German-Polish Energy Platform

KAPE

dena German Energy Agency

ANALYSIS

Best practices for energy communities in Poland and Germany

Legal information

Publisher:
Deutsche Energie-Agentur GmbH (dena)
German Energy Agency
Chausseestrasse 128 a
10115 Berlin, Germany
Tel: +49 (0)30 66 777-0
Fax: +49 (0)30 66 777-699
Email: info@dena.de
Website: www.dena.de

Authors:
Iwona Ciećwierz, WiseEuropa
Krzysztof Kobyłka, WiseEuropa
Kamil Laskowski, WiseEuropa
Dr. Wojciech Lewandowski, WiseEuropa
Renata Rożek, WiseEuropa

Project lead:
Claire Gauthier, dena
Dr. Karolina Jankowska, dena
Franca Pompeÿ, dena

Image credits:
©shutterstock/Hennadii Filchakov

Last updated:
11/2022

All rights reserved. All use of this publication is subject to the approval of dena.

Please cite this publication as follows:

Deutsche Energie-Agentur (Publisher) (dena, 2022) “Best practices for energy communities in Poland and Germany”

Table of contents

Executive summary

Energy communities (ECs) are a concept that has significant potential to support the environmental dimension of the energy transition, as well as fitting into a broader context of the sustainable development of energy systems that also includes socioeconomic and security aspects. By promoting participation of non-traditional actors in the energy market at the local level (energy democracy), ECs contribute to the emerging model of modern energy systems, based on a decentralised network in which energy is produced, consumed and balanced more locally.

A regulatory framework (chapter 1)

ECs have developed in Poland and Germany thanks to – and in spite of – the regulatory framework surrounding them. In any case, both countries are currently amending these frameworks in order to improve the development of ECs. Our analysis of the legislative frameworks at the EU level, in Poland and in Germany shows that, despite similar concepts, the legal definitions developed at the EU level are not fully implemented into national law, and provisions at national level differ considerably. So far, the regulatory environment for ECs in Poland has been too vague and provides little incentive to establish communities. The legal evolutions currently under way are expected to increase both regulatory robustness and incentives, in the form of more favourable metering methods. In Germany, on the other hand, favourable financing conditions – e.g. from feed-in tariffs (FITs) – have led to significantly greater development of ECs in that country, and various business models for operating ECs have been developed there. However, compared to Poland, Germany is less in harmony with EU law – there is no definition of 'jointly acting renewables self-consumer' or a clear distinction between renewable EC and citizen EC.

Conceptualisation of ECs (chapter 2)

Since policymakers see ECs as important actors in the future energy system, it is important to understand how they can contribute to **policy goals** and how they operate (**business models**). Firstly, the European Union (EU) frames its contribution around the overarching objectives of sustainable development: **economy, society and environment** and the additional goal of **security**. The contributions to policy goals described in this chapter form the basis for a proposed set of indicators for use in monitoring the development of energy communities (Energy Communities tracker, see **chapter 4**). Secondly, ECs can achieve those goals by operating under different business models, depending on the stakeholders engaged, the technologies involved in ECs, and the values. The diversity of activities and actors results in multiple business models for ECs that are constantly evolving.

Comparative case study analysis (chapter 3)

Findings of the case study analysis are largely consistent with the initial findings from the analysis of the regulatory framework. However, the answers given sometimes contradicted each other, which suggests a certain degree of heterogeneity and different experiences (such as financial conditions) at country level. The identified strengths and weaknesses show a different level of development of the concept in the two countries. ECs in Germany are more developed and face more nuanced problems. In Poland, on the other hand, ECs are still in their infancy, although opportunities and best practices for ECs do exist there. Adequate public policy support could lead to stronger development of ECs.

Both countries have the opportunity to develop further ECs, which are becoming more and more important due to the EU's increasing climate ambitions and the issues highlighted by the energy crisis triggered by Russia's aggression against Ukraine. In Poland, new opportunities may open up from better transposition of EU law, as well as through the significant potential for community development offered by the large number of private PV installations. In Germany, opportunities related to the uptake of digital technologies and new technologies for energy generation and storage were highlighted.

The analysis indicated that, for ECs in both countries, many threats and barriers are still to be overcome, including better financial support and gaps in legislation, as well as administrative and technical barriers such as grid congestion. In Poland, the development of ECs is still impeded by poor community involvement, vague and imprecise regulations, or a lack of appropriate support for developing these communities in technical, administrative and purely economic spheres. In Germany, the surveyed communities pointed to the threat of insufficient digitalisation and expertise as an obstacle to the development of ECs. In Germany, expectations are shifting towards the development of innovative business models, e.g. based on energy sharing and peer-to-peer trading, which in return require intensive development of digital technologies and the uptake of smart metering.

There are also areas in which both countries can learn from each other. For example, best practices in Germany could be presented in Poland to popularise the idea of cooperativeness. At the same time, Germany could try to engage the local authorities more in the development of ECs, as is the case in Poland.

It is worth noting that not all high-level objectives set by the EU for ECs are equally represented in Germany and Poland. ECs currently focus on the production of energy from RES, its consumption and, in some cases, its resale, lowering the energy prices for participants. More focus could be directed towards other EC targets, such as the fight against energy poverty, reduction of energy consumption/energy saving and efficiency, and the uptake of new energy consumption patterns.

Best practices (subchapter 3.5)

Interviews on both the German and Polish sides, supplemented by secondary research, revealed many best practices that could be implemented on a larger scale:

Poland

- **Strong involvement of local government units:** because of their role in society, they can provide coordination and credibility, as well as administrative and technical support.
- **Strong leadership**: the case of the Tyski Energy Cluster shows that strong leadership and proactivity on the part of individuals or institutions facilitates the development of ECs.
- **Innovation of SMEs and commitment of R&D units**: cases in Poland have shown how ECs can cooperate with businesses and R&D divisions to boost innovation.
- **Involvement of ECs in the development of the region**: ECs can go beyond simple aggregation of energy and engage in other aspects of energy transformation.

Germany

- **Transparency:** this is a key factor in establishing accountability and public trust. In addition, monitoring and reporting provides information about the development and dynamics of ECs and enables governance, both at the individual community and national levels.

- **Replicability and scalability:** solutions in Germany are often replicable and scalable, which has a positive impact on the deployment of ECs and the financial stability of individual communities.
- **Stable financing conditions (FIT):** most cooperatives in Germany were established at a time when simple and safe financing rules were in place in the form of FITs. In their absence, producers are now exploring new business models to remain profitable, such as energy sharing and local energy consumption.
- **Umbrella organisations**: associations of ECs can promote the idea, carry out lobbying activities, and facilitate knowledge sharing.
- **Virtual community power plants:** ECs based on digital solutions demonstrate the ability to put modern digital solutions into practice and to develop innovative business models.
- **Cooperative of cooperatives:** organisations that bring together cooperatives and act collectively, pointing to a remarkable degree of cooperation and networking**.**
- **Landlord-to-tenant electricity:** despite the lack of a separate legal definition, an efficient and relatively simple model for self-consumption in residential buildings has developed.

High-level objectives set by the EU for ECs are only partially reflected in the expectations of the ECs themselves.

Policy recommendations (chapters 4 and 5)

A set of appropriate indicators can help in selecting the right model for operating the community, monitoring its progress, and monitoring the community at the macro level. We present such a set in chapter 4, based on the normative approach and the main sustainable goals that the EU is aiming to achieve (see chapter 2). A proposed set of indicators could provide a future knowledge base for public administrations, R&D units and ECs themselves, one that is essential for developing effective policies and strategies.

Chapter 5 includes specific recommendations for Germany and Poland. Recommendations common to both countries relate to regulatory issues, particularly the transposition of legislation to comply with EU legislation, support for objectives such as tackling energy poverty and reducing energy consumption (which ECs do not address sufficiently in their activities now). We suggest providing a framework for coordinated holistic support in the form of 'one-stop shops'. It is also important in both countries to create a framework for cooperation between energy communities and distribution system operators (DSOs), in order to enable the large-scale implementation of new services. This might include aspects such as flexibility, certain cooperation standards, or a dedicated interface between DSOs and ECs that allows systems integration and information exchange.

For Germany, recommendations include the implementation of consciously differentiated, targeted support, enabling the development of actors with different levels of risk appetite and knowledge, as well as different organisational models, including innovative ones. We also propose to take measures to increase the involvement of local authorities in EC activities. In Poland, activities should focus on providing attractive financial incentives, popularising the idea of ECs among the wider society by increasing awareness and improving the attitudes of Polish citizens, supporting leadership with dedicated training, for example, or adopting best practices from other countries. To facilitate the process of tenders for RES organised by local authorities, it could be useful to create an official catalogue recommending the best available RES technologies (BAT), helping to mitigate significant technological risk and providing information about the cost range for each technology.

Introduction

The ongoing environmental and climate crisis, along with the geopolitical and energy security crisis caused by Russia's aggression against Ukraine, have led to increasingly ambitious objectives for climate neutrality, as well as independence from Russian fossil fuel imports in particular, but also from fossil fuels in general. The axis of the EU's actions in the context of decarbonisation is increasing the use of RES in all economic sectors. In the context of electricity, for which demand will increase due to electrification in other areas, the intermittent nature of renewables entails redesigning our power grids into a more decentralised, flexible grid that will generate power and, to some extent, balance itself locally.

In general, ECs are defined as citizen-driven energy cooperations (i.e. energy generation, distribution, supply, consumption, storage and other services) on a local level that benefits the members of the community. The idea had already been circulating in political and public discourse, but it emerged in EU legislation along with tightening climate protection policies and was finally defined at the EU level in 2019 (Internal Electricity Market Directive (EU) 2019/944 and Renewable Energy Directive (EU) 2018/2001).

At the same time, implementation of ECs at the national level introduces a variety of models that differ in terms of their details but all fall under the umbrella of the EC definition. A concept that is relatively easy to grasp on a general level is subjected to different interpretations for different local conditions. These details often determine the fate of the concept at the national level, which means that closer scrutiny of cross-national differences in implementation can contribute towards a better understanding of the challenges and make it possible to identify best practices and success factors for the deployment of ECs. ECs combine the inclusivity and activation of the energy consumer, support decentralisation, local generation and consumption and thereby contribute towards a resilient, modern energy system. Moreover, they help to increase awareness of how we consume energy, which can spill over to other areas and choices for environmental action, such as undertaking energy efficiency measures, choosing low-emission transport or reducing energy use. For these reasons, they represent one of the most comprehensive solutions to the challenges we are currently facing.

The strategic role assigned to ECs in the European energy system is best reflected in the EU legislation and can be deduced from recitals to the two Directives establishing ECs in the EU law: RED II Directive 2018/2001 (EP, 2018) and Internal Electricity Market Directive 2019/944 (EP, 2019). Hence, the policy goals that are to be achieved with the deployment of ECs include:

- facilitating the uptake of new technologies and consumption patterns (including smart distribution grids and demand response) in an integrated manner;
- advancing energy efficiency at the household level and helping to fight energy poverty through reduced consumption and lower supply tariffs;
- providing environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates, rather than to generate financial profits;
- allowing for the development of decentralised renewable energy technologies and storage under non-discriminatory conditions and without hampering the financing of infrastructure investments;

- promoting the utilisation of local energy sources, increased local security of energy supply, shorter transport distances and reduced energy transmission losses. Such decentralisation also fosters community development and cohesion by providing income sources and creating jobs locally;
- increasing local acceptance of RES.

Whether both the EU and national legislation facilitates the achievement of these targets will be analysed in subsequent chapters. In this report, we take a closer look at what ECs are and how they can contribute towards our social and environmental goals. Furthermore, we investigate the German and Polish implementations of the EC concept in order to determine crucial factors influencing its development. Based on our findings, we provide a set of best practices to be implemented further, as well as recommendations for eliminating policy and regulatory obstacles.

1 Overview of policy and regulatory framework for ECs

The way ECs have developed in the countries studied is a derivative of many aspects. Arguably, the greatest impact in the relatively heavily regulated energy markets is due to dedicated legislation stemming from a general policy direction. This chapter describes the general frameworks for ECs at the EU and individual country levels. ECs are not a new concept, but they have only recently been given a legislative framework. In this and subsequent chapters, we will therefore distinguish between 'broadly understood energy communities' as a meta concept beyond the legal framework and specific interpretations at the EU and national level. The EU definition leaves considerable room for interpretation, resulting in different legislative frameworks at the national level. In the following section, we start with the definitions of communities as included in the EU Directives and present their legal interpretations in Poland and Germany. In addition, we look into how the ECs concept has developed in individual countries and how ECs fit into strategic thinking both at the EU and national levels.

1.1 EU framework

EU law distinguishes between two basic forms of EC: renewable ECs (RECs) and citizen ECs (CECs). Furthermore, 'jointly acting renewables self-consumers' can also be considered a less institutionalised form of EC, as an entity comprising more than one member and which assumes common energy generation and consumption for own needs. Key characteristics of these ECs are presented and compared in the table below.

Definition source		**2018/2001 (RED II)**	**2019/944**	**2018/2001 (RED II)**
Category	Name / Subcategory	Renewable EC	Citizen EC	Jointly acting renewables self-consumer
Governance	Legal entity			
	Open and voluntary participation			
	Autonomous			
	Effectively controlled by shareholders or members			
	Right to leave the community			
Membership	Natural persons			
	Local authorities (including municipalities)			
	Small enterprises			
	Medium-sized enterprises			
	Large enterprises			
Activities	RES required			
	Produce/generate			

Definition source		2018/2001 (RED II)	2019/944	2018/2001 (RED II)
	Distribution (manage distribution grids)			
	Supply			
	Consume			
	Store			
	Aggregation			
	Energy efficiency services			
	Charging services for EV			
	Other energy services			
	Sell			
	Share energy within the community			
Function characteris-tics	Territorial proximity			
	Financial profits not of primary importance			
	Cross-border participation			
	Entitled to own, establish, purchase or lease distribution grids and to autonomously manage them			
	Tools to facilitate access to finance are avail-able			
	Cost-reflective network charges			

Table 1 Different legal forms of ECs in the EU legal system
Red – Member State is not asked to transpose a given provision; Amber – Member State may transpose a given provision; Green – Member State shall transpose a given provision into the national legislation; Grey – not included in the Directive

RECs and CECs are both entities 'to organise collective cooperation of an energy-related activity around specific ownership, governance and a non-commercial purpose' (REScoop, n.d.), but 'due to some of their differences regarding scope of activities and eligibility criteria, renewable energy communities can generally be seen as a subset, or type of citizen energy community' (REScoop, n.d.). CEC actually reflects a broader, general concept of collective and citizen-driven energy action, whereas REC, as the name suggests, emphasises the deployment of RES. Going further, citizen EC is intended to meet some of the EU policy goals, such as the democratic structure of the energy market and fighting energy poverty. For CEC, RES is not required and medium and large enterprises are not allowed to effectively control it, but they are allowed to take part in the community. The 2019/944 Directive does not concede this openly, but it certainly does not forbid the participation of medium and large enterprises. Renewable EC welcomes medium-sized enterprises as leading shareholders/members. This is because one of its objectives is accelerating the development of RES, which might benefit from substantial finance provided by larger private entities. The primary purpose of the two forms of communities is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where they operate, rather than financial profits. (Biresselioglu et al., 2021).

The third of the examined frameworks, jointly acting renewables self-consumers, is not defined as an EC under EU law. However, since they aim to undertake common action in the field of energy, they might be considered as a broadly understood EC, especially since the European provisions on jointly acting renewables self-consumers are not very developed and can be transposed into national legislation in a way that would make it possible to classify them as an EC (REC or CEC). Interestingly, the EU law allows large enterprises to become one of the jointly acting renewables self-consumers operating together, although energy operations cannot constitute the primary activity of this company.

While the definition of ECs at the legislative level and their further transposition into national law was a significant and necessary step for enabling their deployment, the EU seems to fall short of actively supporting their development, which leads to inconsistent support at EU strategic level. Although both communications – *Clean Planet for All Europeans* and later the *European Green Deal*, which are by far the most important sets of environmental initiatives and define the direction of EU action – recognise the role and the need for the deployment of ECs, they receive limited coverage beyond these declarations. The former also addresses the need to provide financial support for this purpose. Furthermore, in its newest communication REPowerEU, the Commission addresses the crisis caused by Russia's aggression against Ukraine and the associated planned decoupling from fossil fuels from Russia. It also mentions ECs in the context of speeding up the implementation of the Electricity Directive and taking additional measures to encourage biogas producers to create ECs (EC, 2018, 2019a, 2022a).

However, some frameworks and programmes at the EU level aim to support the development of ECs. For example, the *Guidelines on State aid for climate environmental protection and energy* (CEEAG), which facilitate government aid in specific areas, state that 'the Commission will generally look favourably at the measures proposed by Member States to facilitate the participation of SMEs and, where relevant, renewable energy communities in competitive bidding processes, provided that the positive effects of ensuring participation and acceptance outweigh the possible distortive effects' (EC,2022b). The EU also established the Energy Communities Repository, a EUR 1 million programme to monitor and support the deployment of ECs. The aim of the project is to identify and disseminate best practices and expertise for local authorities, businesses, citizens and citizen organisations that wish to set up ECs, particularly in EU countries that do not yet have a strong tradition of such initiatives (EC, n.d.). Furthermore, various EC-related initiatives are also supported by funds from different European sources (REScoop, n.d.).

The EU can also provide direct investment support for EC projects, i.e. within European funds, such as the Modernisation and Just Transition Funds. Moreover, national revenues from EU ETS allowances auctions support the financing of programmes that facilitate the creation of ECs. Ultimately, however, it is the Member State that decides how these revenues are allocated.

1.2 Framework in Poland

The Polish regulatory framework specifies three different types of broadly understood ECs: **energy cooperative** (pol. *spółdzielnia energetyczna*), **energy cluster** (pol. *klaster energii*) and **collective renewable energy prosumer** (pol. *prosument zbiorowy energii odnawialnej*).

In Poland, ECs began to form in 2016, after the introduction of a definition of the energy cluster in the RES Act. Similarly to Germany, there is no official information about the number of ECs operating in Poland. The number of clusters officially certified by the Ministry of Energy is 66. The National Agricultural Support Center

(pol. abbr. KOWR) is responsible for registering energy cooperatives. Currently, there are two officially registered energy cooperatives, which both deal exclusively with PV installations. The low number of energy cooperatives is due to low registration rates in the official register of KOWR, as some of them do not meet the requirements of the Act on Cooperatives. The Act is considered obsolete and was established by the government of the People's Republic of Poland in 1982. The collective renewable energy prosumer is a new model presented in the draft amendment to the Renewable Energy Act, which is still being processed. This is why there are currently no collective prosumers in Poland.

Unlike Germany, Poland has not provided any stable and safe financing model, such as FIT. The lack of financing, combined with a relatively low budget of households and a low level of social trust, has translated into modest development of citizen-driven energy initiatives. Financial support aimed directly at citizens was geared towards prosumer installations and the renovation of buildings and replacement of heat sources. A simple support scheme called 'My Electricity' (pol. *Mój Prąd*) and favourable net metering in recent years caused a significant increase in the number of prosumers. With appropriate support, it provides an opportunity for the development of ECs organised in the form of virtual communities of prosumers.

The legislative environment in Poland still requires significant changes and is considered underdeveloped, as evidenced by the small number of broadly understood ECs. However, in the near future, changes are being prepared to facilitate their development. The published draft amendment to the Renewable Energy Act, which is currently being processed by the government, includes significant changes for the energy clusters. The key amendments include:

- clarification of the provisions for the agreement to establish the energy cluster;
- the support scheme in a form of exemptions from distribution charges (depending on the amount of renewable energy generated within the energy cluster) and other fees applicable to the energy generated within the cluster;
- a new definition of the energy cluster that is embracing the objective of providing environmental, economic or social community benefits for its shareholders or members, which is an important element of EU definitions of ECs;
- the national regulator (Pol. abbr. URE) will provide a register of ECs; however, the registration will not be obligatory. As things currently stand, data regarding ECs (namely energy clusters) is not collected or published by any formal entity or umbrella organisation in Poland.

None of the broadly understood EC concepts currently envisaged by the Polish national legislation will enable direct implementation of the RED II Directive or the Electricity Market Directive. The main shortcomings are as follows:

- Energy clusters are not legal entities;
- large enterprises are allowed to participate in ECs and energy clusters (but they are not allowed to effectively control them);
- energy cooperatives and collective prosumers are not allowed to sell energy;
- energy cooperatives are not allowed to distribute generated electricity or manage a distribution grid.

These deficiencies translate into barriers to the development of ECs. The lack of possibilities to sell energy produced within the energy cooperative or through collective prosumers makes the undertaking less profitable, which might discourage potential developers or members of ECs. Moreover, the ECs under Polish law may not be recognised as ECs under the EU law. As a result, they may be denied financial support from EU funds. However, this proves that a wider range of legal forms exist for ECs, and since the EU aims to promote citizen-driven energy actions that contribute to the clean energy transition, the Directives should be less strict and encompass these opportunities.

Poland's energy transformation strategy is envisioned in two documents: the Energy Policy of Poland with a horizon to 2040 (PEP2040), and the National Energy and Climate Plan with a horizon to 2030 (NECP), in compliance with the EU Governance Regulation. Both documents are generally consistent in terms of the direction of transformation and the level of ambition. However, their visions diverge from market realities and the level of ambition envisaged by the European Commission, which has increased with the revision of the 2030 targets under the Green Deal and Fit for 55 package (EC, 2019b).

In the PEP2040, ECs are presented as an important means of empowering and stimulating electricity consumers (Ministry of Climate and Environment, 2021). Therefore, in view of the 21–23 % RES share target of final energy consumption by 2030, the Polish key strategic documents assume that the number of energy sustainable areas at the local level (i.e. energy clusters, energy cooperatives) will reach 300 by 2030 (compared to 66, as for the first half of 2020, of which all were energy clusters; the first two Polish energy cooperatives were established in 2021). One particular example of how the strategies differ from reality is the recent achievement of one million prosumers, eight years before the assumed deadline (European Economic Congress, 2022).

Nonetheless, the documents recognise the need to modernise electricity distribution systems, as the energy system will undergo decentralisation (Ministerstwo Funduszy i Polityki Regionalnej, 2017). This seems to be of primary importance for the development of ECs in Poland, given the current problems encountered by individual renewable prosumers with obtaining permission from the Energy Regulatory Office to be connected to the grid, in particular due to the limited technical possibilities of the obsolete Polish electricity distribution grid (Elżbieciak, 2022).

According to the National Energy and Climate Plan (NECP), in order to promote electricity generation within ECs, Poland is to prepare regulations enabling citizens to store and sell self-generated electricity (Ministerstwo Aktywów Państwowych, 2019). However, although regulations on energy storage have been passed, ECs (except for energy clusters) are not allowed to trade electricity for profit and the surplus of energy produced is part of the bill for the energy used (net billing).

The NECP envisions extensive measures for further empowering the demand side, including:

- extending the information policy for electricity consumers (creating a comparison of energy deals; simplifying information on bills and billing information, i.e. by providing information about the share of certain fees (e.g. distribution charge, RES fee) on the energy bill);
- giving consumers access to markets (generation, DSR services);
- developing rules for market access by ECs;
- enabling aggregators to operate on an equal footing with other market players (Ministerstwo Aktywów Państwowych, 2019).

The appropriate regulations were to be implemented by 2021, but there is a delay as far as some of them are concerned.

Besides regulatory efforts, there are also other notable public sector initiatives, which include the KlastER research project (AGH, n.d.) (funded by the National Centre for Research and Development) focused on developing the strategy and facilitating the deployment of energy clusters in Poland, as well as the recently initiated (March 2021) governmental programme to support pilot energy cooperatives (project RENALDO).

1.3 Framework in Germany

An EC or, to be more specific, a **citizen EC** (CEC) (*Bürgerenergiegesellschaft*) was defined in the 2017 revision of the EEG (*Gesetz für den Ausbau erneuerbarer Energien, Renewable Energy Sources Act*) as 'every company' (*Gesellschaft*) which satisfies the conditions specified in the definition (presented in detail in Table 2). This was the first and remains the only definition of an EC provided in German legislation.

Although the definition of CEC has only been in place since 2017, ECs have a long tradition in Germany. The first entities of this kind emerged at the turn of the 20th century and private individual ownership of RES in the form of cooperatives dates back to early 1970s. However, it was an amendment to the Cooperative Act in 2006 that facilitated a more dynamic development of RES energy cooperatives (German: *Energiegenossenschaften*), especially from 2008. This amendment has made the establishment of cooperatives much easier in Germany – the number of people required to form a cooperative has dropped from seven to three people and the required number of board members was reduced for small cooperatives. For several years, the EEG guaranteed a fixed **feed-in tariff (FIT)** or variable **feed-in premium (FIP)**, which ensured stable conditions for the growth of ECs. Most projects of the community established at this time were cooperatives (*Energiegenossenschaften*) and private limited companies/limited liability companies (GmbH) based on a relatively low-risk and replicable business model, which focused mainly on the operation of renewable energy plants and the feed-in of generated electricity into the grid. Energy cooperatives are based on a form of democratic governance, and they distribute profits and losses in a way that surpluses are reinvested to support its members and the community (Yildiz et al., 2015).

Investment conditions for ECs started to change gradually. In Germany, legal amendments to the EEG have led to a reduction in tariffs for rooftop PV systems, a new obligation to sell electricity on the exchange, an obligation to pay part of the *EEG-Umlage* (charge paid by electricity end-consumers) for electricity consumed for own needs, as well as replacing the fixed tariff mechanism with auctioning (Jankowska, 2014). After 20 years of state support, community-owned plants will no longer be covered by the FIT schemes, which may lead to greater financial risk for EC business models. This is the main reason why, in Germany, the number of energy cooperatives has been (nearly) stagnating since around 2014.

Since 2017, large renewable energy plants, such as wind farms, have to enter tenders in order to be eligible for a FIP. This means the risk profile for investors has changed, which has influenced the legal form and operating models of ECs. We observe that the CECs that participated in auctions were almost exclusively of the legal form GmbH and Co. KG (*Gesellschaft mit beschränkter Haftung & Compagnie Kommanditgesellschaft*). This legal structure corresponds to a hybrid between a limited partnership business entity and a private limited company or limited liability company, and makes it possible to limit the risk for natural persons participating in the project (Yildiz et al., 2015).

It should be noted that many different models of ECs have developed in Germany within this legislative framework, such as:

- *Mieterstrom* (landlord-to-tenant electricity model) – a model in which the plant operator in a multifamily house, having the status of an electricity supplier, can sell locally produced electricity to residents living in direct proximity. In order to receive support, the plant operator can sell the electricity to either the tenants of the building or the owners of apartments in the building.
- *Quartierlösungen* – decentralised energy supply of several building complexes that provide a complete energy supply of heat, cold and electricity.
- Digitalisation also triggered the development of new EC business models, such as virtual communities of prosumers (sharing energy between members through cloud-based software), as well as start-ups and real-labour initiatives. New models are focused on providing products such as **aggregation, peer-to-peer trading, energy sharing, and flexibility** (dena, 2022).

ECs are still searching for a way to develop new business models to remain an important part of the local energy market. A promising business option for CECs, for example, is to enter the electricity retail market and to sell their own generated electricity to retail customers in the region, using the **Regional Certificate of Origin** (Ehrtmann et al., 2021).

The exact overall number of ECs is currently unknown, and there is no separate mandatory register gathering such data. According to estimates, there were 1,747 citizen-led energy initiatives registered in Germany at the end of 2016 (Spasova Braungardt, 2021).

In the two strategic documents adopted by the German government, namely the **Long-term strategy** (LTS) and the **National Energy and Climate Plan** (NECP), ECs are not particularly emphasised, despite the role they have in the German energy system. LTS refers to local community energy projects as a mean for increasing public understanding and support for the energy transition and the expansion of renewable energy use (Federal Ministry for the Environment, 2016). In turn, in its NECP, Germany recognises the role of ECs in the EU internal energy market as a tool to secure energy supply. The federal states (Länder) should be 'committed to creating a European internal electricity market, for example by promoting cross-border citizen energy communities' (National energy and climate plans).

More recently, **the German Coalition Agreement** (German: *Mehr Fortschritt Wagen (Koalitionsvertrag 2021-2025, 2021*) mentions ECs to a limited extent. However, it puts emphasis on the development of RES (80 % in the energy mix until 2030), setting among its targets the development of a decentralised and localised energy model that should take into account the perspective of the regions and their role. For this purpose and to increase the acceptance of citizens for energy transformation, the Coalition Agreement foresees the strengthening of 'citizens energy' (German: *Bürgerenergie*). It also includes the goal of providing a framework 'within the scope of possibilities of the EU law' to develop de-minimis regulations in order to reduce bureaucracy. This framework should be based on energy sharing and certification by a fund to reduce risks. Ruling parties also intend to prepare a new design of the electricity market (German: *Strommarketdesign*) by reforming its financing architecture through incentives for the cross-sector use of renewable energy, decentralised production models and the reduction of emissions. However, ECs or energy cooperatives are not mentioned explicitly.

The definition of a CEC has also been the subject of recent discussion. The assumption of the EEG 2017 framework was to ensure more active participation of citizens in the energy market for the purpose of increasing transparency, regionalising the value chain, and democratisation. However, the clear preference for the legal form of limited liability companies and other types of corporations led to observations that the intended diversity of actors involved in CECs had not been achieved (Grashof et al., 2019). The dominance of commercial enterprises suggests purely economic motives, such as achieving corporate objectives instead of ensuring benefits for society (although these objectives need not be, and often are not, in conflict). For this reason, certain amendments have been proposed by the government in 2022 as part of the so-called Easter Package (*Osterpaket*), Summer Package (*Sommerpaket*) and EEG 2023, which are legislative proposals intended to accelerate the energy transformation in Germany. These amendments are presented as the transposition of the EU legislation requirements (*Überblickspapier Osterpaket, 2022*) and introduce a new definition of CECs (defined as a cooperative or other company with a minimum 50 natural persons as voting members or voting shareholders; 75 % of members within the postcode area that is within a radius of 50 km of the planned installation; voting rights not held by natural persons must be held exclusively by SMEs or by local authorities). The CECs defined in this way will be exempt from the tendering obligation for onshore wind turbines up to 18 megawatts and solar installations up to 6 megawatts from 2023, which translates into lifting an important bureaucratic and procedural barrier (*Energiezukunft*, 2022).

1.4 Comparison of CECs in Poland and Germany under certain legislative frameworks, economic and social conditions

The following table (Table 2) summarises the different legal frameworks in German and Polish law. Although there are more legal definitions offered by the Polish legal system (three, if we count collective prosumers), this has not translated into increased development of ECs in Poland. In comparison, there is only one definition in Germany and the level of development of ECs there is much higher. In Germany, ECs can operate in various legal forms, which are outlined at the beginning of the previous subchapter. Communities in both countries also receive a different level of support. In Germany, ECs had an additional bonus applied in auctioning systems (or FIT and FIP previously). Poland focuses on operational instruments based on different metering schemes and does not provide a clear incentive for investing in ECs. Other differences, barriers and best practices that have hampered or accelerated the development of ECs will be explored in subsequent chapters.

Country	Poland			Germany
Interpretation name	**Energy cooperative**	**Energy cluster**	**Collective prosumer**	**Citizen energy communities**
Legislative source of definition	Act on Renewable Energy Sources (Pol. Ustawa o odnawialnych źródłach energii)	Act on Renewable Energy Sources	Act on Renewable Energy Sources	Act on Renewable Energy Sources (Ger. *Gesetz für den Ausbau erneuerbarer Energien* – EEG)
Direct transposition?	No	No	Yes, REDII 2018/2001	No
Year of implementation	2016 – definition 2019 and 2022 – specific provisions (*under revision*)	2016 (*under revision*)	2022 (*under revision*)	2017 (*under revision*)
Number of initiatives	2	N/A 66 clusters certified as Pilot Energy Clusters in years 2017–2018.	N/A (in force from 1 April 2022)	1747 (Spasova, et al., 2018) 896 in 2020 *(cooperatives after 2006, DGRV)*
Organisational unit	Legal entity (required entry in the national court register and in the registry of energy cooperatives)	Civil law agreement (not a legal entity subject to rights and obligations)	Not defined	Every legal person that meets the requirements provided in Art. 3 para. 1 EEG *Cooperative or other company*
Allowed parties	Without restrictions, natural and legal persons	Natural persons, legal persons, local authorities, universities, research institutes	Owners of flats in multi-residential buildings	Without restrictions, natural and legal persons (min. 10 entities)
Number of members	Minimum 10 natural persons or 3 legal persons, but fewer than 1,000 members	No limits	No limits	Minimum of 10 members, none of the members are entitled to more than 10 % of the voting rights and natural persons with domicile in the local community have a minimum 51 % of voting rights

Country	Poland			Germany
				Minimum 50 natural persons as voting members or voting shareholders; 75 % of members within the postcode area that is within a radius of 50 km of the planned installation, voting rights not held by natural persons must be held exclusively by SMEs or by local authorities
Permitted activities	Generate electricity (max. 10 MW and minimum 70 % of its annual demand), heat (max. 30 MW) and biogas (40 mln m^3) for its own needs	Generate, distribute and trade electricity	Generate for own needs	Build and use renewable energy installations, generate electricity (no more than 18 MW wind energy capacity); selling energy
Spatial and administrative constrains	▪ Up to three neighbouring rural or urban-rural communes involved ▪ One system operator ▪	▪ *At least one local government as a party in the agreement* ▪ One county or five neighbouring communes, but within one distribution network operator ▪ Cross-border connection is not allowed	Not defined, but by definition confined to a multifamily building	▪ In case of onshore wind installations, the energy cooperative has to propose 10 % of shares to the local authorities ▪ Allowance for the operation of an energy cooperative cannot be passed on to other entities within the prescribed period (first 12 months) ▪ Certain contractual limitations apply

Country	Poland			Germany
				▪ Grid authority (*Bundesnetzagentur*) may require the documents to verify information voluntarily shared by the energy cooperative's members
Public financing and metering	▪ Net metering – the amount of energy supplied via the distribution grid that might be consumed for free by the energy cooperative is equal to 60 % of the energy generated and fed into the grid by this cooperative; i.e. energy cooperatives are prosumers and cannot sell the surplus electricity ▪ Exempt from: fees for settlement, electricity distribution charges, RES fee, capacity fee, cogeneration fee, excise duty (on the condition that total installed capacity of the energy cooperative does not exceed 1 MW) – however, these exemptions apply only to the electricity supplied to the energy cooperative within the settlement.	▪ Not specified ▪ *Exempt from: RES fee, capacity fee, cogeneration fee, excise duty and obligations related to certificates of origin* ▪ *Discount on the variable components of the distribution tariff – with self-consumption over 60 %, the discount is to be 5 %, and if it reaches 100 %, as much as 25 %.*	Net billing	Bonus (*Zuschlag*) applies to the auctioning system (*Einheitspreisverfahren*)

Table 2 Comparison of different legal interpretations of ECs in Germany and Poland (changes under revision are in italics).
*italic font means changes currently proposed in the revision process

Economic & social background

ECs in both countries operate in a specific legislative, economic and social environment. The detailed description of the legal conditions is included in preceding subchapters. This subchapter will briefly describe the background in the economic and social context, which is also important for understanding the mechanisms behind the process of developing ECs.

Indicator	Unit	Germany	Poland	%
Population (2022)	mln	83.2	37.7	55 %
Urban population (2021)	%	78 %	60 %	23 %
GDP per capita (2021)	USD	50,801.8	17,840.9	65 %
GDP at purchasing power parity (PPP) (2021)	Int. dollar	57,927.6	37,502.6	35 %
Final energy consumption (2020)	Mtoe	193.6	70.3	64 %
Overall share of energy from renewable sources	%	19.3	16.1	17 %

Table 3 Macroeconomic indicators
Source: Eurostat, World Bank

Based on the indicators provided by the World Bank, it can be said that both countries **differ significantly in terms of economic conditions**. In Germany, GDP per capita is almost three times higher, while purchasing power parity is higher by 35 %. Final energy consumption per capita is approximately 20 % higher in Germany. The share of renewables in electricity production is slightly higher in Germany than in Poland.

Social factors also influence the deployment of ECs. Social trust describes the willingness to trust others, even total strangers, without the expectation that they will immediately reciprocate that trust. It is often considered to be the glue that holds society together and facilitates cooperation between people. **Social trust levels** vary considerably between European countries: the most trusting societies are the Nordic countries (Denmark, Norway, Finland, Iceland and Sweden), followed by the Netherlands, German- and English-speaking countries, and Estonia. Social trust levels are lower in the southern and eastern parts of Europe. The European Social Survey (ESS) shows that the **level of trust in society is twice as high in Germany than in Poland** (European Social Survey, 2021).

This factor negatively influences the development of the idea of a cooperative society in Poland (Bąk et al., 2021). In Germany, on the other hand, where social trust is relatively high and there is a well-established tradition of cooperative society, the environment for establishing ECs is more favourable.

2 Conceptualisation of ECs

In order to determine whether ECs are developing in a direction that corresponds to the strategic plans of the EU and individual countries, it is necessary to determine the direction itself and the contribution of ECs towards fulfilling it. Hence, the purpose of the ECs conceptualisation presented in this chapter is to highlight this direction for further analysis of ECs.

2.1 Goals of ECs

ECs are a concept that potentially affects many development areas. Building upon the targets for ECs set out in the EU legislative framework and drawing on the overreaching priorities of the policy agenda for sustainable development, we defined a broad catalogue of more specific goals for the ECs (see Table 4).

We subsequently assessed these goals in terms of the three main pillars of sustainable development: **(1) economy (2) society and (3) the environment**. Due to the current crisis related to the Russian invasion of Ukraine and the considerable potential of a positive contribution in this matter by ECs, a fourth pillar, **security**, was added. The results are presented in Table 4.

Goal	**Impact area**			
	Economy, development and innovation	Society and health	Environment	Security
Access to energy at an affordable price	**X**	**X**		**X**
Providing income for local society	**X**	**X**		
Creating jobs on the local market	**X**	**X**		
Business development	**X**			
Innovation development	**X**			
Empowering civil society		**X**		
Greater business responsibility	**X**			
Fighting inequalities and energy poverty through the democratisation of access to energy and lowering household energy costs	**X**	**X**		
Reducing GHG emissions		**X**	**X**	**X**
Improving air quality		**X**	**X**	**X**
Rational use of energy and local resources		**X**	**X**	**X**
Local consumption of energy		**X**	**X**	**X**
Reducing energy consumption		**X**	**X**	**X**

Goal	Impact area			
	Economy, development and innovation	Society and health	Environment	Security
Creating an environmentally responsible society by increasing ecological awareness and local acceptance of renewable energy		X	X	
Increasing security of supply locally and nationally				X

Table 4 Goals of ECs

As can be seen from Table 4, ECs can make a significant contribution towards the goals in various areas of sustainable development, and the effects of their development go far beyond environmental aspects, influencing social aspects at both the local and central levels. The challenge that the countries face is to develop appropriate trade-offs between these goals. Overregulation of some targets can lead to hampering deployment, while overregulation can lead to overlooking some of the important aspects. In this regard, some elements can and even should be prioritised differently at different stages of development, but the corresponding decisions should be informed and supported by impact analyses.

In chapter 4, we propose a set of indicators based on the identified goals, which will help to determine the current state and dynamics of ECs with regard to their goals, both for the local community and in the national context. Identified goals also guided the case study analysis (presented in chapter 3).

2.2 Business models of ECs

Business models do not develop or operate in isolation – they are shaped by broader elements of socio-technical systems. This includes market design or changes in national policies, i.e. the promotion of renewable generation technologies. Technological change can influence business activities and the value they create (e.g. declining solar PV costs or the development of digital/smart technologies). Business models of ECs are constantly evolving in line with other elements of socio-technical systems, such as technologies, users, policies and markets (Hansen et al., 2020).

There are different dimensions to operating ECs, such as **stakeholders engaged, technologies involved in ECs, and values** (e.g. motivations, benefits). These factors may change over time in line with the community development: **the emergence, operation and adaptation** (resulting from the changing environment, threats and opportunities) of ECs (see Figure 1). (Hansen et al., 2020).

These elements of EC business models were also the subject of the study presented in chapter 3.

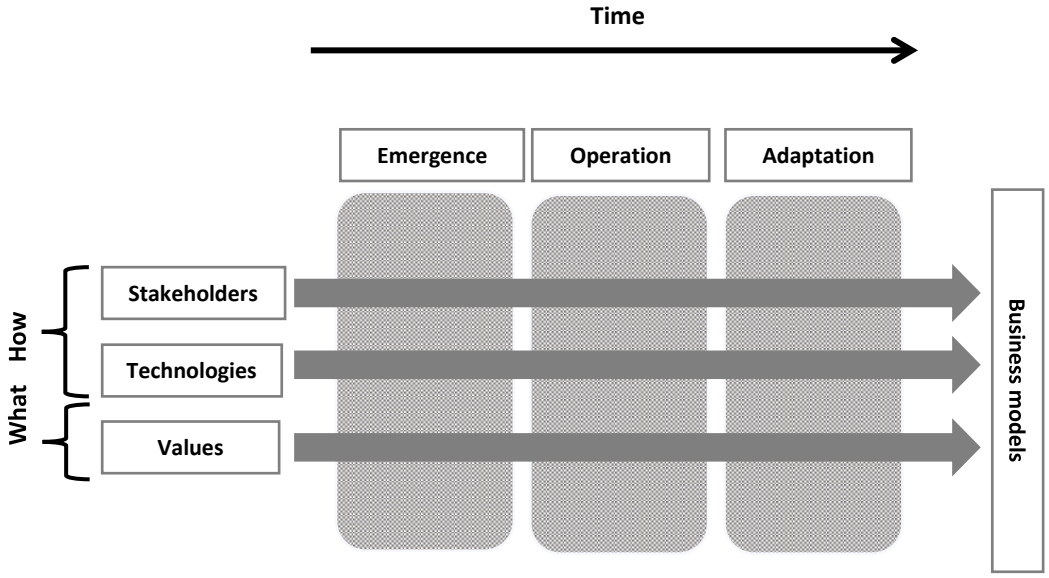

Figure 1 Dimensions of business models of ECs.

ECs can perform a broad range of activities, such as:

- Generation: producing energy and feeding it into the grid, selling it to suppliers or traders.
- Supply: selling energy to the customers locally, carrying out aggregation activities, participating in electricity trading.
- Self-consumption: production and consumption of energy by EC members.
- Distribution: operating own distribution grids (e.g. electricity, heating or biogas)
- Energy services: offering a broad range of services to facilitate energy efficiency, energy conservation and consumption monitoring, financial services, etc.
- Electromobility: services concerning car sharing, operation and management of charging stations, etc.
- Other activities: e.g. educational and social campaigning, reducing energy poverty (Dena, 2022).

ECs can involve various stakeholders, such as residents, local authorities, academics, businesses, associations and NGOs. These stakeholders are able to create new forms of cooperation and contribute towards the development of innovative ways of doing business. ECs can also operate as local or virtual organisations.

Because of this diversity, a wide variety of EC business models have developed, which makes it difficult to classify them. In the literature, we observe different approaches to their classification and description. One example is the division into eight business model archetypes: energy cooperatives, community prosumerism, local energy markets, community collective generation, third-party-sponsored communities, community flexibility aggregation, community ESCO, and e-mobility cooperatives (Wittmayer et al., 2022).

Based on the ERA-NET classification of ECs into business models, dena also provides an overview of this classification and how the classes relate to each other and link to market actors (dena, 2022). Covering a broad spectrum of activities, ECs can be divided into the following 10 classes: (1) collective generation and trading; (2) producer-consumer community; (3) collective self-consumption; (4) energy positive district; (5) energy island; (6) municipal utilities; (7) financial aggregation and investment; (8) cooperative financing of energy

efficiency measures; (9) collective service providers, and (10) digital systems of energy supply and demand response.

Of those mentioned above, the most common EC business models are:

- collective generation and trading – producers grouped together for the purpose of jointly producing and selling electricity, both under market mechanisms and existing support schemes;
- producer-consumer community – a group of producers and consumers involving the local energy market; close proximity is not required;
- collective self-consumption – generation, storage, consumption of energy in multi-apartment residential buildings (e.g. landlord-to-tenant electricity models);
- energy positive district - neighbourhoods with residential and commercial facilities that operate their own energy supply chain;
- municipal utilities – production, supply, grid operation controlled by citizens (e.g. cooperatives).

Other models are still less represented, but observed trends suggest that they may become much more important in the future. Dynamic development may occur in communities based on the use of modern digital technologies, which will enable services such as aggregation, peer-to-peer trading and flexibility services.

In Germany, ECs which correspond to described model no. 9 (collective services providers) are also emerging. They conduct activities such as aggregating demand-side response services (e.g. the ‘Reallabor Strom’ pilot project run by EWS Schönau, described in the following chapter).

Figure 2 shows the classification of existing and future business models of ECs according to their main characteristics (dena, 2022).

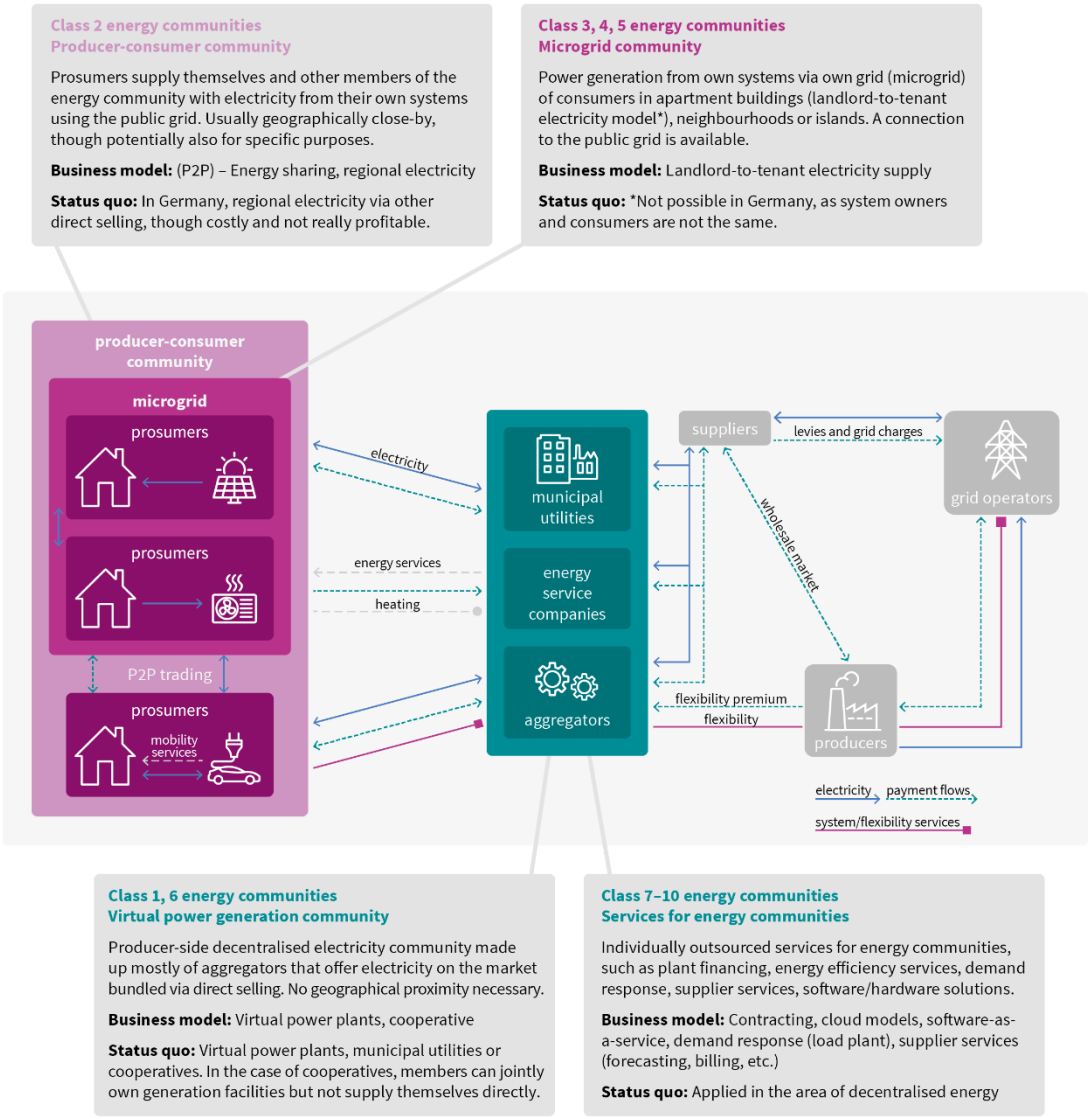

Figure 2 Classification of energy communities

3 ECs in Germany and Poland – comparative case study analysis

This chapter presents the methodology for interviews conducted during the case studies. Subsequent sub-chapters contain short descriptions of the surveyed communities, the results of the comparative case study analysis, a SWOT analysis and a presentation of the identified best practices.

3.1 Methodology

Interview questionnaire

The core of the questionnaire consisted of questions focusing on the following: the types of EC membership and financing, the most important activities of the community, building educational activities, cooperation with energy producers and operators, as well as enablers and barriers to establishing and operating ECs in Poland and Germany.

Sample selection for the interviews

The sample was randomly stratified. We distinguished the following layers:

- Different legal form and models – for example, energy cluster, energy cooperative, energy company, tenant model, district solutions; different location – we attempted to achieve territorial dispersion and representation of the whole country;
- different fields of activity: for example, energy production, distribution, technological innovation, etc.

During the research, interviews were conducted with five communities from Poland and Germany, which gives a total of 10 interviews.

Conducting the survey

Organisations selected for the study received emails inviting them to participate in it and were also reminded and encouraged by telephone to participate. The respondents were persons who hold managerial positions in the organisation and were well acquainted with the situation, e.g. members of management boards, directors and managers. The interviews took place via teleconference.

The duration of the interview ranged from 60 to 90 minutes and depended on the organisation's situation and the specifics of its operations. The interviews were carried out by representatives of WiseEuropa on the Polish side and representatives of the German Energy Agency (dena) on the German side.

Disclaimer: The research was conducted on a small sample and the results may not be representative. We recommend conducting further in-depth research in order to generate more representative results.

3.2 Surveyed communities

For the purposes of this project, we examined four energy clusters and one energy cooperative (not registered in KOWR) in Poland, and five energy cooperatives in Germany.

Although all five interviews were with representatives of energy cooperatives, they represented a broad spectrum of models and activities undertaken by ECs:

- among them are two persons that are also members of the boards of associations working in the field of EC: Netzwerk Energiewende Jetz e.V. and Bündnis BürgerEnergie (BBEn);
- one energy cooperative also implements other ECs models: the tenant model (*Mieterstrom*) and district solutions (*Quartierlösungen*) (Green Planet Energy eG);
- one interview partner represented, in addition to an energy cooperative, one 'citizen energy company' (organised as LLC) – (the founder of Bürgerwerke eG);
- another cooperative, whose representative was interviewed, has subsidiaries which are organised as LLCs (EWS Schönau);
- EWS Schönau also has a pilot project to explore innovative EC models (which the interview mainly focused on);
- additionally, the interviewed energy cooperatives themselves provide examples of various models for operating as an energy cooperative.

Figure 3 presents the geographical location of the interviewed ECs. Their short descriptions are provided in annexes 1 and 2.

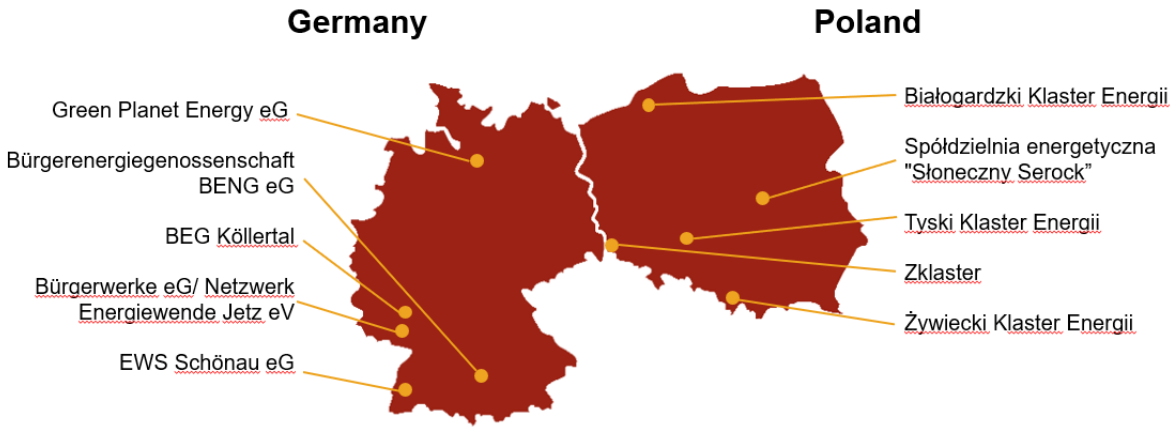

Figure 3 The geographical location of the interviewed ECs.

3.3 Results of the comparative case study analysis

By comparing ECs in Poland and Germany, we focused on the following aspects of the operation of ECs: the main actors, the motivation for establishing and operating the cluster, financing, existing barriers, and enablers.

We obtained the following results through interviews or additional information sent by the respondents. The interview responses were (where possible) presented in a graph and described.

Relevant stakeholders

Based on the member structure declared in the interviews, we observed differences in the structure of ECs in Poland and Germany.

In the case of Polish communities, these are local companies and local government units. It is common practice for a research unit to participate as a cluster member. It is worth mentioning that even if such a unit is not a direct member, almost all clusters have established cooperation with such units as part of ongoing projects. Only one of the surveyed communities (energy cooperative) indicated private persons as members.

In Germany, the surveyed energy cooperatives rely mostly on private persons and inhabitants. Usually, cooperatives are large and consist of several hundred members. None of the communities indicated the research unit as a cluster member. Only in one case were the local authorities indicated as a community member. This conclusion applies in general to energy cooperatives, but it is important to note that many forms of EC have developed in Germany and some of them could be more suited to the participation of other entities than natural persons.

The research indicates significant differences in the structure of the actors involved, depending on the business models of the analysed communities. It should be considered that the stakeholder involvement may have been slightly different if different types of communities had been analysed.

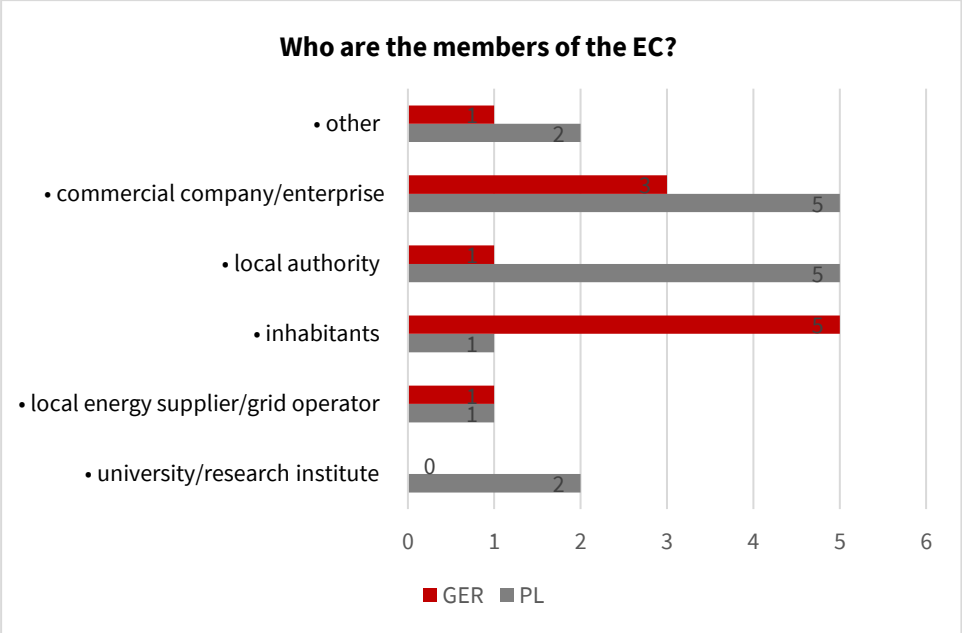

Figure 4 Interview results – members of the EC

Main motivation & benefits of the EC

The most frequently chosen answer by the German interview partners was independency from big companies, RES technology development, business attractiveness and contribution to the energy transition. The social aspect and acceptance were also underlined – 'In Germany, the issue of creating acceptance is elementary. There is knowledge, there is money. Acceptance is the scarcest resource'. Although business does not have to be profitable, business attractiveness also plays a significant role in Germany.

Polish respondents were motivated mostly by local development, which was associated with the development of RES or the reduction of local pollution. Important factors also included business attractiveness and hope for financial incentives for RES investments (which in the end did not materialise).

In general, respondents from both countries showed different motivations for establishing ECs. An important enabling factor, indicated especially in Polish interviews, is economic incentives such as favourable billing or

investment support, which allows members to focus on other goals that stem directly from the definition of ECs (e.g. increasing local energy security or renewable energy deployment).

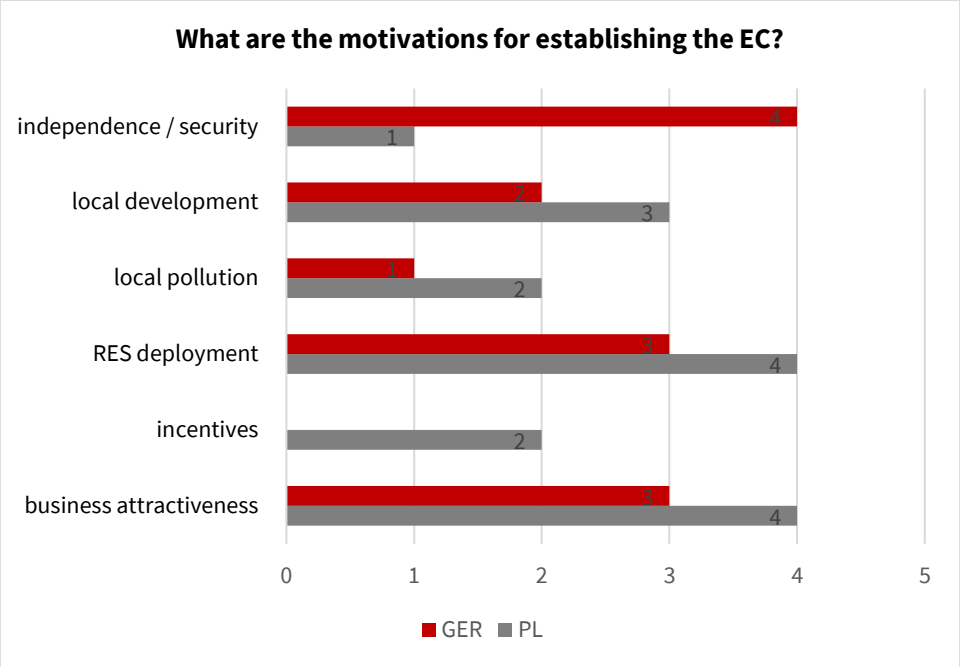

Figure 5 Interview results – motivations for establishing the EC.

Respondents from both countries indicated similar benefits: lower energy prices, improvement of natural environment, increased social responsibility and local development. This may suggest that, despite differences between countries, basic expectations of the EC role are similar in both cases.

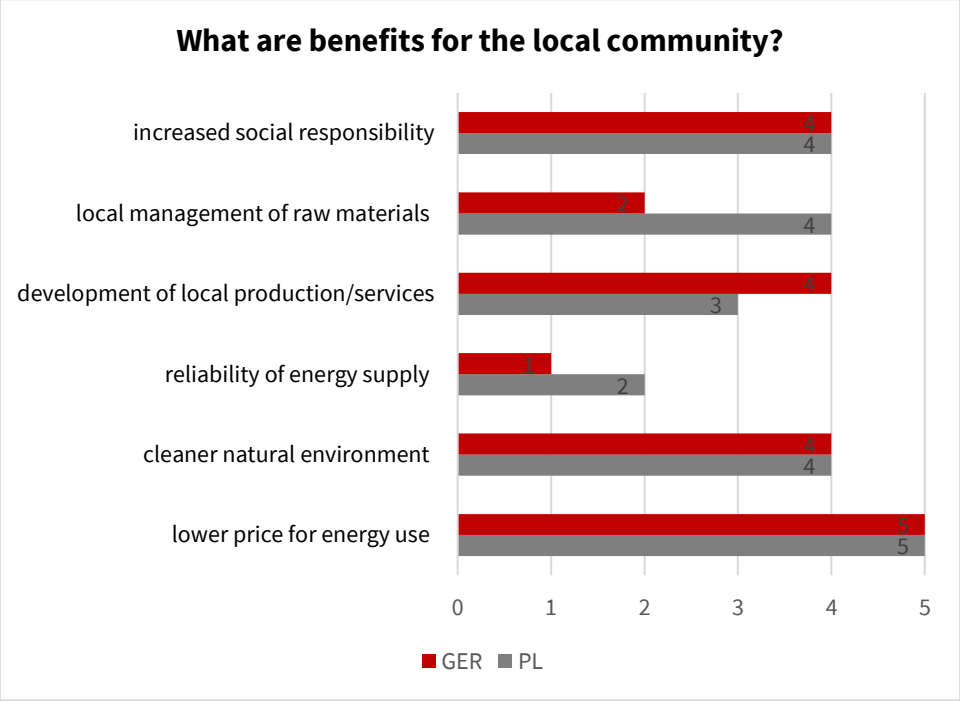

Figure 6 Interview results – benefits for the local communities.

Establishing the EC

In Poland, representatives of the surveyed communities most often indicated commercial enterprises, local authorities, or advisory firms/NGOs as initiators. None of the surveyed communities mentioned a group of private persons/inhabitants as the initiator.

In contrast, the most frequently indicated group in Germany was the group of inhabitants and umbrella organisations/NGOs.

The results suggest that the mechanisms of establishing ECs in surveyed communities are country-specific. In Germany, these are bottom-up initiatives, while in Poland they are animated mainly by the business community and local authorities. This difference is most likely due to the different business models adopted by the ECs, but also to the significant differences in the socioeconomic backgrounds of both countries (differences in the tradition of cooperatives and the wealth of society). Moreover, differences may result from different degrees of awareness and public involvement, the complexity of establishing ECs, or the relative benefits of participating in them. More favourable conditions for ECs and rising energy prices can have a positive impact on public involvement, particularly if accompanied by adequate leadership.

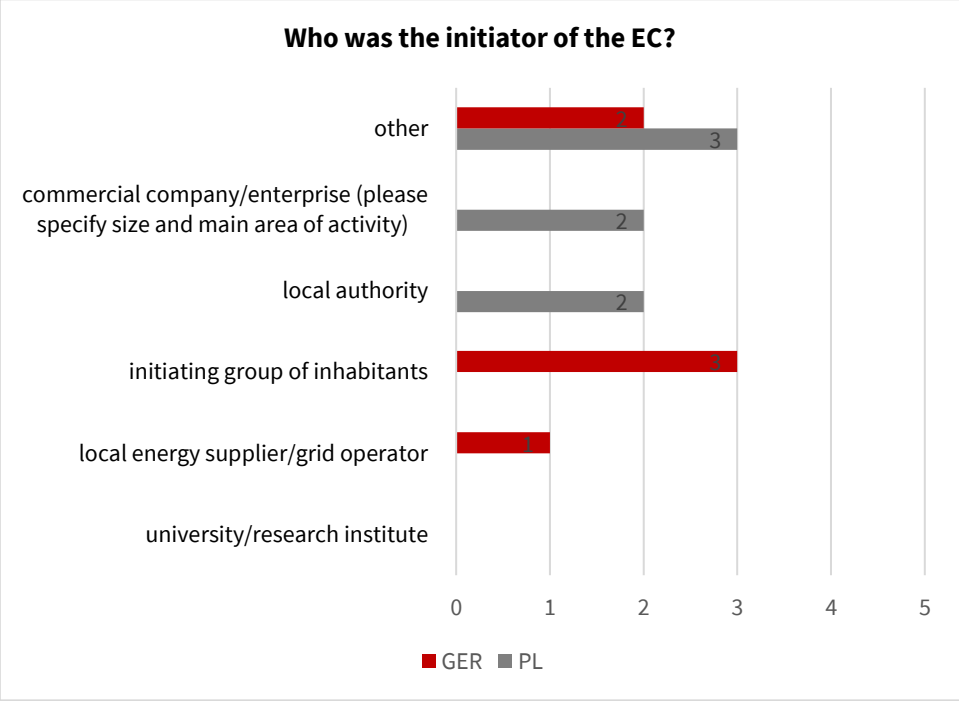

Figure 7 Interview results – EC initiators.

Financing

Both in Germany and in Poland, representatives of the surveyed ECs indicated their own financial resources (from member fees, contributions or revenues) as the sources of financing. In Germany, three of the ECs benefited from public funds/grants, while in Poland only one EC obtained such funds.

In Poland, all ECs described their financial situation as bad, and representatives indicated a lack of sufficient financial incentives and funds for new investments. Representatives of Polish ECs underlined that clusters as such do not have any own finances, due to having no legal form. Investments are conducted directly by cluster members (e.g. commercial companies) instead of the cluster itself.

In Germany, the financial situation of ECs seems to be more diverse. Two representatives described the financial situation as very good, one interviewee as steadily growing, and the rest as not good enough/difficult. One of the respondents indicated that an energy cooperative acting as an energy supplier (green power supply) is profitable in Germany from about 10,000 customers; smaller energy cooperatives are not profitable.

The responses suggest that the financial situation of ECs in Germany is notably better than in Poland. The reason for the poor financial situation of ECs in Poland include an inadequate or insufficient legal framework, but also a lack of adequate financial support. Furthermore, the concept of the EC is much older and more mature in Germany, and Polish communities are only now beginning to emerge in greater numbers and in a more developed form.

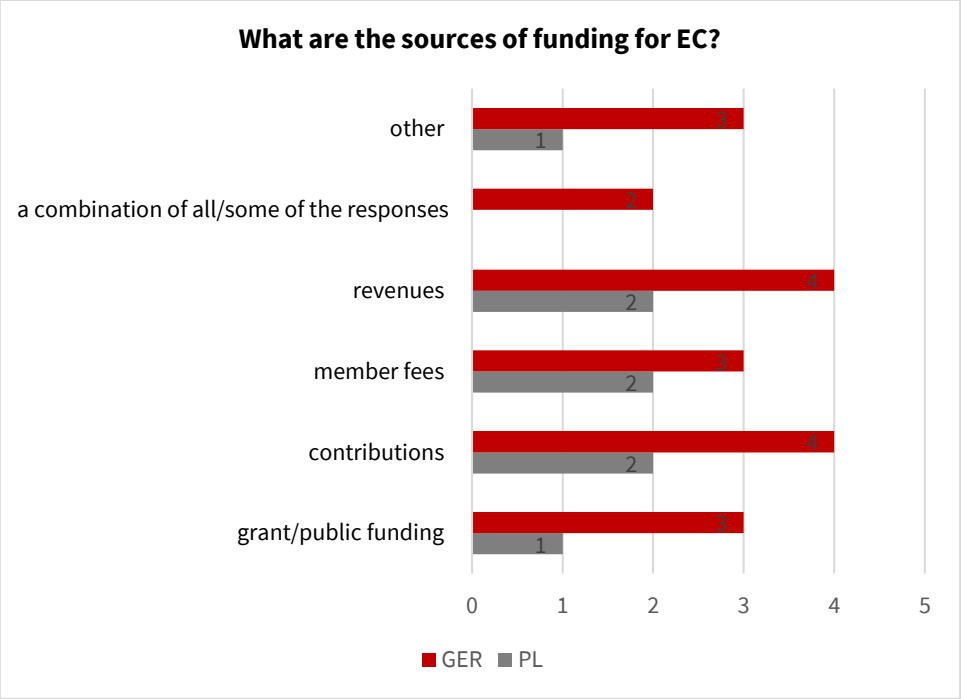

Figure 8 Interview results – sources of funding for ECs.

Main barriers

Despite the fact that ECs in Poland and Germany differ significantly, the respondents indicated the same or very similar barriers to the development of ECs. Nonetheless, even if similar or the same barriers are identified, they may affect the development of ECs to differing degrees.

Importantly, the answers given in the interviews are subjective opinions and may not reflect the whole spectrum of problems. As an example, only German respondents indicated the complexity of the energy market as an obstacle. In addition, only German respondents mentioned the insufficient transposition of EU law, while in Poland we diagnosed the same problem.

Moreover, the barriers indicated only by Polish respondents could be seen more as teething problems, while in Germany the barriers seem to be more pronounced.

Identified barrier	PL	GER
lack or insufficient financial incentives	X	X
regulatory barriers/no clear definitions	X	X
incomplete transposition of EU law		X
administrative barriers (to get projects approved)	X	X
grid capacity/local grid congestion	X	X
lack of possibility to build direct grid connections	X	
difficult access to data DSO (e.g. measurement data)	X	
lobby activities of big energy companies	X	X
lack of incentives for the use of digital technologies	X	X
no local consumption possible/incentivised	X	X
high grid charges for locally produced and consumed energy		X
slow rollout of smart meters		X
access to expertise		X
complexity of the energy market		X
readiness to invest in staff and qualifications		X
lack of entrepreneurial spirit		X
lack of social trust and cooperative spirit	X	
lack of companies interested in innovations (they treat EC as competition)	X	

Table 5 Identified barriers for EC development in Poland and Germany.

Main enablers

Respondents from Germany and Poland also indicated different enablers for ECs. This is a result of the different conditions in the two countries – for example, social engagement was indicated in Germany as an enabler, while in Poland it was seen as a barrier.

Respondents often indicated desired/recommended solutions, which we included as recommendations for further law/market adjustments.

Identified enablers	PL	GER
good public relations (PR)		X
local inhabitants/acceptance		X
strong cooperative tradition/mindset: readiness for participation		X
business case of EC already known and established		X
FITs (*Einspeisevergütung*) for RES		X
stakeholder diversity		X
strong involvement of local government units	X	

strong local business involvement	X	
strong local leadership	X	
use of existing energy sources and infrastructure	X	
Desired /recommended solutions that could enable ECs		
table regulatory framework: for a long time/good framework conditions	X	X
facilitate local consumption of energy		X
better external financial support	X	X
better technical/professional support		X
activity of residents/inhabitants	X	
facilitate regulatory sandboxes*	X	
amendment to the so-called Act of 10 H**	X	
strengthening the idea of local commitment	X	
ecosystem that connects stakeholders and the R&D	X	
clear path for closing coal mines	X	
favourable regulations for energy sharing		X
favourable regulations for flexibility services		X

Table 6 Identified enablers for EC development in Poland and Germany.
* Regulatory sandboxes would allow, in a limited way, the operation of innovative solutions which have not yet been fully constituted in law.
** The Law on Investment in Wind Power Plants, which limited the development of wind power in Poland due to distance requirements; on 5 July 2022, a draft amendment to the law was proposed as a compromise between the possibility of wind power development and the needs of local communities.

3.4 SWOT analysis

In order to complement the comparative analysis of case studies, a SWOT analysis was carried out for each country, which focuses on identifying **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats. The SWOT analysis considers internal factors (weaknesses and strengths) as well as external ones (threats and opportunities). It identifies both favourable and unfavourable factors, which further allows us to reflect on how to address or take advantage of them. Moreover, the results determine common challenges in both countries as well as synergies from cross-border regional cooperation. Thus, this analysis is the essential part of developing the recommendations for further action in both countries presented in chapter 5.

The following table summarises the results of the SWOT analysis.

	POLAND	GERMANY
Strengths	▪ High innovation potential of energy clusters ▪ The ability to take risks ▪ Strong leadership	▪ Maturity of the ECs ▪ Large size of communities ▪ High degree of digital technology use

	POLAND	GERMANY
	▪ Determination – despite many obstacles and lack of incentives ▪ Strong engagement of local authorities ▪ Strong engagement of local business ▪ Strong engagement of R&D units	▪ Diversification of RES sources ▪ Expertise ▪ Transparency ▪ Strong engagement of local society ▪ Good financial conditions ▪ Diversity/multiple models of operation ▪ Possibilities for cooperation, coopetition and networking
Weaknesses	▪ Unclear benefits for participants ▪ Bad financial condition ▪ Lack of legal form for clusters ▪ Difficulties in obtaining funding ▪ Low engagement of local society in existing ECs ▪ Lack of transparency of ECs ▪ Low level of energy self-consumption ▪ Low degree of using digital solutions ▪ Low diversification of RES (high-profile risk)	▪ Low risk appetite of matured cooperatives ▪ Moderate or low innovativeness of cooperatives ▪ Moderate interest in local business ▪ Lack of entrepreneurial spirit in cooperatives ▪ Mainly economic motivation of CEC ▪ Limited citizen involvement in CEC ▪ Readiness to invest in staff and qualifications
Opportunities	▪ Ambitious EU climate goals and REPowerEU, necessity to reduce dependence on imported fuels ▪ Increase in the importance of energy independence as a result of the war in Ukraine ▪ High prices for fossil fuel energy ▪ Growing importance of ECs in the energy transformation	
	▪ Correct transposition of EU law can open up new opportunities ▪ Large amount of private PV	▪ Dynamic developments in digital technology ▪ Development of new energy generation, storage and management technologies
Threats	▪ Lack of insufficient financial incentives ▪ Complicated procedures for obtaining funding ▪ Regulatory barriers – a significant number of provisions regulating the operation of ECs at the organisational and technical level ▪ Lack of tailor-made legislation for EC	

	POLAND	GERMANY
	▪ Administrative barriers (to get projects approved) ▪ Network capacity / local network congestion ▪ Complexity of the energy market ▪ Lobbying of big players ▪ No local supply possible/incentivised	
	▪ Low level of social trust ▪ Lack of tradition of association / negative connotations ▪ Lack of interest in innovation among companies (ECs as competition) ▪ Difficult access to data DSO (e.g. ▪ measurement data) ▪ Small number of qualified advisory institutions, no holistic support ▪ Low disposable incomes of households ▪ Lack of documented best practice ▪ Lack of responsible organisation	▪ Access to expertise ▪ Incomplete transposition of EU law ▪ Lack of sufficient incentives for the use of digital technologies

Table 7 SWOT analysis for ECs in Poland and Germany.

3.5 Best practices

Best practices are activities that produce specific, positive results, are sustainable and replicable, and can be applied under similar conditions elsewhere or by others. Describing best practices is a common method of sharing knowledge and experiences, and it has a positive impact on the dissemination of successful solutions.

Below, we present the best practices that we identified based on the interviews with Polish and German ECs. The following collection provides an overview of which best practices have emerged in both countries.

Due to the level of development of ECs, we could identify significantly more best practices in the German ECs. They are also more diverse and indicate the organisational maturity of these communities. Best practices that apply to Polish ECs mainly indicate their potential for future development, emphasise ambitions and aspirations, and to some extent also indicate specific developed methods for operating the organisation.

	Description	Example
Country	**POLAND**	
Strong involvement of local government units	Local government units in Poland play a key role in the process of initiating and establishing ECs. They are members of the vast majority of functioning clusters. Their presence ensures credibility as well as coordination for certain activities, e.g. obtaining land for new investments. Facilitate contact with the local society, assess energy needs, available resources, etc.	Metropolis GZM has created its own development policy and toolbox for ECs and also conducted a number of training sessions on this subject. The Serock commune is acquiring land for investments in a closed landfill thanks to a local government unit.
Strong leadership	Significant role of strong leadership – an individual or institution that takes responsibility for community development, concentrates activities around it, promotes projects, attracts other participants, and fosters a spirit of optimism and entrepreneurship.	In Tyski Klaster Energii, strong leadership has led to the implementation of bold investments that offer significant benefits for the local community – including building a water park fully powered by biogas energy from a local treatment plant.
Innovation of SME and commitment of R&D units	In Poland, in three out of five cases, universities/research units are members of energy clusters. It has a positive impact on the innovative potential of the community. Rapid increase of innovation potential in the SME sector: being part of a cluster may give SME companies access to a scientific base, which would be difficult for them in other conditions.	ROSA – chargers for electric cars in city street lamps RCGW – own research laboratories and technologies guaranteeing high efficiency of the produced biogas. Innovation AG – electric cars
Involvement of EC in development of the region	ECs can make a significant substantive contribution to the discussion about the future of their region.	Zklaster has developed a vision of transforming the mining region and replacing energy from one of the largest lignite-fired power plants with energy from RES.
Country	**GERMANY**	
Transparency	The surveyed communities in Germany are characterised by high operational transparency; all actions are well described and documented; reports are available.	Almost all of the surveyed German cooperatives provided additional information about their activities, i.e. leaflets, reports, etc. Reports published by umbrella institutions such as DGRV or associations such as Rescoop are available.
Large scale of operations	Cooperatives operating in Germany are often well-established organisations with large-scale operations.	Bürgerwerke eG representing 40,000 members, generating RES from over 1,400 installations.

	Description	Example
	The profitability threshold for cooperatives operating in Germany is approx. 10,000 customers. Large-scale provides financial and operational stability.	
Stable financing conditions (FIT) for cooperatives	Most cooperatives in Germany were established at a time when simple and safe financing rules were in place (FIT tariffs). Energy cooperatives in Germany are initiated and financed by residents, who prefer safe investments and have a low risk appetite.	The large number of energy cooperatives in Germany were established between 2008 and 2013, when FITs were in force; after the amendment of the RES Act in 2014 (implementation of auctions for wind and solar, restricted biomass) the number of new communities decreased.
Umbrella organisations	The presence of umbrella organisations is an extremely important enabler for the development of ECs. They carry out lobbying activities, facilitate knowledge sharing, etc.	German Cooperative and Raiffesen Confederation (DGRV) Citizens Energy Alliance (BBEn)
Duplicating solutions	Solutions for energy cooperatives in Germany are scalable, based on proven solutions and documented best practices.	Bürgerwerke eG has founded two sister initiatives, which are managed by the same persons, but legally connected. 90 % of responses provided by the Bürgerwerke eG could be answered in the same way, regardless of the entity.
Virtual community power plant	Decentralised and citizen-supported energy supply based on digital solutions. With the help of energy managers and intelligent measuring systems, small plant operators are grouped, a flow that can be traced by the users at any time via an app or online.	The subsidiary of EWS Schönau runs the 'Post-EEG Electricity Communities'. Those that installed small PV panels when they first entered the market over 20 years ago stopped receiving financial assistance in 2018. A solution was needed to keep those PV panels in use and ensure financing.
Cooperative of cooperatives	German communities have a remarkable ability to associate and network. This enables them to influence their surroundings (lobbying), exchange information and achieve financial stability as well as social acceptance.	Bürgerwerke eG – an umbrella organisation for energy cooperatives; 107 energy cooperatives and over 40,000 people participating; active throughout Germany, the largest union of energy cooperatives in Germany.
Landlord-to-tenant electricity (*Mieterstrom*)	Tenant electricity models are based on the interaction between landlords, tenants and electricity providers. The landlord produces electricity from RES locally at the house and sells it directly or through an electricity supplier to his tenants.	A number of German ECs, such as Green Planet Energy eG, offer a collective self-consumption model, such as *Mieterstrom*.

Table 8 Best practices for ECs in Poland and Germany.

3.6 Key findings

Below, we summarise the key findings from a comparative analysis of Polish and German ECs:

- High-level objectives set by the EU for ECs are only partially reflected in the expectations of the ECs themselves. Under-represented goals include the fight against energy poverty, reduction of energy consumption, and the uptake of new energy consumption patterns. There also seems to be insufficient support for local energy consumption, especially in Poland.
- ECs are highly adaptive mechanisms that quickly absorb technological innovations and take advantage of the latest market trends. Thanks to their networking capability, they can facilitate knowledge sharing and the dissemination of positive achievements. With the appropriate support, ECs could become an important accelerator of technological and social innovations.
- ECs often take action despite many obstacles and the lack of clear legislation. This may indicate strong non-economic motivations and missions. As a result, ECs may be more resilient to failures and more persistent in overcoming obstacles.
- The definition of ECs in Germany is rather general, which did not hamper the development of many different operating models. On the other hand, the evolution of EC business models often followed changes to the proposed support schemes, which affected the legal form, the actors involved and the undertaken activities.
- In Germany, the ECs studied were in the operation (had started their statutory activities) or adaptation phase (had developed and evolved from the original intention). In Poland, two of the five ECs were in the emergence phase (organisation, preparation of investments), and the others in the operation phase.
- Communities in Poland and Germany have different weaknesses and strengths, but some of them are complimentary. For example, the presentation of best practices observed in energy cooperatives in Germany may be an important element of a social campaign in Poland aimed at popularising the idea of cooperativeness. The German communities could adopt the best practice of positive engagement of local authorities in the development of ECs.
- In both countries, the most frequently pointed barriers and threats were: unstable, unclear legislative framework, insufficient support mechanisms, and excessive bureaucracy from the point of view of ECs, which often lack adequate expertise and are treated in the same way as commercial entities.

4 Energy Communities tracker – recommendation for future monitoring of ECs

In chapter 2, we presented the most important goals that ECs should meet in relation to EU law and the idea of monitoring these goals. In chapter 3, we presented our analytical approach that allowed us to determine which of these goals are relevant to the ECs, and to identify which activities have the greatest development potential and are worth supporting (best practices).

In this chapter, we propose a set of indicators (tracker) that we selected based on the results of the conducted analysis. The tracker includes a set of indicators according to the following criteria:

- they represent the most important goals for ECs defined in the EU policy;
- they concern the most important areas and processes indicated by stakeholders in the interviews;
- they can be calculated/determined based on the available data for most ECs. Problems may arise, for example, from difficulties in obtaining appropriate data because of the lack of smart metering.

We propose to use these indicators for the future monitoring and evaluation of ECs. To make this possible, it is necessary to build an appropriate **base of evidence**. However, at present, neither Poland nor Germany collect such data in a systematic manner. It is therefore possible to apply only selected basic indicators for benchmarking purposes.

Indicator name	Description	Related goals	Example
Economic benefits	Sum of profits and/or saving	Access to energy at an affordable price; providing income for society; fighting inequalities and energy poverty through the democratisation of access to energy and lowering household energy costs	BEG Köllertal, Balance sheet 2021: Profit EUR 48,817.63, Distribution of dividend: EUR 37,697.00
Energy costs	Average unit cost of electricity or other type of energy (if applicable)	Access to energy at an affordable price; providing income for society; fighting inequalities and energy poverty through the democratisation of access to energy and lowering household energy costs	Approximately EUR 51 in 2021 (calculated based on BEG Köllertal, balance sheet 2021)
Aid absorption capacity	Ratio of capital from subsidies to expenses (e.g. investment, education and information activities, etc.)	Access to energy at an affordable price; providing income for society;	N/A

Indicator name	Description	Related goals	Example
		fighting inequalities and energy poverty through the democratisation of access to energy and lowering household energy costs	
Return on investment	Net income divided by the original capital cost of the investment	Providing income for society	N/A
Energy poverty	Number of households affected by energy poverty	Fighting inequalities and energy poverty	0
Local labour market	Number of local jobs created	Creating local jobs	For example, ZKlaster declared that it created 35 jobs
Share of RES	RES share of total consumption within the community	Reducing GHG emissions; improving air quality	
Supply/demand ratio	Ratio between energy produced and energy consumed	Rational use of energy and local resources; increasing energy security locally and nationally	For Tyski Klaster Energii: 1.5 (produces 21 GWh, consumes 14 GWh)
Self-consumption	Ratio between consumption of self-produced energy and energy produced	Rational use of energy and local resources; increasing energy security locally and nationally	N/A
Lost load	Average number and length of supply interruptions per community member	Increasing energy security locally and nationally; fighting inequalities and energy poverty through the democratisation of access to energy and lowering household energy costs	N/A
Decrease of energy consumption	Decrease of average energy intensity of EC participants	Rational use of energy and local resources; improving air quality; reducing GHG emissions; fighting inequalities and energy poverty through the democratisation of access to energy and lowering household energy costs	N/A

Indicator name	Description	Related goals	Example
Air quality	Concentration of PM10, PM2.5 and other pollutants Avoided CO_2 emissions	Improving air quality	BEG Köllertal, Avoided 4,236 tonnes of CO_2 in 2021
Smart solutions	Intelligent solutions used for specific purposes: smart meters, energy management, community management; digital platforms for energy trade, etc.	Innovation development	*Białogardzki Klaster Energii* uses the system EGERIA, based on an AI solution
Cooperation with research units	Number of R&D projects or projects involving research units	Innovation development	ZKlaster declares cooperation with at least two universities and runs several R&D projects
Empowerment and democratisation	Subjective qualitative assessment of the influence of EC members on its decisions and actions	Empowering civil society; business responsibility	N/A
Education	Increasing social awareness and knowledge about RES	Creating an environmentally responsible society by raising ecological awareness and increasing local acceptance of RES	N/A

Table 9 Measuring the impact – set of indicators for ECs
Light grey – relevant, most of the data required is available; Dark grey – less relevant or most of the required data is impossible or difficult to obtain

The set of indicators presented above could not only help individual ECs to make decisions, but also inform the public administration how it could govern and strategically plan the development of ECs through tracking and evaluating the progress. Ideally, such data could be made available online to increase the transparency of policymaking.

5 Further policy recommendations and conclusions

As shown by the analysis, ECs still have significant development potential in both countries and can be the source of many multidimensional benefits. Enabling this potential requires eliminating a number of obstacles and simultaneously implementing adequate incentives. The situation of ECs in Poland and Germany differs significantly, and detailed recommendations should be adapted to the conditions in each of these countries.

The development of ECs in Germany is already very advanced and there are a multitude of experiences, analyses, models and knowledge for their deployment. Action in Germany should focus on further increasing the importance of ECs in energy transition and its role in creating a decentralised and robust energy system. While ECs in Germany continue to grow, and supporting their deployment should continue to be a key element in their development, the multiplicity and maturity of ECs makes it possible to focus on other aspects, such as new ways of producing and managing energy usage and finding innovative business models with the help of advanced digital technologies. German ECs are successful developers of RES installations, with relatively more barriers relating to local energy consumption and sales. With the expiration of the FIT support scheme, producers are exploring new business models to remain profitable. Supporting the idea of energy sharing and local energy consumption is therefore an important issue at present.

In Poland, the development of ECs is still at an early stage – while some experience has been gained, the scale and maturity of the solutions is still inadequate in relation to the potential. Activities in Poland should therefore be concentrated on removing the main obstacles, adopting best practices from other countries, and developing business models adjusted to local conditions. At present, an extremely important issue in Poland is to work harder on social attitudes.

Most of the directional recommendations for both countries remain the same or are similar. Many of the recommendations are still relevant for both countries. However, due to differences in the level of development of the ECs, they also have different levels of relevance for Poland or Germany.

In the table below, we first present general recommendations for both countries, followed by specific recommendations for each country.

General recommendations	
Legal framework	Generally improving and simplifying the legal framework, in particular: Better **transposition of EU directives** (setting the definitions for the renewable EC, citizen EC and jointly acting renewables self-consumer). It is important to maintain a balance when implementing provisions, in order to avoid overregulation. The legal framework should remain relatively universal and simple. The nuanced direction of EC development could be steered at the level of financial incentives.

	Tailor-made regulations for ECs. The complexity related to the energy market makes the analysis of legal aspects extremely complicated. Placing the most important provisions in dedicated documents would reduce this barrier and limit the regulatory risk. Provide a framework for coordinated holistic support – 'one-stop shops'.
Goals – setting and monitoring	In order for ECs to become an important tool for energy and social transformation, it seems important **to set parameterised goals** for the development of ECs at the EU and national level and to **monitor** the implementation of these goals. The results of this monitoring would be a valuable addition to the national statistical resources. It is important to have a good evidence base for community energy, both at the national level and the local level. At the national level, it is needed in order to learn from experience and develop effective new policies. At the local level, monitoring and evaluating different community energy activities helps groups to maximise their chances of success and to increase their impact.
Energy poverty	One of the goals set for ECs at the EU level is **the fight against energy poverty**. This aspect has now become particularly important but does not seem to be sufficiently represented either in national regulations or in the activities of the ECs. Because of the ongoing energy crisis and unprecedented price increases, the group of citizens at risk of energy poverty is increasing. Legal mechanisms and incentives should be designed to encourage and reward action taken to reduce energy poverty and protect the most vulnerable, such as: - setting additional funding, benefits, relief, etc. for ECs that take action (e.g. offering a solidarity tariff for households), - local authorities could own a certain number of bearer shares in ECs and make them available to local citizens, if necessary, in the form of the right to buy cheap energy.
Reduction of energy consumption	Currently, ECs do not sufficiently address the goal of reducing energy consumption in their activities. In view of the war in Ukraine and in relation to the EC objectives, activities in this respect should be implemented on a broader scale, such as: - conducting an information campaign; - developing a system of incentives to reduce energy consumption.
Cooperation between ECs and TSOs/DSOs	Strengthen the positions of ECs in the interaction with DSOs so that they should be treated in a partnership manner. For example, the following solutions could be implemented: - Provisions that regulate the cooperation between the DSOs and the ECs, which will require the DSOs to maintain certain cooperation standards; - a dedicated interface between DSOs and ECs that allows systems integration, information exchange, network management, and providing flexibility services, etc.; - making it easier to obtain permission to connect new RES – e.g. in the case of grid constraints, the DSOs will propose alternative possible locations for the connection of new RES capacities; - accelerating the installation of smart meters.

Germany	
Legal framework and Incentives	Establishing the principles of **financial support in a more sophisticated** manner to adjust them to different groups of recipients with different needs and risk profiles but also focused on **current challenges**. Most importantly: - creating a supportive framework for energy sharing, local energy consumption, retail sale of energy for ECs (simplified procedures for commissioning, billing, energy labelling, support for the development of software and blockchain technologies); - providing support for innovative new technologies (e.g. storage, hydrogen technologies, car sharing), and more complex business models (e.g. cross-commodity energy management, virtual communities); these solutions should lead to a better correlation between local consumption and local production and increase the flexibility that could be offered as a product for the energy system; - restoring predictable and simple financing mechanisms for new energy cooperatives, e.g. based on the former FIT system; this could result in a renewed increase in the number of cooperatives (while maintaining support for more commercially oriented players); - reducing grid charges for ECs to foster local energy production and consumption.
Social innovations in the energy sector (SIE).	Supporting the idea of **social innovations in the energy sector (SIE)**. The ECs in Germany are organisations that are evolving, creating innovative business models and adopting innovative (technical, digital) solutions. In order to strengthen this process, it is necessary to: - facilitate the **use of regulatory sandboxes**; the sandboxes make it possible to test innovative technologies, products, services, business models or approaches. The advantage of using regulatory sandboxes is that they deliver proven, stable solutions that do not need further improvements; - facilitate **cooperation between R&D units and ECs**, citizens, SMEs, etc. – e.g. dedicated to sharing knowledge and partner searching; - facilitate the uptake of new technologies by targeted incentives and educational actions (free training sessions); - disseminate developed innovative solutions; - train **innovation brokers** who could advise on the implementation of innovative solutions.
Commitment of local authorities	Strengthening **cooperation between local authorities and ECs**. The example of the Polish market shows that the positive involvement of local authorities can be a very important factor in facilitating the development of local communities, such as by indicating optimal locations for investments, giving credibility to projects, coordinating the consultation process, negotiations, etc.

Poland	
Social awareness	Conducting a **broad information campaign** about the idea of association at the local level, as well as the role of the ECs and how they operate. Ensure broad access to training for citizens on how civic energy works and what kinds of benefits it offers. Due to the weak tradition of cooperatives in Poland and the negative connotations created during the communist era, it is necessary to work deeply on the awareness and attitudes of Polish citizens.
Leadership	Case study research has shown that one of the conditions for the success of ECs in Poland is the existence of strong leadership. Organising dedicated training for future leaders could significantly expedite the EC development process in Poland.
Incentives	The formation of ECs is a relatively new and little-understood phenomenon in Poland, which means funding rules should be relatively simple in order not to create additional barriers, e.g. based on the former FIT system in Germany. Adjust the intensity of financial support to the needs of a given group of recipients. Polish households with a relatively small budget that could be allocated for investments. This group requires higher incentives. Propose more diversified solutions for cities and urban areas. In Poland, most of the population live in an urban area.
Absorption of best practices	Identification and absorption (the most appropriate for the Polish market) of proven business models that have been developed in other countries (e.g. cooperatives, landlord-to-tenant electricity model for residential buildings, virtual power plant (VPP), etc.) Examples of activities: - on-site visits, - meetings with representatives of well-developed ECs, - setting the pilot ECs for demonstration and educational purposes, - in-depth analysis of the available literature, - identifying legislative gaps in order to implement desired solutions. Also consider a strategic complementary alliance between Poland and Germany in order to support further EC development, as well as sharing experiences and searching for common solutions.
Best available RES technologies (BAT)	Local authorities make many of the investments in the energy clusters in Poland. To this end, they initiate tenders in which they define the technical conditions for the installation of RES. To facilitate this process, it could be useful to create an official catalogue recommending the best available RES technologies (BAT). The BAT could help mitigate significant technological risk, as well as providing information about the cost range for each technology.

Table 10 Recommendations for further action for Poland and Germany.

Annex

POLAND	
Name	**Zklaster**
Region	Zgorzelec, Lower Silesia district
Founded	ZKlaster was established based on a civil law contract in 2017.
Structure	Energy cluster
Size and members	Around 100 entities, including: 83 RES energy producers, 1 distribution company with its own energy network, 2 companies from the modern technology sector, 2 universities, local government units, a heat energy company with its own network, 1 non-governmental organisation, 1 scientific institute.
Capacity and energy resources	PV plant: 78 MW. Planned wind farms: 6 MW. Power station 220/110 kV, grid 110 kV (13.5 km), smart grid.
Description	The cluster, apart from the development of RES production units, also undertakes activities aimed at implementing the following in the region: efficient use of local energy resources, development of energy-efficient heating systems, implementation of R&D projects (e.g. electric vehicle in Poland based on an eco-conversion – Innovation AG). ZKlaster is involved in the energy transformation of the Bogatynia mining region. The coordinator of the Zgorzelec cluster is the Association for the Development of Energy Innovation in Zgorzelec.
Name	**Tyski Klaster Energii**
Region	Tychy, Poland
Founded	*Tyski Klaster Energii* was established in 2020 and is located in the area of two communes of the city of Tychy and the city of Tychy Bieruń.
Structure	Energy cluster
Size and members	The leader of the cluster is Regionalne Centrum Gospodarki Wodno-Ściekowej S.A. (RCGW), while Control Process S.A. acts as the cluster coordinator. The cluster comprises 23 members, including 21 entrepreneurs.
Capacity and energy resources	Biogas cogeneration units fired from sewage treatment plants: 2.29 MW Cogeneration units (biogas from landfill): 0.964 MW Natural gas fired cogeneration: 0.878 MW Photovoltaic installation: 207.36 kW
Description	RCGW is the owner of the sewage treatment plant in Tychy, as well as the owner and operator of Tyskie Water Park, which is the only facility of this type in Poland and is powered by energy from biogas from the wastewater treatment plant in Tychy. Future investments are to significantly contribute to the expansion of the local area energy independence and significantly accelerate economic development. The level of electricity consumption in the cluster is about 40 GWh. Electricity production among cluster members oscillates around 21 GWh, of which the level of self-consumption is around 14 GWh.
Name	**Białogardzki Klaster Energii**
Region	Białogard, Poland
Founded	Established in 2017.

Structure	Energy cluster
Size and members	Cluster members are Szczecin University of Technology, local energy supplier and grid operator, municipal government, housing association**.**
Capacity and energy resources	Combined heat and power plant fuelled by gas from local extraction. Wind power plant. Capacity: 3.6 MW. Distribution grid: 15 kV.
Description	*Białogardzki Klaster Energii* balances the supply and demand of energy and uses local energy sources, which leads to reducing energy transmission costs through medium- and high-voltage networks. The cluster also conducts research and development projects on energy management systems (smart energy) and plans to run other projects on energy storage and the use of electric cars.
Name	**Żywiecka Energia Przyszłości**
Region	Żywiec, Poland
Founded	The energy cluster *Żywiecka Energia Przyszłość* was established on 9 February 2017.
Structure	Energy cluster
Size and members	Over 20 entities, including the Inter-Communal Union for Ecology in Żywiec, which acts as the cluster leader, and the company Unimot S.A.
Capacity and energy resources	Installations combined into a virtual solar power plant will include approximately: • 3,000 installations in 10 communes: aggregate capacity of 9 MW, Słoneczna Żywiecczyzna. • 500 installations in 4 communes: aggregate capacity of 1.5 MW.
Description	The main goal of the activity of the Żywiec energy cluster is to achieve energy independence in the region by 2030. The main initiatives currently being implemented are the creation of a central database for the needs of the low-emission economy, aggregating the information collected in the municipalities, as well as the preparation of the Energy Spatial Information System. In the future, installations combined into a virtual solar power plant will provide 10–12 % of power for the entire cluster area.
Name	**Słoneczny Serock**
Region	Serock, Poland
Established	15 February 2022
Structure	Energy cooperative
Size and members	28 residents – individuals and 2 entrepreneurs. The cooperative will admit any member that wants to meet its own energy needs.
Capacity and energy resources	The basis for the operation of the cooperative will be a central photovoltaic installation. Estimated capacity of 0.5 – 0.7 MW.
Description	The basis of the cooperative's operation will be a photovoltaic installation with a capacity of 0.5 – 0.7 MW and the photovoltaic installation will operate on the site of the former landfill in Debem. This is a site in need of reclamation and a change in its current functions. It perfectly meets the criteria for selecting a location for the new photovoltaic installation. This will achieve two things: the reclamation of the closed landfill site and the creation of a photovoltaic installation that will serve the residents and members of the cooperative.

Annex 1 Characteristics of ECs in Poland.

Germany	
Name	**Bürgerwerke eG**
Region	Heidelberg, Germany
Founded	13 December 2013
Structure	It is an umbrella organisation for energy cooperatives. Energy enterprises (energy cooperative + subsidiaries organised as limited liability companies); model project 'Reallabor der Bürgerenergie' (real civic energy laboratory).
Size and members	107 energy cooperatives and over 40,000 people participating; active throughout Germany, largest union of energy cooperatives in Germany.
Capacity and energy resources	Solar and wind (more than 1,400 projects). Hydropower facility. Citizen eco-gas from organic residues.
Description	Bürgerwerke pools electricity production from citizen-owned utilities so that the citizens can be supplied with citizen-generated electricity independently of the energy companies. Members are mainly private individuals. The founder of the Bürgerwerke eG is also a co-founder of one CEC organised as a LLC, as well as a member of the board of the association Netzwerk Energiewende Jetz e.V., which primarily qualifies, coaches and advises actors from ECs, and the company Wir solar GmbH, which conducts PV projects.
Name	**Green Planet Energy eG**
Region	Hamburg, Germany; Austria
Founded	Founded in 1999 by Greenpeace Germany, famous environmental NGO, as Greenpeace Energy (changed its name to Green Planet Energy in 2021).
Structure	Cooperative is in close affiliation with Greenpeace. A share in the cooperative costs EUR 55; membership is possible starting from one share; maximum holding of 200 shares per person. The subsidiary company Green Planet Projects GmbH builds and runs wind parks and PV plants.
Size and members	In June 2021, the organisation had about 28,000 members (private individuals) from Germany and more than 200,000 customers.
Capacity and energy resources	Gas: biogas. Electricity: PV (5.3 MW), wind (72 MW), water. 2 electrolysers (one planned). Heat: heat pumps. Mobility. Total capacity: 86 MW
Description	Activities conducted by the community: energy generation from RES, energy supply for private and business customers (e.g. railway companies), heat pumps (*Wärmestrom*), e-mobility (*Mobilstrom*), gas (biogas and natural gas, a small amount of hydrogen; the goal is to supply only RES gas by 2025), partnering for green mobility, e.g. installation of private charging stations, carsharing, e-(cargo-) bikes, collective self-consumption (*Mieterstrom*, *Quartierelösungen*), subsidiary company in charge of developing/building RES installations (e.g. second electrolyser).
Name	**BEG Köllertal**
Region	Püttlingen, Germany

Founded	Established in 2015 by 15 founders
Structure	Cooperative
Size and members	Over 1200 members, mostly inhabitants. Equity: almost EUR 3 million
Capacity and energy resources	Main fields of activity are setting up and leasing PV systems. Capacity: 3 MW.
Description	The primary goal of BEG Köllertal eG is to accelerate the energy transition, i.e. away from fossil fuels and towards renewable energies in electricity generation. The associated environmental service is advising citizens on changing electricity suppliers (for members and non-members), advising those interested in photovoltaic systems, and preparing offers and profitability calculations, etc.
Name	**EWS Schönau eG (subsidiary EWS Vertriebs GmbH)**
Region	Schönau in the Black Forest, Germany (Baden-Württemberg)
Founded	EWS was founded in 1994 through a citizens' initiative. The project *Modelprojekt Stromgemeinschaft* was initiated by the EWS Schönau in 2017.
Structure	EWS Schönau is organised as a cooperative. Its subsidiary, which runs a pilot project, is structured as a limited liability company.
Size and members	EWS Schönau has 9,052 members (2020). More than 200,000 customers supplied throughout Germany. The described pilot project ***Modelprojekt Stromgemeinschaft*** belongs to EWS and consists of 30 members.
Capacity and energy resources	The project 'Post-EEG Electricity Communities' includes about 20 PV systems, different battery systems, electric cars and some small combined heat and power plants.
Description	EWS was founded in 1994 through a citizens' initiative in response to the nuclear catastrophe in Chernobyl. In 2009, it became EWS eG and adopted a cooperative structure. The subsidiary runs the pilot project 'Post-EEG Electricity Communities', which aims to develop a climate-friendly, decentralised and citizen-supported energy supply based on digital solutions. With the help of energy managers and intelligent measuring systems, small plant operators are grouped into a virtual community power plant. The energy flows can be traced by the users at any time via app or on an internet portal.
Name	**Bürgerenergiegenossenschaft BENG eG**
Region	Munich, Germany
Founded	Founded in 2011 by a group of inhabitants (18 people)
Structure	Cooperative
Size and members	Around 500 members, mostly inhabitants.
Capacity and energy resources	Solar energy: about 40 citizen solar systems Capacity: currently more than 1.25 MW.

Description	BENG eG runs PV projects, mostly on rooftops and in open-space facilities, but also tenant electricity projects and balcony PV systems. The cooperative conducts educational activities for local communities and members, e.g. workshops on several topics connected to sustainability and mobility. Participants are mainly inhabitants, but also local authorities and a few companies.

Annex 2 Characteristics of ECs in Germany.

Figures

Tables

Abbreviations

EC	energy community
EU	European Union
EEG	German Renewable Energy Sources Act
CEC	citizen energy community
LTS	long-term strategy
NECP	National Energy and Climate Plan
DSO	distribution system operator
RES	renewable energy sources
GER	Germany
PL	Poland
FIT	feed-in tariff
FIP	feed-in premium
KOWR	Krajowy Ośrodek Wparcia Rolnictwa (Eng.: National Agricultural Support Center)
URE	Urząd Regulacji Energetyki (Eng.: Energy Regulatory Office)

References

Akademia Górniczo-Hutnicza w Krakowie (2019): Klastry energii – bariery i szanse rozwoju. https://www.energetyka-rozproszona.pl/media/magazine_attachments/2019-11-07_broszura_ER_1_druk.pdf

Akademia Górniczo-Hutnicza w Krakowie (n.d.): Projekt KlastER w ramach GOSPOSTRATEG. http://www.dwag.agh.edu.pl/dwag-w-projektach/projekt-klaster-w-ramach-gospostrateg/

Bąk, Nina J.; Erbel, Joanna; Galiński, Jan; Małańczuk, Paulina; Pasierbski, Marcin; Zygmuntowski, Jan J. (2021): Spółdzielczy Plan Odbudowy. https://www.hub.coop/wp-content/uploads/2021/09/CoopTech-raport-wersja-mobilna-1.pdf

Biresselioglu, Mehmet Efe; Limoncuoglu, Siyami Alp, Demir, Muhittin Hakan; Reichl, Johannes; Burgstaller, Katrin; Sciullo, Alessandro; Ferrero, Edoardo (2021): Legal Provisions and Market Conditions for Energy Communities in Austria, Germany, Greece, Italy, Spain, and Turkey: A Comparative Assessment. Sustainability, 13(20), 11212. https://doi.org/10.3390/su132011212

Brown, Donal; Ehrtmann, Moritz; Holstenkamp, Lars; Hall, Stephen; Davis, Mark (2020): PROSEU – an EU project. Policies for Prosumer Business Models in the EU.

Bundesministerium für Wirtschaft und Klimaschutz (2022): Überblickspapier Osterpaket. https://www.bmwk.de/Redaktion/DE/Downloads/Energie/0406_ueberblickspapier_osterpaket.html

Bündnis Bürgerenergie (2017): Bürgerenergie ernst nehmen – Zuschläge genau prüfen. https://www.buendnis-buergerenergie.de/presse/pm-pressemitteilungen/artikel/2017-5-19/buergerenergie-ernst-nehmen-zuschlaege-genau-pruefen

Bündnis Bürgerenergie (2022): Osterpaket: Habeck muss regionale Versorgung mit Erneuerbarer Energie durch Energy Sharing möglich machen. https://www.buendnis-buergerenergie.de/presse/pm-pressemitteilungen/artikel/2022-3-9/osterpaket-habeck-muss-regionale-versorgung-mit-erneuerbarer-energie-durch-energy-sharing-moeglich-machen

Deutsche Energie-Agentur (2022): Energy communities: Accelerators of the decentralised energy transition. https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2022/dena_ANALYSIS_Energy_communities_Accelerators_of_the_decentralised_energy_transition.pdf

Ehrtmann, Moritz; Holstenkamp, Lars; Becker, Timon (2021): Regional Electricity Models for Community Energy in Germany: The Role of Governance Structures. Sustainability, 13(4), 2241. https://doi.org/10.3390/su13042241

Elżbieciak, Tomasz (2022): Sieci kluczowe dla rozwoju zielonej energii. WysokieNapiecie. https://wysokienapiecie.pl/70132-sieci-kluczowe-dla-rozwoju-zielonej-energii/

Endell, Marike; Elxnat, Marc; Groß, René; Quentin, Jürgen; Weigt, Jürgen (2018): Beteiligung der Gemeinde an einer Bürgerenergiegesellschaft. Fachagentur Windenergie an Land. https://www.fachagentur-windenergie.de/fileadmin/files/Veroeffentlichungen/FA_Wind_Gemeindebeteiligung_BEG-Zuschlaege_07-2018.pdf

Energiezukunft (2022): Knackpunkte für die Bürgerenergie. https://www.energiezukunft.eu/buergerenergie/knackpunkte-fuer-die-buergerenergie/

ERA-Net Smart Energy Systems (ERA-Net) (2021): Local Energy Communities. Taskforce Energy Communities as part of the Horizon 2020 BRIDGE Initiative; Taskforce Local Energy Communities – an activity started in the framework of ERA-Net SES Working Group 'Regional Matters'. Published by B.A.U.M. Consult GmbH (Smart Energy Systems ERA-Net). Available online at https://expera.smartgridsplus.eu/Living%20Documents/Local%20Energy%20Communities.aspx.

European Commission (2018): A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773

European Commission (2019a): The European Green Deal. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640

European Commission (2019b): Commission Recommendation of 18 June 2019 on the draft integrated National Energy and Climate Plan of Poland covering the period 2021-2030. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019H0903(21)

European Commission (2021): Economies of Energy Communities: Review of electricity tariffs and business models. https://ec.europa.eu/energy/sites/default/files/documents/bridge_tf_energy_communities_report_2020-2021.pdf

European Commission (2022a): REPowerEu Plan. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483

European Commission (2022b): Guidelines on State aid for climate, environmental protection and energy 2022. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2022:080:FULL&from=EN

European Commission (n.d.a): Energy communities. https://energy.ec.europa.eu/topics/markets-and-consumers/energy-communities_en

European Commission (n.d.b): National energy and climate plans. https://ec.europa.eu/info/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en

European Economic Congress (2022): Fotowoltaika znalazła się na zakręcie, ale nadal ma się opłacać. https://www.eecpoland.eu/2022/pl/wiadomosci/fotowoltaika-znalazla-sie-na-zakrecie-ale-nadal-ma-sie-oplacac,1274.html

European Parliament (2018): Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.), 2018 O.J. (L 328). http://data.europa.eu/eli/dir/2018/2001/oj/eng

European Parliament (2019): Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Text with EEA relevance.), 2019 O.J. (L 158). http://data.europa.eu/eli/dir/2019/944/oj/eng

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2016): Climate Action Plan 2050: Principles and goals of the German government's climate policy. https://ec.europa.eu/clima/sites/lts/lts_de_en.pdf

Grashof, Katherina; Guss, Herrmann; Weiler, Katja (2019): Detailauswertung der ersten Ausschreibungsrunde für Windenergie an Land – Implikationen für die Entwicklung des Monitorings von Akteursvielfalt (No. 32/2019). Umweltbundesamt. https://www.umweltbundesamt.de/publikationen/entwicklung-umsetzung-eines-monitoringsystems-zur

Grzegorczyk, Wojciech (2015): Wybrane problemy zarządzania i finansów: Studia przypadków. https://dspace.uni.lodz.pl/xmlui/handle/11089/14265?show=full

Hansen, Paula; Barnes, Jake; Darby, Sarah (2020): Final report on clean energy community business models: emergence, operation and prospects of European case studies. NEWCOMERS project (Horizon 2020). https://www.newcomersh2020.eu/upload/files/NEWCOMERS%20D4_6.pdf

Jankowska, Karolina (2014): Spółdzielnie energetyczne – przykład niemieckiej energetyki obywatelskiej. Czysta Energia, 9/2014. https://www.cire.pl/pliki/2/edukacja_jankowska_iii_wersja_poadpo_kor.pdf

Koalitionsvertrag 2021-2025 (2021): Mehr Fortschritt wagen - Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit. https://www.spd.de/fileadmin/Dokumente/Koalitionsvertrag/Koalitionsvertrag_2021-2025.pdf

Mielcarek, Paweł (2014): Metoda case study w rozwoju teorii naukowych, Organizacja i kierowanie, 1(161). https://www.researchgate.net/publication/305328666_Metoda_case_study_w_rozwoju_teorii_naukowych

Ministerstwo Aktywów Państwowych (2019): National Energy and Climate Plan for the years 2021-2030. https://www.gov.pl/attachment/e64830c9-440f-4f17-b3e7-8abd7667d406

Ministerstwo Funduszy i Polityki Regionalnej (2017): Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030). https://www.gov.pl/documents/33377/436740/SOR_2017_streszczenie_en.pdf

Ministry of Climate and Environment (2021): Energy Policy of Poland until 2040 (EPP2040). https://www.gov.pl/attachment/b1febd0c-e544-412d-a0d7-f6bff01707c1

Rachlinski, Jeffrey J. (2006): Bottom-up versus Top-down Lawmaking. The University of Chicago Law Review, 73(3), 933–964. https://scholarship.law.cornell.edu/cgi/viewcontent.cgi?article=1710&context=facpub

REScoop.eu (2019): Q&A - What are citizen and renewable energy communities?. https://www.rescoop.eu/toolbox/q-a-what-are-citizen-and-renewable-energy-communities

Reyes, Julian J. (2015): Institutional policies and stakeholder engagement: Comparing top-down and bottom-up approaches of environmental indicators for decision-making. http://www.wpsanet.org/papers/docs/Reyes_WPSA2015_Environmentalindicators.pdf

Romero-Rubio, Carmen; de Andrés Díaz, José Ramón (2015): Sustainable energy communities: A study contrasting Spain and Germany. Energy Policy, 85, 397–409. https://doi.org/10.1016/j.enpol.2015.06.012

Scottish Community Development Centre (n.d.): National Standards for Community Engagement. https://www.scdc.org.uk/what/national-standards

Spasova, Deyana; Braungardt, Sibylle (2021): Building a Common Support Framework in Differing Realities—Conditions for Renewable Energy Communities in Germany and Bulgaria. Energies 2021, 14, 4693. https://doi.org/10.3390/en14154693

Wittmayer, Julia M.; Hielscher, Sabine; Fraaije, Maria; Avelino, Flor, & Rogge, Karoline (2022): A typology for unpacking the diversity of social innovation in energy transitions. Energy Research & Social Science, 88, 102513. https://doi.org/10.1016/j.erss.2022.102513