, which were never mentioned as the main driver for purchasing PV systems.

#### 3.1.2 The decision-making process regarding PV installations - barriers

For most households, investing in PV installations is a significant expenditure, even with various forms of state financing. This decision carries considerable risk due to the uncertainty of energy prices and regulatory changes, compounded by low trust in state institutions and legal complexity. *"The number of these regulations, which regulate even the issue of electricity sales, when you receive any kind of sale contract from the power plant ... I do not know. I read these contracts, so I am a bit more aware of what I am committing to"* (P4).

Additionally, the change to the net-billing system is considered disadvantageous for prosumers and creates a less transparent settlement system. Respondents believe that an investment in a PV installation should pay off over a multi-year period (up to 10 years), but profitability is hard to estimate even a few months after installation. S4: *"People who think this is a quick return from it are wrong because, in reality, it is a minimum of 10 or more years" (...)* *"I think you have to wait about a year for the year to close. Only then will I have some opinion"*.

Economic uncertainty is often accompanied by doubts about technological aspects, such as sizing the installation, choosing a supplier, and technical limitations of the building's infrastructure. There are also procedural concerns, such as obtaining permits and accessing state funding. This necessitates cooperation with external advisors or sales representatives. Consumers with greater awareness and technical knowledge point to problems with the energy infrastructure, which often cannot accommodate energy

TABLE 1 Respondents' characteristics (N = 16).

Label	Gender	Age	Education	Occupation	Residence	House
L1	M	56	S	Production Manager	ST	DH
L2	F	54	H	Teacher	V	DH
L3	F	30	H	Farmer	V	DH
L4	F	42	S	Medical Services	T	SdH
L5	M	58	S	Transport Services	V	DH
S1	M	35	H	Manager in Mining Industry	ST	DH
S2	M	42	H	Teacher	T	DH
S3	M	55	H	IT Specialist	V	DH
S4	M	38	H	Production Manager	ST	SdH
S5	M	34	H	Lab Technician	T	DH
P1	M	32	S	Catering Activity	T	SdH
P2	M	33	H	Physiotherapist	ST	SdH
P3	M	49	H	Business Analyst	V	SdH
P4	M	39	S	IT Specialist	LC	DH
P5	F	42	S	Clerk	V	DH
P6	M	40	H	Logistics	ST	DH

Note: Gender: M - male, F - female, Age (years), Education: H, higher education, S, secondary education; Occupation (as listed by the interviewee); Place of living: V - a village; ST - a small town (with less than 30,000 inh.), T - a town (with more than 30,000 but less than 100,000 inh.), LC - a large city (more than 100,000 inhabitants); Type of house: DH - a detached house, SdH - a semi-detached house.

fed into the grid during peak production periods due to energy curtailment.

Less frequently mentioned themes included privacy concerns, such as fears of external entities accessing personal data and household activity, and ecological concerns related to the limited durability and disposal of panels.

### 3.1.3 Assessment of PV installations

After purchasing PV installations, users evaluated their decisions by considering both the positive aspects and the problems they encountered. All respondents felt their decision was correct, mainly due to profitability calculations. L3: *"It certainly worked out for us because currently, if we did not have photovoltaics, we would pay 20 thousand a year for energy, while now we pay 2.5-3 thousand PLN"*. However, some expressed frustration with continuing charges after installing PV. L2: *"I naively imagined that once we set up the panels, that would be the end of the bills, and nothing would come anymore"*. This sentiment reflects a broader theme where distributors and energy system operators are seen as exploiting prosumers. A notable point of contention was the misconception about energy independence. Despite owning PV installations, some respondents were surprised these systems did not protect entirely against power outages. This revealed a significant gap in

understanding the technological aspects of PV systems and their economic logic.

### 3.1.4 Education and sources of knowledge

Considering the complexity and weight of decisions related to purchasing PV systems, the sources of knowledge indicated by respondents are significant. Three main themes emerged in the interviews. First, recommendations from family or friends play a prominent role. Friends or family members already using PV systems are considered the most reliable sources of proven knowledge. Second, participants turn to online expertise, especially in the early decision-making stages. This includes forums, articles, and primarily video materials. Testimonials from "ordinary" people are seen as more credible than those professionally involved in energy. S1 *"People like me, for example, who make these videos, have a bigger impact because, in my opinion, they are very credible"*. Third, PV companies' sales departments are crucial in the period immediately before purchase. Due to the dominant sales model in Poland (direct meetings with sales representatives), much of the knowledge about PV installations was conveyed during these meetings. It is also worth noting that state structures (governmental or local) played a less noticeable role in education or information. Respondents only occasionally mentioned local

actions promoting PV subsidy programs. An interesting paradox emerged regarding the educational impact of purchasing, owning, and using PV installations. Many misunderstandings about the system's functioning or settlement were clarified only after purchase (such as the inability to “store” produced energy without proper storage facilities). This was also reflected in the accuracy of terminology used by participants; those with PV installations made fewer mistakes, differentiating between terms like kW and kWh.

## 3.2 Perception of the REC concept

Although some energy cooperatives and clusters exist in Poland, no REC initiatives have been established yet. Energy cooperatives mainly exist in large cities and are limited to buildings where photovoltaics have been installed to meet common needs. Energy clusters combine distributed energy generators with small businesses and typically do not involve individual consumers (Jasinski et al., 2021; Dragan, 2020). Hence, it was essential to understand spontaneous associations with the term “renewable energy community”. We asked about these associations before and after presenting a short description of the REC concept.

### 3.2.1 Top-of-mind associations with the REC name

The first most common associations with the term “renewable energy community” were the following:

- The combination of several energy sources, mainly photovoltaics, but also heat pumps or energy storage. Many thought of a shared photovoltaic farm as a joint investment. L4: “The whole estate will just set up, for example, a photovoltaic or a pump, and they will share this energy, yes? That it will be for all of them.” or P6: “Together, we are putting up some big photovoltaic investment”;
- The exchange and sharing of electricity: L3: “So that we share this energy with each other”, P2: “Everyone is together, that some produce, others use this energy (...) community, meaning that something is common, that is, shared by all”.
- The energy bank: P5: “An exchange of electricity, that what I give away, they will have to pay me back later,” P1: “It is just such an energy bank that people make for themselves around their houses. It is a kind of bank of a small estate, houses and everybody has some kind of panels and uses energy from that”, S1: “A circle of users, where everybody gives energy, and then I use it in turns”.

Participants believed a community linking individual households could have a stronger market position, allowing for better negotiation terms with energy distributors (S3: “Several people like me unite together (...) They have more power because they have a larger volume of energy. Then they can negotiate terms”).

For some, a community is a venture or business that must be profitable to succeed. “It is the kind of business that involves someone generating energy and making a deal directly with his consumer” (S3). Others saw the community as an opportunity for distributed prosumers to unite in energy production and purchase, similar to an energy cluster for smaller actors, P6: “setting up some kind of cooperative, where simply one produces electricity, the other one

uses it, they account for each other, or as one entity they account for the power plant.” Interestingly, many associations referred to solutions for blocks of flats or housing estates rather than single-family houses, e.g., L2: “housing communities can install such panels on their neighborhoods and use them jointly.” This is probably because the interviewees might have heard about the energy cooperatives, which, as already mentioned, function mainly for the block of flats.

### 3.2.2 Understanding of the REC concept

The interviewees were then asked to read a short description of the concept of REC, as shown in the [Supplementary Appendix](#). Their reactions varied, primarily driven by their perception of the economic principles governing the functioning of RECs. Some emphasized the advantages in terms of energy savings and efficient management (P2: “Cool thing, it is like the energy is not wasted (...) is just managed wisely”). Others evaluated the REC as utopian and politically or market unrealistic due to opposition of large players (P4: “What do power plants say to this because it will be distasteful to them, that we are going to sell electricity among our neighbours”, L4: “It is a bit utopian because some Kowalski said that he burns less, that he shines lights, and Iksinski probably more”). Some found REC interesting but were unclear on the practical side: L4: “I do not really understand how it transfers electricity to someone else. Does it just transfer like that and someone benefits? Or how does he resell it?”, P5: “Terribly confusing”, L3: “And on what basis? Is this about these photovoltaic panels like I have?”.

## 3.3 Factors driving the decision to participate in REC

Respondents mentioned various compelling arguments during the interviews for participating in an energy community. The primary drivers for joining REC were financial profitability, fair settlement and legal formalities, and the solution's convenience and time efficiency. Additionally, data access, increased energy independence, and supply stability were noted as important factors, but these had less impact on their decisions. These drivers are elaborated in the following subsections.

### 3.3.1 Financial profitability

The primary factor influencing respondents' decisions to participate in REC is financial profitability. Respondents expect that joining a REC will result in lower energy costs or financial gains from selling excess energy. For instance, interviewee P2 said: “if participating in REC is cheaper than selling excess energy to the grid, it would be appealing. On the other hand, if it is more expensive or the same price, there would be no sense in being part of the community”. Two groups of prosumers were identified based on their financial expectations:

- Prosumers valuing savings: This group aims to eliminate electricity costs in annual settlements. With anticipated energy demands from electric vehicles or heat pumps, they see RECs as a way to mitigate rising expenses.
- Prosumers seeking profit and additional earnings: This group focuses on generating income through energy sales and is willing to expand photovoltaic installations for greater financial returns.

In the financial context, optimizing the production and consumption of locally generated energy is crucial. Respondents view RECs as a way to reduce energy losses and efficiently use locally produced energy, resulting in financial benefits. They expect that local energy trading within RECs could reduce distribution network upgrades, cut out intermediaries, and lower energy bills. Additionally, RECs, as larger customers, can negotiate better pricing terms with energy distributors than individual customers.

Indirect financial incentives, such as tax benefits and extended warranties for renewable installations, also influence the decision-making process. Participants expressed the need for detailed financial calculations, including installation costs, insurance, and maintenance, to comprehensively evaluate the profitability of joining a REC. Significant considerations include initial costs associated with connecting to a REC or investing in a shared installation. High initial costs would be a barrier, while low costs could be an opportunity for those who cannot afford renewable energy installation. Also, respondents desired clarity on subscriptions and their calculation principles. The presence of dues may be controversial—some respondents would accept paying subscriptions, while others would not.

### 3.3.2 Fair settlement system and legal formalities

A key driver for respondents is creating a fair settlement system between REC members. Respondents are concerned about the potential for unfair distribution of benefits or fraud, emphasizing the need for the solution to be “*well thought out so that one does not benefit more while the other benefits less*” (L1). Transparent, understandable regulations ensuring equitable energy exchange and consumption are crucial. The legal formalization of RECs also garners significant attention. This includes defining community competencies, formalizing agreements, and instituting governing and supervisory structures to ensure lawful operations. Clear, unambiguous laws that eliminate interpretative flexibility are essential.

### 3.3.3 Convenient and time-efficient solution

Respondents expect a comprehensive, hassle-free REC experience. They envision an organization where a competent entity handles the management of the REC, including documentation, permits, equipment selection, and maintenance. Participation in REC should not be time-consuming or demanding, functioning “*from the level of an application, not from the level of local meetings*” (P2). Respondents expect REC to provide convenience, time savings, and task facilitation, such as electronic payment for energy and avoiding the need to install and maintain domestic heating boilers. Some participants were even willing to pay extra for convenience. The mobile application for REC participation should be straightforward to install and use. P2 stated: “*Either someone will come and take his phone and install an app for him, or there will be some very simple instructions for using it, either in the application or on YouTube.*” Appropriate support must be provided if installation and initiation are complex and require synchronization with other devices. Some respondents would like the ability to automate buying and selling transactions through the mobile application, believing it would save time and effort. However, the extent of automation should be customizable to accommodate users’ varying levels of trust in technology.

### 3.3.4 Data access

Interviewed prosumers responded very positively to the idea of being provided with data on energy production, consumption, and conducted transactions. They believe that accessing data through the application would be more convenient than receiving bills in current forms (paper or electronic). P5: “*Now I have to go outside, open the mailbox, calculate the average for the month, and I know how much I pay in a day. In the application, I would have it up to date, with statistics, from a specific day, from daytime hours, nighttime hours*”. Some respondents note that this would give them a sense of peace and control, L1: “*everything in the app, you see how much energy you have consumed, how much you have sold and so on. If you had that control, you would be calmer*”.

The necessity for a user-friendly and credible presentation of data was emphasized. Prosumers express the desire for an interface that is not only appealing but also intuitive, presenting crucial information in a visual and straightforward manner. The potential for such detailed data to influence user behavior is noted, suggesting that plots showing hourly consumption could encourage more energy-conscious decisions.

However, there is a distinct lack of interest in functionalities that would enable comparison of energy usage with neighbors. Respondents do not view such features as beneficial and express concerns about the potential for causing discord or conflict within the community. The focus remains on personal management and control of energy data rather than comparisons with others.

### 3.3.5 Increase in energy independence and supply stability

One key argument for joining REC is to increase the community’s energy independence and ensure energy supply stability. Adopting REC is perceived as a strategy to mitigate risks associated with large-scale power plant failures or grid instabilities, providing a safeguard for local businesses and, by extension, higher employment within the region.

The importance of community size in achieving energy independence is emphasized. A larger REC is seen as more capable of accumulating energy reserves, ensuring resilience during periods of low energy production, such as on cloudy days. The interviews also reveal an interest in integrating energy storage solutions within REC. Such systems would allow for more effective utilization of personal renewable energy installations, reducing dependence on external weather conditions. P3 stated: “*By sharing a common energy storage with other REC participants, I will be able to make better use of my PV installation. Currently, I cannot always count on the availability of energy from PV because the sun is not always shining*”. Additionally, diversifying energy sources within RECs is vital to increasing energy independence. Respondents advocate for a mix of renewable energy sources, including solar farms, wind farms, and hydrogen production facilities, to create a robust and resilient electrical system.

### 3.3.6 Other aspects supporting REC

While not universally recognized as primary drivers, certain aspects emerged during the interviews as potential motivations for joining REC. These factors, noted by a few respondents, add depth to our understanding of the diverse incentives for REC participation:



- Minimization of technical exclusion: RECs are a solution to technical and financial barriers preventing individual renewable energy installations. RECs offer an alternative pathway to renewable energy utilization for residents with constraints like roof warranty concerns or limited space in urban settings. Additionally, individuals with oversized photovoltaic installations view RECs as an opportunity to distribute excess energy within the community efficiently.
- Decision making and control: Despite a preference for comprehensive design and management of RECs, participants desire a sense of control and agency within the community. The structure of RECs should allow members to feel involved without being burdened by organizational responsibilities. Moreover, the flexibility to join or leave an REC at regular intervals, such as every 3 months, is desirable. Respondents emphasize that RECs represent a new solution, and before deciding to join, they would like to observe how such communities operate and verify whether other people, including neighbors and friends, are satisfied.
- Ecological considerations: Few respondents referred to aspects related to ecology and environmental care in the context of REC. Several declared that ecology would be a supporting argument for REC, but economic benefits play a much more significant role in decision-making. L2 stated: *“For me, the second, and even the first argument, is ecology, but I realize that for most people, financial matters are still the most important.”* P3: *“The solution is timely because we have generators, energy storage, etc. We are very environmentally friendly. However, in the end, the economic calculation, the real one, matters.”* The low emphasis on environmental arguments ensures that individuals with diverse viewpoints, even those who do not acknowledge their role in mitigating climate change, may be motivated to participate in REC due to the financial incentives offered.
- Economic patriotism: Some participants preferred locally-based or national companies managing RECs. This preference stems from a desire to support the national economy and distrust of foreign enterprises. Corporate nationality perceptions and geopolitical views may influence trust in REC management.

## 3.4 Barriers

During the interviews respondents expressed their concerns about joining REC and identified factors that would certainly discourage them. Among the frequently mentioned barriers that significantly influence the decision are: 1) the novelty and complexity of the solution, 2) a decrease in energy security, stability of energy supplies, and associated financial losses, 3) technological barriers, 4) neighbor disputes and a sense of dependency on others, and 5) the lack of trust and access to new technologies. The identified key potential barriers are described in the following subsections.

### 3.4.1 The novelty and complexity

One of the key barriers mentioned by respondents is the novelty of REC and the inability to test it. S4 stated: *“I feel uncertain because it*

*is something that does not exist at the moment, I have not encountered it, and it would be a challenge to overcome”*. Additionally, the concept of REC is intricate and difficult for respondents to imagine. They emphasize the need for a pilot project to see how REC actually functions. They do not fully understand the purpose of forming REC. L1 asked: *“What is the purpose of these cooperatives? I currently have an arrangement with the energy company and settle with them on favorable terms (...) Who would benefit from this, and who would lose out?”*. S1 added: *“The idea is cool and definitely developmental, but there a lot to coordinate (...) Honestly, I do not entirely see how it can work. The concept is nice, but for now, I do not really know why, in the end”*.

### 3.4.2 Decrease in energy security, stability of energy supplies, and associated financial losses

Respondents unanimously express the need to secure energy supplies. They expect the availability of energy backup in case of a shortage of locally produced energy. S5 asked: *“How does REC operate during the winter when PV does not generate energy? REC should connect to power plants during the winter season.”* Additionally, respondents want to know how prepared REC is for various emergency scenarios. Some individuals, drawing on their experience with PV installations, are concerned that REC installations may operate defectively and cause an increase in voltage in the grid. They emphasize the importance of proper safety devices for REC installations. Respondents are also concerned about interruptions in electricity supply when switching to a backup energy provider or during the exchange of electricity between neighbors. They worry about associated financial losses when participants, instead of using their own PV, are supplied with more expensive energy from the backup service provider.

Moreover, respondents expressed concern that locally produced energy would be insufficient to meet their needs while participating in RECs. This concern relates to both the financial aspect, as P5 noted: *“I would like it to be based on selling excess production, not current production because it is of great importance. Because why do we install photovoltaics? To reduce costs at home, not to reduce costs for the neighbor”*, and to energy security, as P3 stated: *“The downside is that someone could switch entirely to such a solution, and it would not be enough electricity for me”*.

### 3.4.3 Neighbor disputes and lack of independence

Respondents strongly prefer individual installations over communal ones. This preference gives them a sense of independence and control and helps avoid conflicts. P3 noted: *“We Poles are more like ...when we have our own, we have our own. So here I am rather conservative, and I think I would rather have my own PV.”* Additionally, a significant portion of the respondents identified potential conflicts as barriers to REC community formation, specifically related to:

- Differences of opinion among participants – *“That is how it is - two Poles mean three opinions”* (L2),
- Envy from neighbors, suspicion, mistrust, or the desire to act against the group by individual participants – *“People are naturally suspicious. One wants more than the other. Envy sometimes affects behavior in different ways”* (L1),

- Fraud and dishonest division of benefits among REC members – “How to divide this electricity so that it is enough for everyone, and no one has complaints? (...) I would be afraid that when electricity is free, people will start overusing all kinds of electronic devices and equipment” (P5).
- Ineffective communication – “Later, it can turn out that I thought one thing, and the other meant something else” (L1).

In this context, the importance of well-crafted laws and operating principles for REC becomes even more salient.

### 3.4.4 Technological barriers

Some respondents argue that the current electricity grid infrastructure is unprepared for REC. “Our electricity grids should undergo a thorough change. They are absolutely not ready for an electrical boom. We would simply have a blackout all the time because overcurrent is harmful” (P4). Implementing RECs would require significant investment, and with the current bureaucracy, it would take a lot of time. “The infrastructure is not ready for this. Because, after all, all members have to connect everywhere. It will be expensive, someone will have to pay for it, and that will be the biggest problem” (P1). Additionally, respondents anticipate resistance from energy monopolists and utility companies, as RECs may lead to customer and profit losses while presenting organizational and technical challenges.

Respondents also foresee difficulties in managing energy flows among community members with similar consumption and production patterns throughout the day. They emphasize problems related to excess energy production from photovoltaic installations that the grid infrastructure cannot accommodate. Potential solutions include installing energy storage facilities or diversifying REC membership to include small businesses or establishments with higher daytime energy consumption. A recurrent theme in discussions is the potential for both residents and local businesses to participate in these communities.

### 3.4.5 Lack of trust and access to new technologies

During the interviews, some respondents pointed out generational differences, stating that older individuals may face barriers to accessing and trusting new technologies. “Different people will want to use it, including older individuals. Not every phone has the function to have an application (...) I think older people are less open to such solutions. Because they are afraid of being cheated.” (P3). “People are not ready for this type of change. Looking at the mentality of my neighbors, I believe it would take another 40 years for such changes” (P4). We also observed that some middle-aged and older respondents negatively associate the energy community with communism or Marxism. “I am from the 1960s era, where we underwent transformations like cooperatives and similar things, state agricultural farms, and all that did not work out” (L1).

The interview outcomes reveal significant variation in individuals’ trust in technology. Some prosumers would prefer a gradual transition rather than abruptly abandoning familiar solutions, such as receiving paper bills. L3 said: “At the beginning of participating in REC, I prefer paper bills, to make sure that there

are no differences or mistakes. It looks more credible to me (...) If I am convinced, then definitely the app”. They would require time to familiarize themselves with the new system and build trust. Conversely, others would not feel the need for additional verification of data. P2 remarked: “An app would be completely sufficient for me”.

### 3.4.6 Other barriers and concerns

During the interviews, several additional concerns emerged from individual respondents that may constitute potential barriers to REC participation. One such concern relates to energy justice. For example, it was noted that an increase in the number of individuals who decide to disconnect from the electricity grid and transition to off-grid solutions will result in higher prices for conventional energy supply, including the technical maintenance of electricity grids, for the remaining users. Similarly, this could apply to REC-individuals outside the community may pay higher energy bills than at present since fewer people will “contribute” to the maintenance of the infrastructure. According to these respondents, this is why current energy laws do not permit energy trading between individual consumers and prosumers.

Some respondents also pointed to the lack of appropriate legislation as a potential barrier for REC. They noted that current Polish law does not allow for the sale of excess energy between energy community participants. They also believe that Polish regulations are too complicated to implement REC legally. “The complexity of Polish regulations partly results from the mentality of Poles, who look for loopholes in the law” (P4).

Another potential barrier for REC mentioned by some respondents is high prices and the lack of available land in cities. Landowners in suburban areas with high prices would find it much more profitable to sell the plot to developers than to lease it for a REC installation. This could pose a potential threat to the development of energy communities, and for this reason, REC should utilize spaces that are difficult to access for other investments, such as the roofs of houses or apartment buildings.

## 3.5 Trust in various institutions and key stakeholders

We address trust issues concerning various stakeholder categories in a separate subsection for two reasons: first, they are fundamental to REC development, and second, participants’ statements revealed significant contradictions that prevented clear classification as opportunities or barriers. This ambivalence manifests in contradictory perceptions of the EU, state structures, and enterprises. The tension between lack of trust and the acknowledged need for institutional support emerges as a key characteristic of narratives on this topic.

Many respondents are skeptical about the role of Europe, including Poland, in reducing CO<sub>2</sub> emissions globally by switching to renewable energy sources, saving energy, and improving energy efficiency. They believe that unless similar measures are initiated globally (e.g., by India, China, or the United States), Europe alone will not significantly impact climate change. “Big countries like China, India, America, Africa, and so on are not worried about this climate because there is such pollution there. And all

of us in Europe are in favour of the fact that we will save the world" (L1).

There is also a lack of trust in the national government. "Wherever the state has its fingers, it is clear that they want money and nothing else" (P1). Conversely, if well-run and depoliticized, local government is seen as an excellent entity to support the creation of RECs. "The state should then regulate and support the development of such communities" (P6). Respondents believe that local authorities should be responsible for setting up RECs rather than the government or companies. "That it would be credible. They would be more trustworthy than some private company, somewhere, I do not know, a phantom ...or something came into existence and ...and you do not know who, what (...) It seems to me that if it originated from local authorities, it would be more credible" (L5). This belief is due to local authorities being seen as guarantors of stability and representatives of the local community, understanding its needs.

The role of companies, both public and private, is perceived differently. For private companies, some respondents fear not only the pressure to maximize profits at the expense of consumers but also the risk of company failure, which could leave them without technical, administrative, or financial support. "I would like it to be a monopoly like a power company or some, I do not know, kind of a state-shifted entity. Safer, as it were? (...) because, let's assume, I put a lot of money into such an investment, and suddenly they disappear. And then what? (S4)". However, some believe that companies installing PVs could play a vital role in creating RECs. "The companies that deal with photovoltaics know the most. And they should be the ones to create such communities" (L3). Some respondents think that state-owned energy companies should create RECs because they are more reliable than private ones and have the infrastructure, know-how, and experience in the energy industry. As L5 suggested: "the big energy companies should be in charge of that. It does not make sense to set up another private company, because you know, maintenance costs".

## 4 Discussion and conclusions

This paper examined the motivations and obstacles for Polish current and prospective prosumers to participate in REC. Additionally, we sought to systematically understand and structure this knowledge, providing a better foundation for discussions on REC policy implementation in Poland. The discussion is structured as follows: first, we briefly summarize the barriers and drivers regarding REC, followed by a more detailed presentation of them in the context of Bronfenbrenner's model; then, we discuss the specificity of the Polish socio-cultural context; and finally, based on these results, we undertake a broader reflection on methodological issues and limitations of our study.

### 4.1 Drivers, barriers, and expectations towards participation in REC

Participants highlighted several persuasive reasons for engaging in the energy community, identifying key factors influencing

the decision to join REC: financial profitability, fair settlement and legal procedures, and the solution's convenience and time efficiency. Additionally, considerations related to data access, energy independence, and supply stability were essential but had a lesser impact on decision-making. Conversely, participants voiced apprehensions about REC participation and identified significant deterrents. Notable barriers included the perceived novelty and complexity of the solution, concerns about diminished energy security, instability in energy supplies, financial setbacks, technological hurdles, potential conflicts with neighbors, and perceived reliance on others. Lastly, a lack of trust and limited access to new technologies were crucial barriers. Importantly, both aspects of the perception of RECs—potential benefits and difficulties—are significantly shaped by experiences related to the recent "photovoltaic revolution."

### 4.2 The need for systemic analysis of the decision-making environment

The study results demonstrate the importance of a systemic approach in understanding the decision-making and motivational processes that influence the behavior of prospective REC participants. Although the users' statements most often concern their individual and personal histories or beliefs, their analysis allows us to reconstruct a field of motivational, social, and cultural forces acting on them at all levels of the hierarchy proposed by Bronfenbrenner.

Figure 2 presents a synthetic summary of the motivational factors identified in the study, characteristic of PV users and individuals interested in RECs, while simultaneously proposing their preliminary hierarchization. Additionally, these factors are categorized according to Bronfenbrenner's model, which will serve as a starting point for discussing the unique, specifically Polish context of the obtained results in the next section.

Some identified motivations and barriers operate at the individual level, such as technological self-efficacy or environmental beliefs. Others exist at the microsystem level, encompassing an individual's closest relationships, including family dynamics and household economic factors like investment costs and energy consumption patterns. At the mesosystem level lie factors related to social interactions and information exchange, such as social relationships, neighbor pressure, and transparency of available options. The exosystem includes structures and institutions that indirectly affect individuals, such as technology infrastructure availability and trusted third parties including companies and local government. The macrosystem level encompasses elements that form the decision-making environment, such as accessible technological platforms, clear legal frameworks, financing mechanisms for energy transformation, and characteristics of Polish socio-cultural context, including attitudes and social norms. Finally, chronosystem elements—factors correlated with time that significantly shape respondents' environments—appeared in users' narratives. These include the 2022 Ukraine war and its consequences for the Polish energy market, as well as evolving EU energy policies and their associated current and anticipated impact on energy prices.



	PV specific	PV and REC (shared)		REC specific
INDIVIDUAL		<ul style="list-style-type: none"> <li>• <b>Financial expectations</b></li> <li>• <b>Technological self-efficacy</b></li> <li>• <b>Intrinsic rewards</b></li> <li>• Political orientation</li> <li>• Environmental beliefs and concerns</li> <li>• Real-time energy data availability</li> </ul>	<ul style="list-style-type: none"> <li>• Change readiness and age</li> <li>• Education, domain knowledge and experience</li> <li>• Data privacy and security concerns</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Energy security and stability</b></li> <li>• <b>Convenience / UX</b></li> <li>• <b>Control and independence</b></li> <li>• Trust in community and sense of belonging</li> <li>• Digital skills</li> </ul>
MICROSYSTEM	<ul style="list-style-type: none"> <li>• Technical limitations (house or roof construction)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Investment cost</b></li> <li>• <b>Opinions and influence of important others</b></li> <li>• Microgeneration unit ownership and experiences</li> <li>• Energy consumption patterns</li> </ul>	<ul style="list-style-type: none"> <li>• Current and expected energy use including changes in family structure.</li> <li>• Accessibility for other family members - possibility of cooperation within REC</li> </ul>	<ul style="list-style-type: none"> <li>• Place of residence facilitating REC creation</li> <li>• Parameters of PV installation</li> </ul>
MESOSYSTEM		<ul style="list-style-type: none"> <li>• <b>Social relationships and neighbor /peer pressure</b></li> <li>• <b>Transparency and fairness</b></li> </ul>	<ul style="list-style-type: none"> <li>• Access to reliable information sources</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Alignment of individual and community interests</b></li> <li>• <b>Keeping agency and control</b></li> <li>• Conformism and social comparisons</li> </ul>
EXOSYSTEM		<ul style="list-style-type: none"> <li>• Technology and infrastructure availability (grid readiness)</li> </ul>	<ul style="list-style-type: none"> <li>• Trusted third parties including companies and local government</li> </ul>	<ul style="list-style-type: none"> <li>• Inclusive and just transformation</li> </ul>
MACROSYSTEM		<ul style="list-style-type: none"> <li>• <b>Accessible technological platforms and infrastructure</b></li> <li>• <b>Clear legal frameworks</b></li> <li>• <b>Financing of energy transformation</b> (subsidies, settlements).</li> </ul>	<ul style="list-style-type: none"> <li>• Stability of state and government institutions</li> <li>• Policies shaping energy markets and prices</li> <li>• Attitudes and social norms</li> </ul>	
CHRONOSYSTEM		<ul style="list-style-type: none"> <li>• War in Ukraine and its consequences</li> <li>• EU policy shifts</li> </ul>		

FIGURE 2

Key factors impacting the decision to invest in PV and participate in REC classified according to their prominence and Bronfenbrenner's socio-ecological model.

### 4.3 The role of specific socio-cultural factors

Regardless of the complexity revealed in the systemic analysis, the results clearly indicate that understanding how people think about RECs involves both universal and local mechanisms. This locality is expressed through various interconnected dimensions, such as the Polish economic context, cultural idiosyncrasies, customs, and the specifics of legal or political frameworks. A recent publication by (Krupnik et al., 2022) suggested that the humanities and social sciences play an instrumental role in understanding energy transformation. Our results support this observation, demonstrating that an in-depth analysis of the variables determining the effectiveness of implementing REC has to incorporate knowledge and methodological tools of social sciences and humanities. This aspect of the results could be the subject of separate analysis, but here, we will refer to a few illustrative examples. The first two highlight issues that polarize and differentiate respondents in the Polish context. The remaining two characterize all respondents and are universally relevant in Poland and - simultaneously distinctive

compared to other countries, even those geographically and culturally close.

Firstly, a series of statements indicate observed or anticipated difficulties in establishing REC due to ambivalence in the perception of potential stakeholders, including local government and distribution network operators. Addressing these concerns is crucial for the success of REC implementation. Interviewees strongly expected REC operators to guarantee stability and energy security. The perception of individual stakeholders is highly polarized in Poland, influenced by political and ideological beliefs that affect trust in business, local authorities representing certain parties, etc., (Radkiewicz and Jarmakowski-Kostrzanowski, 2021).

Another significant local condition affecting reactions and attitudes is the diversity in levels of trust in EU institutions and policies. This polarization is shaped by top-down factors and the intensification of populist and divisive discourse among power elites (Worzecki, 2019; Cinar and Nalepa, 2022). These discrepancies influence the perception of ecological issues and EU Green New Deal policies. The discourse on energy has been politicized and has become a hostage to political conflicts (Zuk and Szulecki, 2020; Herudziński and Swacha, 2022a).



Compared to Western countries, the topic of climate catastrophe in Poland, although becoming more significant, is not at the center of public discourse (Herudziński and Swacha, 2022b). This may be due to historical and political conditions related to the rapid systemic transformation after the fall of communism (Chodkowska-Miszczyk et al., 2021). Additionally, economic factors related to Poland's current situation, as a neighboring country to the war in Ukraine and experiencing a rapid increase in energy prices, are significant. As evidenced by the interview data, economic motivations overshadow ecological considerations.

Finally, a highly distinctive phenomenon important for the future of REC in Poland is the educational influence of the PV revolution. The ubiquity of experiences related to PV, including ownership, purchase decisions, interactions with sales departments, and discussions in everyday life, has significantly shaped knowledge about energy use and the energy market. For many people, considering and using PV is their first experience with citizen energy. Our interviews indicate that opinions on how REC may operate are significantly based on PV experiences, including trust in information sources, economic expectations, and cost-benefit analysis. The specific trajectory of renewable energy has become a formative experience for the future of REC in Poland.

## 4.4 Implementing and communicating REC - strategic insights

As explained in Section 4.3, barriers and drivers to participation in REC may appear at different levels of Bronfenbrenner's socio-ecological model. Below, we present several recommendations that seem credible in light of the obtained results and demonstrate how an approach considering the full range of conditions for REC acceptance can be helpful as a tool for generating more effective policies better suited to local specifics.

- REC solutions operate differently from the existing retail electricity market, are novel, and are difficult to conceptualize. This implies that effective change management is crucial in REC implementation. One of the critical aspects will undoubtedly be the development of effective communication policies. Based on respondents' feedback, we assert that the operational model of REC should be flexible and tailored to the characteristics of each group and region to meet users' needs. These include location-based differences, such as land availability in urban or rural areas, and variations in lifestyles and preferences for additional services offered by REC, which will dictate the most suitable REC model.
- Our results indicate that issues related to ecology and global warming are still seen as debatable and controversial, which may make them less compelling and even deter specific audiences. If we intend to construct a message based on ecology and environmental conservation, it should be targeted specifically to a chosen audience.
- Importantly, cohort effects were evident in reactions to certain aspects of REC, such as environmental awareness or the

perception of the cooperative movement as an adequate (or ineffective) form of self-organization. Prosumers could become advocates for REC solutions in Poland, but only if the narratives are tailored to the resonate with their specific characteristics.

- Furthermore, implementing a pilot projects in Poland would be a significant and desirable action in communicating REC, also building on the experiences gathered within initiatives such as REScoop (2025). One of the most robust psychological barriers to REC is their lack of presence in the media space (and even more so in the respondents' immediate vicinity). Such pilot projects would address current respondents' difficulties by allowing them to understand how REC operates, test the solution, and grasp its benefits and limitations.

These examples are, of course, only a few selected recommendations. The heuristic value of the synthesis presented above extends far more widely.

## 4.5 Broader methodological considerations

Regardless of the detailed recommendations for effectively implementing RECs, our findings also yield broader insights. These insights pertain to the challenges of generalizing our results in developing REC-related policies and, more expansively, in studies concerning energy transformation. This topic certainly warrants further in-depth examination. Within the scope of this discussion, we summarize these insights through four key learnings.

First and foremost, our research underlines the importance of adopting a systemic perspective when studying energy transformation processes. An approach that exclusively focuses on a single dimension—be it macroeconomic, social, or psychological—is likely to result in oversimplification diminishing the explanatory and practical value of the resulting models. This multidimensional approach is essential to capture the complexity and interconnectedness inherent in energy transformation studies.

Secondly, while many factors we identified as significant for REC attitudes parallel findings from international studies, several aspects remain strongly locally conditioned. This demonstrates that disregarding the specific cultural, social, and political research context can lead to significant misunderstandings or oversights. People are the decision-makers in consumer energy. Therefore, recognizing their immersion in local environments—shaped by collective historical memory and cultural patterns—is crucial.

The third key finding emphasizes the importance of recognizing individual differences and population diversity when designing policies and interventions. While variables affecting REC attitudes appeared relatively consistent across interviewees, significant perspective variations existed within the group—ranging from technological expertise to its absence, and from cooperation advocates to laissez-faire proponents. In FMCG markets and typical services, target group diversification is natural and embedded in established communication and marketing processes. However, REC solutions present a greater challenge, as they must address needs across user groups with fundamentally different worldviews,

attitudes, and technological competencies. This challenge stems partly from the systemic, often national-level introduction of REC-type solutions, where possibilities for effective individualization or personalization remain considerably limited.

Finally, our analysis of the Polish context reveals a crucial yet subtle aspect of implementing Renewable Energy Communities (RECs): their significant unpredictability over multi-year horizons. The Polish case demonstrates how various, often unforeseen factors can profoundly shape prosumer beliefs and attitudes. Financial support mechanisms for prosumers led to the emergence of commercial entities conducting effective sales and educational activities. External events, such as military conflict near Poland's borders causing substantial energy and raw material price shifts, have also played a key role. This combination created a “perfect storm” that catalyzed rapid photovoltaic system expansion, shaping the landscape for future citizen energy solutions. Notably, Poland's prosumer revolution—a distinctive feature compared to neighboring markets and a pivotal factor in its energy future—did not result from top-down strategy. PV installation growth has consistently exceeded forecasts, driven primarily by unexpected positive feedback loops rather than deliberate policy. This underscores the dynamic and unpredictable nature of energy transformation, particularly in citizen-led initiatives like RECs.

## 4.6 Limitations and future work

The decision to base this study on qualitative data was driven by the scarcity of preexisting knowledge and the complexity of the studied problem. Although this approach yielded many interesting results, it is not without its inherent limitations. One notable constraint is the limited sample size, which affects the generalizability of the results. The restricted sample size prevented an in-depth exploration of socio-demographic variables and their potential influence on attitudes toward RECs. Another important aspect is the need for quantitative verification, a concern already acknowledged within our project framework. Incorporating robust quantitative methods will enhance the reliability and validity of our findings and enable more comprehensive analysis of socio-demographic differences.

Furthermore, the current dynamics in Poland introduce additional challenges and potential limitations. The political turmoil and geopolitical instability, particularly the situation in Ukraine, shape the context in which our study unfolds. These external factors may introduce fluctuations and uncertainties that could impact the accuracy and applicability of our results. Future research should consider incorporating real-time data and adjusting methodologies to account for the dynamic geopolitical landscape in the region.

To address these limitations and strive for a more comprehensive understanding, future studies should expand the sample size, supplement the qualitative approach using quantitative methods, and adapt research strategies to accommodate the evolving geopolitical climate. In that respect, future studies could also benefit from collaborations with experts in political science and international relations to provide valuable insights into the broader contextual factors influencing the dynamics under investigation.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary Material](#), further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving humans were approved by Komisja ds. Etyki Badań Naukowych Politechniki Wrocławskiej [Ethics Committee for Scientific Research of Wrocław University of Science and Technology]. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

MB: Conceptualization, Data curation, Investigation, Methodology, Software, Writing – original draft, Writing – review and editing. EN: Conceptualization, Data curation, Investigation, Software, Visualization, Writing – original draft, Writing – review and editing. AK-P: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing.

## Funding

The author(s) declare that financial support was received for the research and/or publication of this article. This work was supported by the National Science Center (NCN, Poland) with grant no. 2022/45/B/HS4/03805.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenrg.2025.1500038/full#supplementary-material>

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