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WESHARE

Business Energy Collaboration

D3.1 MAPPING THE BUSINESS

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Table of acronyms	Meaning
BI	Business Intelligence
CIEG	Custos de Interesse Económico Geral (Costs of General Economic Interest)
CSC	Collective Self Consumption
DSO	Distribution System Operator
EC	Energy Community
ESCO	Energy Service Company
EV	Electric Vehicle
IEC	Industrial Energy Community
PPA	Power Purchase Agreement
REC	Renewable Energy Community
TSO	Transmission System Operator
VAT	Value Added Tax

Deliverable Review table		
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EXECUTIVE SUMMARY

The transition to a decarbonized and sustainable energy system is one of the most pressing challenges of our time. In this context, energy communities represent a promising solution, allowing businesses and citizens to collaborate in energy production, sharing, and consumption, fostering economic, environmental, and social benefits. The WESHARE project aims to empower businesses in the creation and operation of industrial energy communities (IECs) by developing adaptable business models aligned with the evolving European legal framework and industrial contexts.

This deliverable, D3.1, "Mapping the Business," presents a comprehensive analysis of business models applicable to IECs. It outlines implementation choices and explores the dimensions critical to their long-term success. The report identifies key structural and contextual variables that influence the viability and sustainability of IECs. It also reflects on how national transpositions of RED II and IEMD Directives in Flanders, Spain, and Portugal affect the feasibility of different business configurations.

BACKGROUND

The European Union (EU) is leading the global energy transition, aiming to limit global warming to 1.5°C and achieve climate neutrality by 2050. As set out in the European Green Deal, the Energy Union Strategy, and the "Clean Energy for All Europeans" package, the EU has committed to reducing greenhouse gas emissions by 45% by 2030 while increasing the share of renewable energy and improving energy efficiency. The European 2050 long-term strategy, the Green Deal roadmap, and the Recovery Plan have paved the way for Europe to become the world's first climate-neutral continent.

As energy-related activities account for nearly three-quarters of global greenhouse gas emissions, decarbonising this sector is essential to mitigating the worst impacts of climate change. Transitioning from fossil fuels to renewable energy sources offers a substantial opportunity to reduce carbon emissions at scale.

In recent years, a growing number of countries, cities, corporations, and institutions have committed to net-zero targets. The Race to Zero campaign exemplifies this momentum, mobilising over 9,000 businesses, around 1,000 cities, more than 1,000 academic institutions, and over 600 financial organizations to implement tangible emission reduction strategies by 2030. Meeting these commitments requires not only high-level pledges but also robust, actionable decarbonization pathways.

Within this global framework, the industrial sector emerges as critical stakeholder in the energy transition. In the European Union alone, this sector is responsible for roughly one quarter of final energy consumption. Despite notable improvements in energy efficiency, substantial untapped potential for savings remains across many enterprises. Between 2020 and 2023, the convergence of technological innovation and widespread disruptions— natural, geopolitical, and societal—prompted a strategic rethinking of energy policies and industrial practices.

The European Commission's Green Deal Industrial Plan for the Net-Zero Age (2023) recognises this urgency, placing decarbonization at the heart of industrial transformation. It advocates for a shift towards low-carbon energy sources, greater energy efficiency, and the integration of circular economy principles. Central to this vision is the mobilisation of **collaborative action among businesses**, where energy communities are increasingly seen as high-impact models for cooperative, decentralised energy systems.

Energy communities represent a transformative mechanism for restructuring local energy systems. By enabling collective investment and shared governance, they support the clean energy transition while delivering concrete benefits to participants. These include improved energy efficiency, cost reductions, greater energy independence, and job creation at the local level. Crucially, energy communities foster public engagement and can catalyse private investment through trusted partnerships. Energy communities can adopt a variety of legal forms, enabling businesses to pool resources and co-invest in renewable generation, storage, and demand-side management assets.

Historically, self-consumption models were perceived as a financial burden rather than a viable economic option. Today, even SMEs, through local energy communities and cooperatives, are increasingly empowered to become prosumers, actively producing and consuming energy through their participation in local energy communities and cooperatives.

BUSINESS MODELS FOR ENERGY COMMUNITIES

Introduction to Business Models

A Business Model (BM) is a conceptual tool that describes how an organization creates, delivers, and captures value. In the context of energy communities, especially industrial ones, business models extend beyond traditional economic logic to incorporate environmental and social value dimensions. Unlike conventional models that prioritize profit maximization, ECBMs (Energy Community Business Models) aim to deliver shared value across a diverse stakeholder base—including SMEs, public entities, and prosumers—by aligning energy goals with community well-being.

The uniqueness of ECBMs is reflected in their emphasis on collective ownership, decentralized governance, and co-creation of services. These models follow an "outside-in" perspective, responding primarily to external societal and environmental needs rather than internal corporate priorities.

The Business Model Canvas

The business model canvas is an attempt to structure and visually represent the main building blocks of the business model. It includes nine building blocks that collectively describe the logic of how a business creates, delivers, and captures value.

Building blocks regarding value creation encompass the value proposition, which highlights the unique products or services that create value for specific customer segments; key activities, and key resources, that respectively outline the critical actions needed to implement the BM and the assets required to deliver the value proposition and operate the business; and key partnerships, representing the external alliances and essential suppliers for the business's success. Regarding value delivery, the related blocks are customer segments, defining the different groups of people or organizations the business aims to serve; channels, describing how the organization delivers its value proposition to customers; and customer relationships, which specify the type of relationship the company establishes with its customer segments. Finally, value capture is composed of revenue streams and cost structure, which respectively identify how the business generates income from its customer segments and the major costs incurred to operate the BM.

Partners	**Activities**	**Value proposition**	**Customer relationships**	**Customer segments**

<table>
<tr>
<td rowspan="2">Strategic alliances, joint ventures, buyer-supplier relationships.</td>
<td>Actions that must be fulfilled to realize the Value Proposition: purchasing, production, sales, invoicing, etc.</td>
<td rowspan="2">Unique features, benefits, or services offered.</td>
<td>Activities to support customers: Personal assistance, self-service, automated services, communities, co-creation, etc.</td>
<td rowspan="2">Groups in which the customers can be divided – according to their needs, size, configuration, intermediaries, pricing power, etc.</td>
</tr>
<tr>
<td>Resources

Physical, intellectual, human, financial or technical resources.</td>
<td>Channels

Communication, distribution, and sales channels (online, retail, direct sales, etc.).</td>
</tr>
<tr>
<td colspan="2">Cost structure

The composition of the costs and their flexibility: fixed costs, variable costs, and possible economies of scale and scope.</td>
<td colspan="3">Revenue streams

How to generate revenues from the value proposition: asset sale, usage fee, subscription, lending/leasing, licensing, advertising.</td>
</tr>
</table>

Figure 1: Example of a Business Model Canvas

Energy Community Business Models (ECBMs)

ECBMs exhibit unique characteristics that set them apart from traditional BMs. While conventional approaches often prioritize profit maximization for a single entity, these models focus on delivering environmental, economic, and social benefits to the community. The collaborative and decentralized nature of ECs introduces new dynamics, such as collective ownership, multisided interactions, and significant reliance on network effects. These distinctive features necessitate a tailored approach to BM innovation, emphasizing shared value creation and community-driven objectives. In addition, main differences are highlighted between citizen energy communities and industrial energy communities.

The key aspects are identified below:

- <u>Sustainable BMs</u>: to effectively integrate the diverse roles of citizens into energy BMs, a shift from traditional BM frameworks to sustainable BMs is recommended. Sustainable BMs align with the broader sustainability transition, aiming to create "complex value" that extends beyond economic benefits to include social and environmental dimensions
- <u>Key functions</u>: in ECBMs key functions define characteristics and tasks fundamental for EC and comprehend the BMC dimensions that are referred to channels, customer relationships, key resources, key activities, and key partnerships
- <u>Outside-in perspective</u>: ECs are primarily focused on addressing energy-related challenges rather than generating profit for a single company. Their main objective is to deliver environmental, economic, and social benefits to their members and the broader community. ECs embrace an outside-in perspective, aligning their efforts with societal and environmental needs

- <u>The community</u>: in ECs, no single firm drives BM innovation. The community collectively operates and benefits from the model. Energy consumers are empowered to take an active role, often combining consumption and production into a prosumer approach. Beyond energy generation, the focus may extend to energy efficiency or sufficiency. These communities encompass a diverse range of actors, including residential consumers, SMEs, and public authorities. Given this diversity, ensuring that each member perceives a net positive value proposition is essential, as participation depends heavily on individual motivations influenced by institutional and spatial factors
- <u>Exploiting co-creation and co-benefits</u>: sustainable BMs emphasize co-creation, where multiple stakeholders collaborate reciprocally to create and deliver value. This approach redefines the dynamics of value creation, fostering deeper stakeholder engagement and addressing the holistic needs of ECs. Since ECs offer value only when supply and demand are aligned, its relative value is by definition dependent on the collaboration between producer and consumer, leveraging synergies between services. This interconnected approach amplifies the value delivered to community members and enhances overall system effectiveness
- <u>Multisided platforms</u>: the inherent characteristics of ECs often lead them to function as multisided platforms. These platforms facilitate direct interactions between multiple parties while potentially involving providers of storage, platforms, or other enabling features. This structure fosters collaboration and aligns with the community's goal of maximizing shared benefits
- <u>Network effects</u>: these play a pivotal role in the success of ECBMs. These effects arise when the value of a product or service increases with the number of users or complementary offerings. As the size of an EC grows, so do the benefits for its members, including access to a broader range of services and revenue streams. Direct network effects, driven by the growing community size, and indirect network effects, derived from the complementarity of goods and services, play a central role in amplifying the value and sustainability of EC initiatives.

Traditional BM vs	**ECBM**
- Economic value - Key channels, customer relationships, key resources, key activities, and key partnerships - Inside-out and individual perspective - Unidirectional value creation.	- Environmental, social and economic value - Key functions - Outside-in and community perspective. - Value co-creation - Multisided platforms - Network effects.

Figure 2: Evolution from traditional BM to ECBM

Below is a deep dive on each of the dimensions of the business model canvas for energy communities, and specifically for industrial energy communities.

Description of the EC Business Model Canvas dimensions

Partners

Partners are at the heart of an energy community. They influence all other factors, as the value proposition of the community itself depends on its members. The number of participants in an industrial energy community is likely to be smaller than in the case of citizen energy communities, leading to a larger role for each participant and a reduced influence of the Energy Community Manager. Key partnerships include also consumers, prosumers, aggregators, and energy suppliers, as well as external stakeholders like monitoring system providers and blockchain-enabled transaction platforms. Such collaborations ensure the smooth functioning of ECs and amplify their ability to achieve shared value creation.

Understanding the dynamics of these partnerships is crucial for the optimization of ECBMs, as it allows for a more inclusive, collaborative, and efficient approach to value creation, delivery, and capture.

EC participants engage in both energy generation and consumption, fostering a prosumer-based approach that is fundamental to the community's success. Alongside them, external stakeholders also play a pivotal role, and the most important ones identified are the following:

- Energy suppliers and aggregators facilitate financial transactions while supporting theoretical and physical energy flows. Energy suppliers guarantee the supply of electricity, while electricity aggregators balance supply and demand to maximize the efficiency of the energy market
- Distribution grid operators are crucial for managing the infrastructure required for community electricity distribution. They handle data flows related to grid performance and energy distribution and ensure stability and reliability
- Financing institutions like banks and other institutions enable the initial investments required for EC projects, providing financial flows
- Energy service providers contribute to the technical and operational efficiency of energy systems, providing help in maintenance, metering, data gathering or other specialized solutions
- Coordination centres and local authorities facilitate communication and governance of ECs. While ministries and authorities oversee and support regulations, coordination centres can act as information hubs
- Third parties: businesses, industries, and other ECs establish collaborative networks through the exchange of theoretical energy flows, financial resources, and information. These relationships encourage scalability and innovation
- Local leaders and regional initiatives support the socio-economic integration of the community, providing solutions to the specific context and needs of the community

Activities

From an operational standpoint, key activities obviously include local energy generation and related maintenance operations, but, since value is derived but the simultaneous production and consumption, the consumption of energy is also a key value-generating activity. These activities should be supported by important and challenging activities linked to data management and analysis to support intra-community billing procedures and active community building – an energy community can only be successful when trust exists between the partners. Ancillary activities can also contribute to this goal, such as childcare, catering, lighting, security or any other service that can be organized at community level with benefits for the participants.

Value proposition

The value proposition of Industrial Energy Communities (IECs) encompasses a multidimensional mix of **social**, **ecological**, and **economic** benefits. Unlike traditional business models that primarily target profit maximization, IECs adopt a holistic view, creating value across community, environmental, and financial domains.

These domains are often interconnected: for example, an increase in self-consumption provides an economic impact in terms of savings and environmental impact in terms of renewable production and consumption. While enabling elements such as legislative frameworks, technological advancements, and innovation are prerequisites for the functionality of ECs, the actual outcomes depend on how these communities are implemented and managed. The impacts of ECBMs reflect their ability to contribute to sustainability goals, foster social cohesion, and deliver economic value, making them critical to assessing the overall success and replicability of ECs.

Social value

The social role of ECs outlined in EU legislation is explicitly aimed at energy poverty alleviation and the participation of all social groups in ECs, or more generally, to promote citizens' empowerment. ECs actively impact on social issues, contributing to energy justice, energy democracy, community empowerment, and social capital. IECs contribute to the strengthening of local networks and community identity, particularly within industrial districts. By fostering collaboration among enterprises, public institutions, and local actors, these communities enable new forms of cooperation and governance. This collaboration helps build trust, encourages collective engagement, and often results in the formation of long-term partnerships around shared energy goals. Furthermore, the participatory nature of IECs encourages democratic governance, increasing transparency and enhancing community resilience. Including citizens in IECs boosts the community dimension of the IEC even further by acting as a catalyst and can lead to higher economic value creation due to the complementary energy uses between citizens and industry. These social mechanisms also contribute to greater user awareness, local job creation, and the stabilization of local economic ecosystems, especially in areas vulnerable to industrial relocation or economic stagnation. Finally, ECs support sustainable lifestyles by promoting energy literacy and enabling individuals to better understand the role and impact of energy in their daily lives.

However, some models can also disempower consumers, limiting their supplier choice or complicating energy decision-making. Clear and open communication is key to realize the social benefits.

Ecological Value

From an environmental perspective, IECs accelerate the decarbonization of the energy system by incentivizing investments in local renewable energy sources—primarily solar photovoltaic installations (PV), but also wind, biomass, or sector-coupled solutions. Consequently, they contribute to the reduction in GHG emissions. By promoting self-consumption and optimizing local energy use, IECs reduce dependency on fossil fuels and lower greenhouse gas emissions. Additionally, IECs help enhance grid flexibility. The alignment of energy consumption and production—particularly through demand-side management and accurate forecasting—plays a key role in stabilizing the grid. Accurate forecasting tools and collaborative planning enable companies to adjust production in response to energy availability, contributing to more efficient and resilient energy systems.

Economic Value

IECs provide tangible financial advantages to their members through the reduction in energy bills via collective self-consumption and in revenue generation from surplus energy sold to the grid, and in savings on ancillary services such as flexibility provision or capacity management. A breakdown of those value streams is offered in the paragraph Economic impact of energy sharing at p.21.

Considering a larger perspective, ECs also provide indirect economic benefits for the whole system, like better security of local supply in case of power supply disturbances, creation of local economic development by supporting job creation, increased expertise, and other cascading effects. The cost of energy is reduced since self-generated renewable energy is usually cheaper than the retail tariff. While aggregation effects allow for lower grid tariffs, reductions in consumption have a positive impact on decreasing transmission expansion and, consequently, on reducing the average cost of electricity.

Benefit distribution is a key success factor for ECs and their BMs. Different approaches can be adopted, ranging from equal distribution among all members to allocation according to the energy produced, consumed, or the investment quotas. Therefore, it is critical for a community to agree on a sustainable way of sharing benefits, as it impacts the community's ability to attract members with diverse generation and load profiles.

Compared to citizen energy communities, industrial contexts typically involve higher energy volumes and fewer participants, allowing for comparatively lower administrative costs and greater economies of scale. As a result, Return on Investment (ROI) tends to be more substantial. Furthermore, the financial structure of industrial participants—often more robust and risk-tolerant than that of households—enables larger upfront investments and longer-term planning, which further enhances the profitability and scalability of the IEC model.

ECs, through their aggregation of multiple stakeholders, can also reduce the risks linked to an investment in renewable energy, and, in turn, the associated financing costs. By pooling the energy demands of all participants in an EC, the resulting revenue or savings pattern is much smoother, and the risk of default is greatly diminished, compared to the energy and financial flows of a single participant. Since any financing will therefore be considered as less risky, interest rates will be lower, and it will be possible to realize more projects.

Resources

The success of an Industrial Energy Community (IEC) relies on a combination of physical infrastructure and intangible capabilities. Central to this are the renewable energy assets—such as photovoltaic systems, wind turbines, storage technologies, and smart metering infrastructure—that enable decentralized energy generation, management, and optimization. However, technical resources alone are not sufficient.

Equally critical is the availability of technical and managerial know-how. This includes expertise in energy systems design, data analysis, maintenance operations, and regulatory compliance. The ability to operate digital platforms for energy monitoring and coordination also plays a strategic role, especially in configurations involving flexibility services or dynamic pricing. These digital platforms are enabled by rapid advances in data analysis capabilities and Internet of Things (e.g. smart meters). Further advances in blockchain platforms and associated smart contracts could augment the traceability and automation of the transactions on the platform, whereas advanced production and consumption forecasting through machine learning has the potential to greatly maximise the value of the EC – further increasing the importance of technology as a key resource in ECs.

Human capital is another essential resource. The skills, commitment, and coordination of stakeholders—including energy managers, planners, and company representatives—ensure that the community can function smoothly and evolve over time.

Finally, the legal and organizational structure chosen for the community acts as an enabling resource, shaping how decisions are made, how responsibilities are distributed, and how benefits are shared.

Together, these resources provide the technical, institutional, and human foundation necessary for an IEC to be both operationally viable and resilient in the long term.

Customer segments

The customer segments in ECs include diverse groups of individuals and organizations who either contribute to or benefit from the community's operations. These segments include residential prosumers of different typologies (residential, large scale, and others), pure consumers, local energy producers, storage operators, and aggregators. Additional segments, like platform operators, ESCOs, and network operators, can also be customers in specific configurations. Members of an EC often wear multiple hats, acting as asset owners, facilitators, or service providers, depending on their involvement. Customer segments are further specified as prosumers and consumers, with an additional focus on entities like Distribution System Operators (DSOs) and Transmission System Operators (TSOs).

Customer relationships

Effective customer relationships are vital to maintaining trust, ensuring participation, and driving the success of ECs. These relationships are facilitated both onsite and virtually through management and monitoring platform (see “channels”). The most important item in EC customer relationships is the fostering of a sense of community and collaboration – therefore, it is important to ensure that the governance of the EC allows for sufficient inputs from its members and organize activities where the members can meet and bond.

Channels

The most relevant channels for reaching participants are through existing relationships, building on pre-established trust. Acting in tandem with either local governments, energy management agencies and/or existing business park managers is the most effective way to reach potential participants in an energy community. Once a community has been set up, it becomes key to showcase its results and benefits to other companies, thus becoming the main channel for new customer acquisition. The channels to reach the existing members of the energy community can be any number of the following:

- Billing – mostly monthly and either paper based or electronic. The format should be leveraged to include tips on how to maximize the impact of the company’s participation in the EC
- Electronic platform – ideally, an electronic platform is created to show the various energy flows in the EC, with the most granularity possible. It can be enriched with forecasting tools to add even more value to the participants, showing when to time their consumption to maximize their benefit.
- Newsletter – a newsletter at fixed time intervals (e.g. quarterly) that showcases the main realizations of the EC can be circulated to increase the sense of connection within the EC. Where there is an existing newsletter (e.g. in the business park), it makes sense to include the EC as a
- In-person meetings: in line with the governance of the EC, in person meetings are favoured when decisions must be taken regarding the operations of the EC.

Cost structure

The cost structure of ECs reflects the complexity of managing distributed energy resources and collective initiatives. Broadly speaking, the costs associated with ECs can be divided into fixed (capital expenditures or CAPEX) and variable (operational expenditures, or OPEX) categories. CAPEX primarily covers the installation of infrastructure, such as renewable energy systems, smart meters, and energy storage solutions. These upfront investments are significant but critical for establishing the physical and digital backbone of the community. OPEX includes the ongoing costs of operating and maintaining the community’s assets, such as management platforms, energy monitoring systems, and physical infrastructure. The EC manager’s fees and related platform also are an important contributor to OPEX. Taxes, network charges, and compliance costs also fall under OPEX, reflecting the regulatory environment in which ECs operate. These costs are not only financial but also technical and administrative, requiring efficient management to maintain the community’s financial health.

Financing also carries costs, that depend first and foremost on who will own the production assets – either the EC, one of its participants or a third party (e.g. an ESCO). In the first two cases, the EC or the business either must finance the generating capacity from its own means or through bank financing, with the latter incurring interest costs. In the case of third-party ownership, high upfront CAPEX and interest costs are avoided, but there will be other costs associated with the third party: either the cost of energy offtake or a fixed leasing fee. Robust financial modelling is key to identifying all these costs and determining the solution that best fits the needs of the participants.

The availability of accessible financing mechanisms is essential to support the growth and sustainability of ECs, since they are essential to meet the significant upfront costs associated with energy generation, storage, and distribution assets. Financing depends strongly on project's characteristics, such as size and technology used, governance schemes, and technology ownership. The most current financing schemes are self-financing, bank loans, capital and investment grants from public funding schemes, equity and investment grants from private funds, and venture capital from promoters of energy cooperatives.

Finally, since the EC acts as a settlement platform, it has costs associated with paying the shared energy. One of the key challenges for ECs lies in managing costs while ensuring the equitable distribution of the value generated among their members. It is important to develop the benefit-sharing mechanisms that can be proportionally distributed among members based on their level of investment or consumption patterns, fostering trust and sustaining active engagement within the community.

As mentioned before, all these costs are influenced by network effects, since the benefits are linked to the amount of energy shared and costs are mainly fixed. While peer effects help build a sense of community and encourage collaboration, economies of scale lower per-unit costs as the community expands and learning effects lead to better operational efficiency and resource management over time.

Revenue streams

The primary revenue streams of ECs reflect their multi-faceted roles as providers of energy services, platforms for collective action, and enablers of the energy transition. Revenue sources in ECs can be categorized into four main areas.

Energy services represent a direct income stream derived from offerings such as electricity, heating, mobility, and EM services. These services are tailored to community needs, allowing members to access affordable and sustainable energy solutions. For instance, communities can provide bundled energy solutions that integrate renewable electricity with smart management systems, ensuring both economic and environmental benefits.

Secondly, energy cost savings play a significant role in EC revenue models. By leveraging strategies such as demand response, self-consumption, and peak shaving, communities can optimize energy use and minimize expenses. Smart EM tools enable participants to shift consumption patterns or store excess energy for later use, thereby reducing dependency on expensive grid energy during peak hours. Furthermore, ECs can generate income from external services, such as selling flexibility and balancing capacity to grid operators. By aggregating and managing distributed resources like batteries and flexible loads, communities can participate in ancillary service markets, providing critical support for grid stability and earning revenue in the process.

Another important source of revenue is community investment, where members contribute financially to the EC through membership fees, shares, or tariffs. This model not only funds the operation and maintenance of the community but also strengthens members' sense of ownership and engagement.

Additionally, data valorisation offers an emerging revenue opportunity, as communities can monetize insights derived from production, consumption, and behavioural data. For example, anonymized energy usage data can be shared with service providers or used to optimize community operations. The revenues can be developed from energy supply, including both self-consumed energy and additional grid consumption, as well as income from participation in electricity markets such as balancing and capacity markets. Additional streams include leasing or selling technology to members and offering ancillary grid services, such as congestion management and local grid balancing.

These diverse revenue sources underscore the financial versatility of ECs and their capacity to align market-based income with broader community objectives. Although consumers may be willing to pay more for the environmental and social benefits, competitive market prices limit the potential for substantial price increases. Grid and data services linked to consumption and production patterns offer further potential, though market mechanisms for these are still developing.

Archetypes of Energy Community Business Models

The classification of energy community business models (ECBMs) has been widely studied, focusing primarily on the **degree of user participation** in financing and governance. This involvement shapes the **ownership structures** and engagement levels.

The most comprehensive approach classifies ECBMs into **eight archetypes**:

- Energy cooperatives
- Community prosumerism
- Local energy markets (LEMs)
- Community collective generation
- Third-party sponsored communities
- Community flexibility aggregation
- Community ESCO
- E-mobility cooperatives

These archetypes differ by goals, ownership, and stakeholder roles, and often blend into hybrid forms or overlap on some aspects.

Energy Cooperatives

Energy cooperatives are citizen-led initiatives in which end-users participate to pool financial resources for purchasing energy generation systems. Different organizational forms and financing mechanisms can be adopted by cooperatives, but they are all based on voluntary membership, open participation, and democratic control. They can be constituted either as for-profit companies, being able to compete with other market players, or not-for-profit cooperatives, to satisfy electricity demand for a local region and reinvest the gains from the sale of surplus generation.

Governance is usually retained by members, who act as shareholders. Generally, part of the revenues is reinvested in the community, while the rest is distributed among them through direct payment to remunerate their investment. In some countries, energy cooperatives may be involved in the management of regional low voltage distribution networks, acting as DSOs and being able to define billing conditions, incentivize self-consumption, and exempting users from payment of some use-of-system tariffs. Energy cooperatives often collaborate with municipalities that can provide additional funding and technical expertise. In some cases, especially in countries where municipalities play a role in energy supply or distribution, they may become responsible for the management of the cooperative in exchange for benefiting from cheaper renewable energy.

Community Prosumerism

It refers to communities exclusively created by prosumers, which are users who own distributed renewable energy generators used for self-consumption and for selling excess energy produced. The main purpose of this type of community is to increase user benefits by aggregating demand and surplus, enabling participation in flexibility markets and Local Energy Markets (LEMs), or benefiting from bulk purchases when collective generation assets are acquired.

Aggregating demand and surplus allows prosumers to negotiate better conditions with retailers and energy traders, although this generally requires infrastructure capable of tracking energy, money, and information flows. In this context, the forecast of Renewable Energy Sources (RES) output plays a crucial role by significantly optimizing energy usage. Indeed, the operation of the appliances should align as much as possible with PV generation hours, while any surplus can be sold by participating in LEMs. Long-term PPAs are often established between members and energy suppliers, which take responsibility for buying energy surpluses or providing the needed power. In this arrangement, transactions can be tracked by a local grid controller, which may also play an active role by assisting members in making better decisions and selecting the best offer. Alternatively, if a LEM is available, members can buy and sell their electricity within the community boundaries, benefiting from the exemption of payments on certain network tariff components. Overall, potential revenues can either remunerate prosumers or be reinvested in the community.

Local Energy Markets

LEMs are typically developed by communities of prosumers to sell the excess of production to other members, thus maximizing self-consumption and reducing the amount of electricity taken from the grid. They can also integrate with other BMs, such as storage-based or e-mobility-based models. In LEMs, trading conditions can be directly negotiated with market participants, who can be either consumers or prosumers. Therefore, prosumers can select who to sell their excess production to, making an additional margin on their sales, while consumers can buy electricity at a more advantageous price by selecting who to buy their energy from. This dynamic also contributes to making the grid more stable and resilient. The savings from the difference between retail and market tariffs for buyers and the gains from higher selling prices for sellers are distributed among prosumers and consumers. Generally, LEM members are physically close, but configurations in which participants are geographically distant are possible. In such cases, members virtually join to create virtual ECs, although this may be limited by national legislation. LEMs are designed to promote P2P exchanges, which are organized in either a decentralized way or a centralized one, depending on whether an intermediary exists. P2P trading platforms act as digital marketplaces that provide information, facilitate transactions by finding the best match between buyers and sellers, and solve community imbalances. Members can collaborate to reduce grid exchanges or compete to improve overall efficiency. Unlike vertically integrated companies that control interactions, P2P trading platforms empower participants to set the terms of their transactions directly, fostering a sharing economy where risks and benefits are distributed among users. However, challenges related to free negotiation between members have hindered the adoption of decentralized P2P configurations. For this reason, centralized configurations are expected to become more prevalent in the coming years.

Three distinct configurations for LEMs are identified in:

- <u>Local Energy Provider</u>: a centralized model where a single entity owns the whole production and storage capacity of the local network, while the other users are only consumers. Therefore, this entity manages the sale of locally produced energy, optimizing distribution and pricing mechanisms.
- <u>Local Energy Community</u>: a shared ownership model where a common plant is owned by all or a group of users, based on principles such as the energy used or the initial investment. In this arrangement, electricity can be provided for free or sold at production cost, aiming to ensure equitable resource distribution and enhance local consumption.
- <u>Local Energy Market</u>: a decentralized P2P setup where prosumers retain ownership of their generation and storage assets, balancing local supply and demand through digital platforms for transparency and efficiency. This model is more complex since producers, consumers, and prosumers may coexist. However, participants could achieve higher earnings. To establish these configurations, advanced ICT is required, including net-metering infrastructures and software-

based trading platforms to monitor energy, financial, and information transactions. Blockchain technology is a promising tool for ensuring security and transparency, but it requires significant computational power and energy consumption.

Community Collective Generation

Community collective generation configurations are based on shared generation and storage systems, usually installed on the rooftop of multi-tenancy buildings or near consumption sites. Members generally remain passive consumers except when the generated energy is used to cover the common loads of the condominium. Typically, the investment is shared among dwelling owners who benefit from reduced energy bills for the common loads and potential revenues from the sale of surplus or institutional incentives. The distribution of generated energy and revenues is governed by predefined rules established collaboratively among participants, which allow for equitable allocations of benefits among them. Generally, advanced ICT is required to manage these systems and facilitate energy monitoring, distribution, and revenue sharing.

Third-Party Sponsored Communities

Since initial investment is generally an obstacle to the formation of ECs, external entities may intervene to support the financing of the project. Utilities and technology companies frequently provide financial and technical support, aiming at expanding their customer base and services portfolios. In these cases, they usually maintain the asset ownership and may retain royalties or usage fees while being responsible for governance, financial effort, and associated risks. Despite maintaining control over the assets, external entities closely collaborate with local communities to develop customized solutions and often try to include community representatives in the decision-making processes to ensure alignment with local needs. External investors, who bear the financial risk, are typically remunerated through PPAs signed with users, allowing the latter to benefit from renewable production at a reduced price.

Community Flexibility Aggregation

Community flexibility aggregation configurations aim to group different types of users (producers, consumers, and prosumers) to aggregate their volumes and gain access to flexibility markets. For instance, they can participate in DSM programs by providing demand flexibility to grid operators through aggregation. The aggregation is necessary to achieve sufficient volume and overcome the high costs. In this way, not only commercial and industrial customers but also residential users can participate by pooling their demand. Aggregators can act as virtual power plants, namely systems that combine several distributed energy resources and manage them as if they were a single power plant, bringing value both to the customers and system operators. Aggregators can develop a competitive advantage through profiles, forecasts, and digital services. Community aggregators perform key activities such as trading surplus energy on the wholesale market, optimizing energy consumption to increase self-consumption, and pooling customers' flexibility to trade on ancillary services markets.

Additionally, aggregators that operate at a local level can be grouped by a larger aggregator that operates at a power system level to meet the required volumes. In this context, the literature proposes several BMs for aggregators that can be grouped into three main categories:

- Standard Aggregator Model: the most basic configuration, where the aggregator performs core functions, such as trading energy and flexibility, implementing DSM programs, managing platforms and ICT infrastructures, and defining exchange contracts.
- Distributed Energy Resources Operator Model: in this model, the aggregator owns the power plants, directly providing the energy produced to the users. This represents why the aggregation of resources is a feature that utilities of the future will be required to have.

- Central Planner Model: this comprehensive model includes all the services of the first two configurations, with the aggregator also responsible for purchasing, constructing, and installing customer assets.

Bilateral contracts are typically signed between aggregators and customers, who agree to deliver a specific amount of flexibility, which they achieve by adjusting their consumption patterns and benefiting from reduced energy bills. Electrical appliances of users may be directly controlled by aggregators themselves during peak periods (dispatchable DSM), or customers may be exposed to dynamic price signals to influence their demand profile autonomously (non-dispatchable DSM).

When customers fail to deliver the agreed flexibility, penalties can be charged. Users also maintain two contracts: one with the aggregator and another with the energy supplier to purchase electricity or sell surplus energy as prosumers. To enable these activities, customers are provided with sensors, smart meters, home EM systems, and monitoring applications by aggregators. Indeed, ICT infrastructures are essential to exploit this BM. Although aggregators bear the financial effort entirely, end-users are included in decision-making processes as specified in the contract. This ensures a level of engagement and customization that aligns with the users' needs.

Community ESCO

In community ESCO configurations, an external entity intervenes to jointly create a community to provide energy efficiency services and renewable energy supply. However, ESCOs differ from utilities since they finance the projects with remuneration based on the reduction in energy costs (or increase in energy-related revenues) achieved by the customer. Under this configuration, several variants can be implemented. For instance, solar-as-a-service models are adopted when PV panels are installed, or heat-as-a-service models when combined heat and power systems are provided. In addition, ESCOs typically provide energy efficient systems or building retrofit solutions to ensure extra energy savings, safeguarding their remuneration. Two primary remuneration schemes are used: guaranteed savings, if ESCOs ensure to achieve a certain level of savings, or shared savings, if savings are split between the ESCO and the customer over a defined period, as specified in the contract clauses. The role of an ESCO can overlap with that of an aggregator, allowing some activities related to the creation of an EC to be externalized to them. This involvement may be limited to providing support during the initial design of the system or may include responsibilities for the operation and maintenance of the assets. Consequently, the responsibility and ownership of the assets operated in an EC represents a significant challenge. However, ESCOs typically own the assets and retain decision-making authority, with customers remaining involved in the process, as projects are generally customized based on their needs and local conditions. This involvement ensures that the solutions provided align with the requirements of the community.

E-Mobility Cooperatives

This configuration aims to enhance the diffusion of clean mobility solutions, such as e-mobility. Generally, e-mobility cooperatives are created through the active involvement of their shareholders to provide community-focused services, such as public transportation, car-sharing, or car-pooling, and enabling the exploitation of their assets as flexible resources. For instance, electric vehicle batteries can be used as storage resources to enable vehicle-to-grid and grid-to-vehicle solutions, storing energy during off-peak hours and providing flexibility services. This can be facilitated by designing smart charging schemes in which shifting or interrupting the charging sessions may use a battery to store energy or feed it back into the grid.

Generally, mobility providers own electric vehicles or electric buses to deliver car sharing or public transportation services, and these are powered by energy resources delivered by community prosumers, who, instead of feeding surplus energy into the grid, make it available to e-mobility services providers. Since these BMs are for-profit, fees are charged to mobility providers for accessing these energy resources.

However, the diffusion of these BMs can be hindered by regulatory barriers in vehicle-to-grid transactions and vice versa. Overcoming these obstacles will be necessary for the widespread diffusion of clean mobility solutions and full exploitation of the potential offered by ECs in supporting e-mobility.

While the eight archetypes provide a theoretical framework for categorizing ECBMs, practical applications demonstrate how they can be adapted to specific contexts.

Business Models as the collection of implementation choices

The WESHARE project follows a pragmatic and modular approach. Rather than imposing fixed archetypes, it explores the range of possible configurations that emerge from combining key implementation dimensions. This flexibility allows each community model to adapt to its specific regional, regulatory, and industrial context. As shown in Figure 3 , the basic configuration revolves around energy sharing, which can then be enhanced through the inclusion of further value-generating elements.

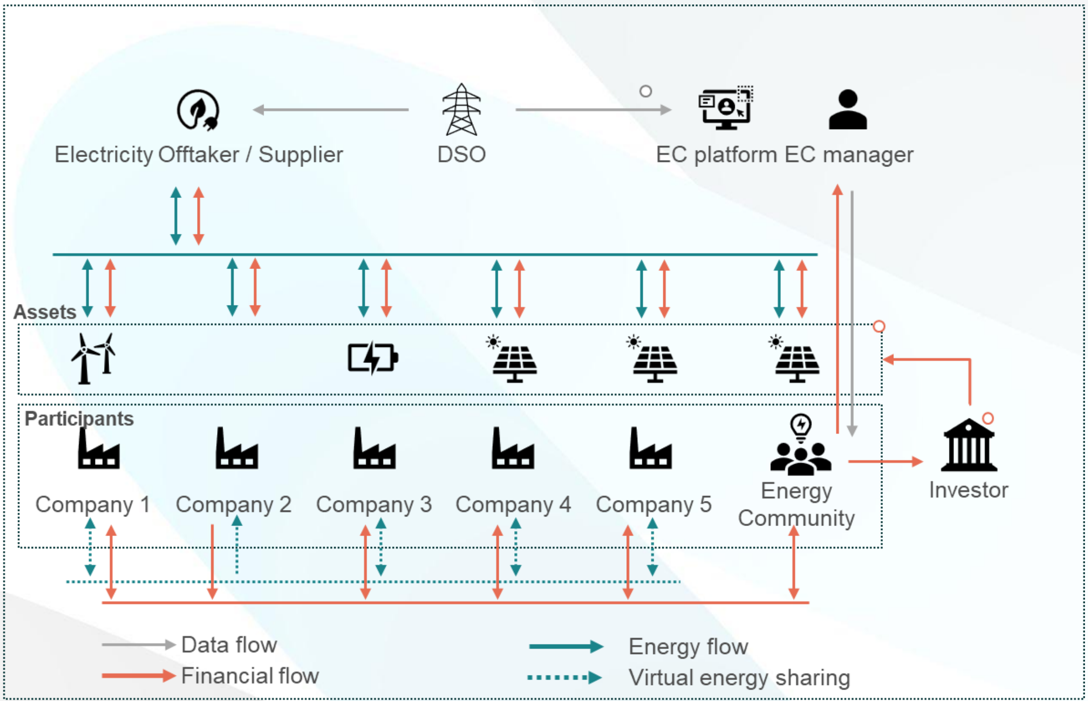

Figure 3: Example of a basic Energy Community business model

It begins with a **basic model focused solely on energy sharing**, which can then be expanded through additional value-adding dimensions.

However, not all configurations are feasible or relevant in every context. The applicability of different options depends on two main factors:

- Regulatory context: The national or regional transposition of European directives can impose significant constraints. These may include geographic or size limitations on eligible participants; restrictions for public entities due to procurement laws; and mandatory ownership of assets by the energy community, which excludes third-party ownership models in some countries. A comprehensive legal analysis is available in Deliverable 1.1.

- Non-regulatory regional context: Operational or market-specific barriers may further limit participation, such as administrative fees charged by some energy suppliers, which reduce the economic incentive for smaller actors; complexity in accessing and managing consumption and production data; and local grid management practices that hinder flexibility integration.

The **application of these dimensions and combinations** to each WESHARE pilot case will be detailed in the upcoming Deliverable 3.2.

Participants

The first critical decision concerns **participants**. The nature and complementarity of consumption and production profiles, as well as pre-existing trust relationships, will influence the formation and functioning of the community. Industrial communities generally involve fewer actors than citizen ones, which affects dynamics, coordination, and governance.

Assets

Once participants are defined, the **assets** to be deployed should be studied in detail to ensure the best fit with existing assets and the consumption profiles of the identified participants. These may include solar generation, battery storage, or even thermal systems like heat exchange networks. Capacity and expected production levels must be carefully assessed in advance.

Ownership

Ownership models can vary widely—from individual to collective to third-party **ownership**—and will determine how investments and risks are shared. Similarly, **management** responsibilities may be taken up by a single member, a pre-existing structure, or an external entity, with different implications for trust and financials.

Management

Deciding who manages the energy community and how this role is remunerated is crucial. In simpler setups, one of the members—often the most experienced—can act as **manager**, coordinating operations and receiving a modest fee or indirect benefits. Where a pre-existing structure (e.g. a business park association) exists, it may naturally assume the role, leveraging its administrative capacity and established trust among participants. Alternatively, a third-party manager can be appointed to ensure neutrality and professional oversight, though this adds cost and requires clear governance to align with community objectives. The choice depends on trust, capacity, and the scale of the community and can evolve over time.

Finance

The **financial structure** must support not only infrastructure investment but also operational costs. Financing may come from banks, ESCOs, community shares, or crowdfunding platforms. Importantly, financial planning should cover digital and legal services as well as energy infrastructure.

Data

Data management is central to the operation of any IEC. **High-quality data** enables accurate simulation, billing, and forecasting. The regional data ecosystem plays a pivotal role: where DSOs facilitate streamlined access to granular consumption and production data, the setup and ongoing optimization of the community is significantly eased. Shared dashboards and open reporting mechanisms can enhance transparency, trust, and economic optimization among participants. Finally, a mature energy community may expand into ancillary services. These include electric vehicle charging, co-investment in storage, and community-focused initiatives such as shared services or events, which not only improve the community's value proposition but also foster cohesion and trust. This comprehensive, modular approach to business model construction allows for robust adaptation to diverse industrial and legal environments, ensuring that each IEC is both resilient and contextually appropriate.

Ancillary Services

All of the above dimensions constitute an energy community in its most basic form. As we have seen, trust and community building are very important in most of these aspects. To foster that trust and capitalize on it, several ancillary services can be proposed that also increase the value of the community beyond the purely financial gain of participating in the energy community. Specifically for business parks, other services can be provided, both linked to energy in general (electric vehicle sharing, installation of charging stations, co-investment in storage capacity) and other services that can act as a catalyst for community building (organization of events between the companies and residents, the organization of childcare services, etc.).

Beyond their practical utility, ancillary services can also serve a strategic function. They help maintain participant engagement during periods when direct economic benefits may be limited—for example, during low generation seasons or in early project phases. By offering continuous, visible value, these services reduce the risk of participant attrition and support the long-term viability of the community.

Furthermore, ancillary services can facilitate cross-sector innovation and collaboration. By creating structured spaces for interaction—such as mobility platforms, co-working zones, or digital service exchanges—communities can generate new business models, improve resource efficiency, and even attract external investment. In some cases, these services can be the entry point for companies less interested in energy but keen to access a broader ecosystem of shared services. In this way, ancillary services not only reinforce the energy community internally but also position it as a broader enabler of regional industrial transformation.

ECONOMIC FRAMEWORK FOR ENERGY COMMUNITIES

Economic framework

The economic sustainability of an energy community is a decisive factor in its long-term viability. Understanding how value is created, distributed, and monetized within these communities is essential to ensure participation and commitment, especially in industrial settings where return on investment is critical. In the subsequent paragraphs, first the various components of an energy bill will be detailed and subsequently the impact of national regulation in the three pilot countries (Belgium, Spain and Portugal)

Components of an energy invoice

Because of its importance in determining the financial viability of an energy community, firstly a deep dive on the components of an energy invoice is proposed.

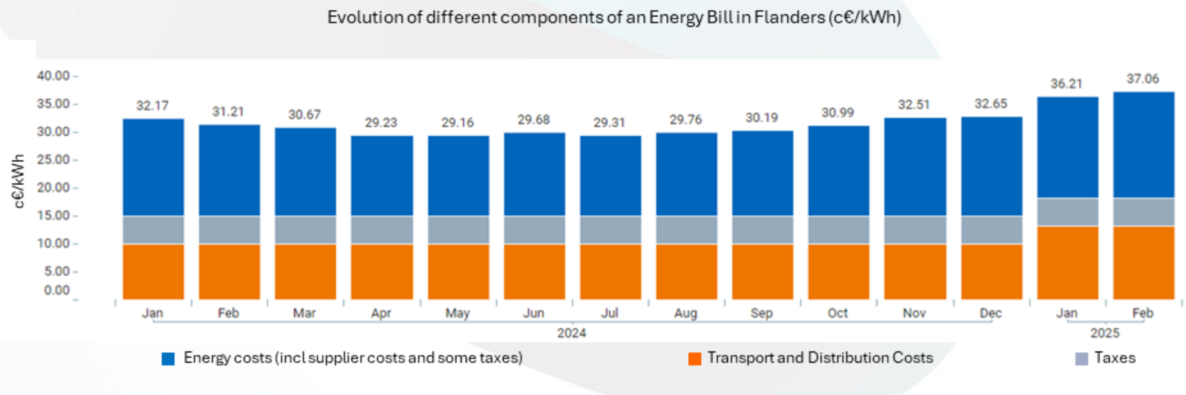

Figure 4: Evolution of the various components of an energy invoice in Flanders (source VREG)

An energy invoice consists of any of the elements shown graphically in Figure 44:

- **Energy costs** (€/kWh): the costs purely for the remuneration of the energy generation, invoiced according to the amount of energy consumed (kWh, for example).
  For **consumption**, three types of price structures generally exist:
  - Fixed: the price is fixed for a determined amount of time.
  - Variable: the price is variable based on the monthly price of a pre-set benchmark. This tariff can be further split according to peak and off-peak hours that are pre-set.
  - Dynamic: the price reflects the instantaneous price (often within a 1-hour timeframe) negotiated on the spot market.

The difference between variable and dynamic pricing is best exemplified by a real-world example. In Figure 5, the evolution of wholesale electricity price is shown for the Belpex exchange of May 2025: a client with a dynamic contract would have paid anywhere from -463€/MWh (being remunerated for his consumption) to a maximum of 178€/MWh, depending on the hour in which he would have consumed the energy, whereas a variable contract (without peak and off-peak distinction) would have invoiced at the month's average rate of 61€/MWh, without considering the exact moment in which the energy was consumed.

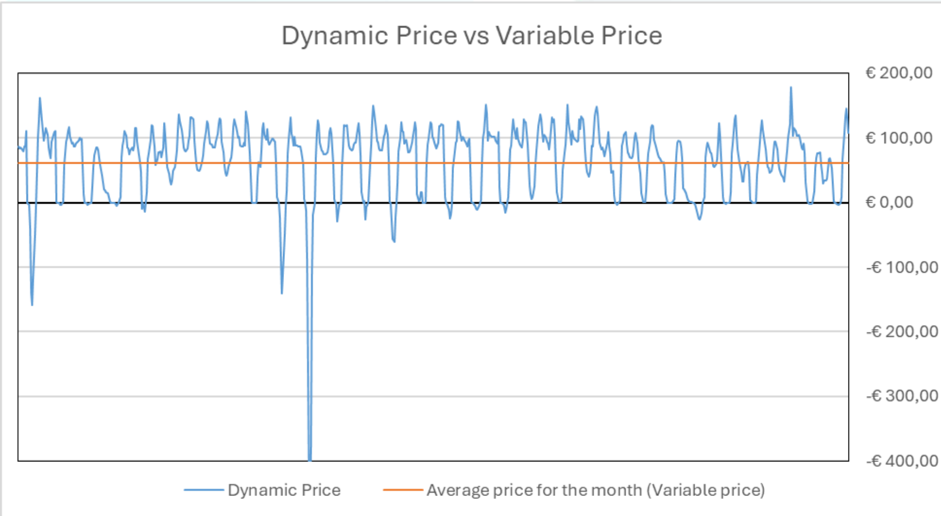

Figure 5: Example evolution of dynamic pricing (Belpex evolution of May 2025)

For **production/grid injection**, the remuneration obtained by the producer is either fixed, variable or follows a dynamic pattern, similar to the examples above.

An important part of the energy cost is the supplier markup: this refers to the margin added by the retail energy supplier on top of the benchmark price. Likewise, the remuneration for electricity that is injected into the grid is going to be remunerated by the energy off-taker at a rate lower than the benchmark price. Figure 6 shows the difference in those rates for a retail client in Flanders: the consumption price is about 30€/MWh higher on average than the benchmark price, whereas the injection price is about 45€/MWh lower than the benchmark price.

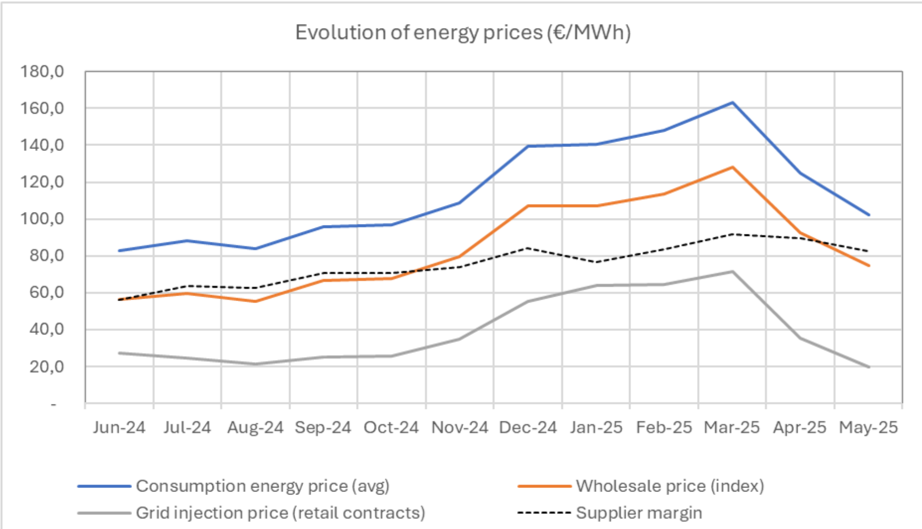

Figure 6: Difference between consumption cost and production remuneration in Flanders

- **Transport and distribution costs**: these include both volumetric and capacity-based costs associated with the use of the public grid. These can either be charged on a fixed basis (€), but more often on a percentual basis (%), power basis (€/kW) or on an energy basis (€/kWh)
- **Fixed costs**: these cover various administrative and contractual charges, such as:
  - Peak power charge (€/kW)
  - Metering fees/fixed commercial fees (€)
  - Administrative fees (€)
- **Taxes**: these include excise duties and levies to support national energy policies (mostly €/kWh), and VAT (%). It should be noted that in industrial contexts, VAT is not a real cost, as it is fully recoverable. Therefore, any savings on VAT have no economic impact for industrial participants.

Economic impact of energy sharing for participants

The economic benefit of energy sharing within an Industrial Energy Community (IEC) derives from the potential to reduce specific components of the electricity bill for the consumer, or obtain a larger price for the producer, as exemplified by Figure 7. However, this advantage varies considerably across national contexts, depending on how shared energy is valued and which cost components can be avoided. The economic advantage of energy sharing is determined by the sum of all these components, multiplied by their relative volumes, and subtracting the fee to the energy community. In the following paragraphs, we

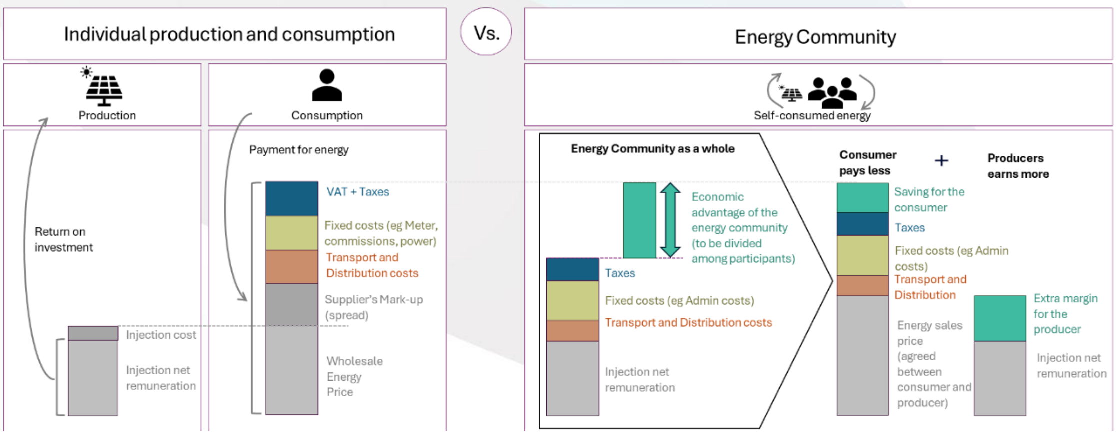

Figure 7: Breakdown of economic advantage of energy sharing

examine the benefits of energy sharing on energy bills or revenues, compared with individual consumption and injection.

Energy Costs

The advantage of self-consumed energy compared with injecting the same energy into the grid lies in the fact that the remuneration for injected energy is lower than the price for consumed energy. In the example of Figure 6, energy that is self-consumed instead of injected into the grid has a potential benefit from the prosumer standpoint of about 75 €/MWh.

The same reasoning applies to energy shared in an EC (within the applicable limits of the relevant national transposition) – therefore, it is important to constitute an EC with participants that have complementary consumption patterns, to maximize the amount of energy shared.

Transport and Distribution Tariffs

Some countries have a total or partial exemption of transport and distribution tariffs, reflecting the lesser amount of usage of the grid when self-consuming energy.

Taxes and Excise Duties

In some countries, no excise duties or VAT are levied on shared energy, in a bid to further incentivize the roll-out of renewable energy.

Fixed costs

In some cases, suppliers charge extra administrative costs linked to the management of the data flow in the invoice – this acts as financial penalty for participating in an EC, causing the participation in an EC to be uneconomical for smaller prosumers. Furthermore, smart meters are almost always required to be able to input the energy to the grid, which could carry extra costs.

Finally, the energy community itself has costs linked to data management, customer care, set-up and invoicing, which cause additional fixed / variable costs for the participating prosumers.

Value distribution

All the above factors contribute to generate the value for the sum of all participants. How this value is divided among participants depends on the rules adopted by the EC – and may provide strong differences between participants. A strong and inclusive governance is key to ensure sustained participation in the EC by all participants.

EU economic framework

The financial viability of energy communities across Europe depends not only on internal business model design but also on national regulatory and economic frameworks that determine cost savings, incentives, and administrative conditions. In the WESHARE context, particular attention is given to the pilot regions of Flanders (Belgium), Spain, and Portugal, where diverse transpositions of EU directives create varying levels of opportunity and constraint.

Belgium's economic framework

In Belgium, electricity incentives are decided at the regional level. The following data focuses on the region of Flanders, as it is the main location of the WESHARE pilots. In Flanders, the economic benefit from energy sharing is limited to the energy component of the electricity bill. Shared energy is still fully subject to grid fees and taxes, and suppliers often charge administrative fees per participant, significantly reducing the net advantage. Despite the presence of digital tools and a clear regulatory structure, the economic return remains modest without additional incentives.

Energy Community Stakeholders

This section identifies key players influencing the development and progress of ECs in Flanders. These entities can act as essential stakeholders in EC projects and are categorized into three main groups:

1. **Institutions** – Policymakers and Regulators: these public bodies create the **legal and regulatory framework** that enables energy communities to function and grow.
   - **Flemish Ministry of Environment, Nature, and Energy:**
     - Designs and implements regional energy and environmental policies.
     - Sets the strategic direction for sustainability and supports community energy initiatives.
   - **Flanders Energy and Climate Agency (VEKA):**
     - Promotes energy efficiency and renewable energy in the region.
     - Provides technical and financial support for sustainable projects.
   - **Vlaamse nutsregulator / VREG (Flemish Electricity and Gas Market Regulator):**
     - Ensures fair operation of the energy market and oversees ECs.
     - Requires ECs to **register** and disclose information about their operations, structure, and geographical proximity of members.
     - Publishes EC data on its website to promote transparency and oversight.

These institutions **establish rules**, **monitor compliance**, and **offer incentives** that directly shape how ECs are formed, financed, and maintained.

2. **Energy Sector Players** – Infrastructure and Market Enablers: these are the **technical and commercial operators** that provide the physical energy networks and manage distribution and billing.
   - **Elia (Transmission System Operator - TSO):**
     - Operates and maintains the high-voltage electricity grid in Belgium.
     - Ensures energy transport across regions and countries.
   - **Fluvius (Distribution System Operator - DSO):**
     - Manages local electricity and gas grids across Flanders.
     - Plays a key operational role in ECs by enabling energy sharing among members.
     - Facilitates EC registration and configuration (e.g., how energy is distributed among members) via the Mijn Fluvius online portal.
   - **FeReSO (Financial Settlement Organization):**
     - Works with Fluvius to calculate and reconcile financial transactions in energy sharing schemes.
     - Ensures that each member receives accurate compensation or charges based on agreed distribution keys.
   - **Energy Suppliers (e.g., Engie, Eneco, Total, Luminus):**
     - Provide electricity to consumers.
     - These four major suppliers hold 83% of the market, making them dominant stakeholders in energy delivery and customer interaction.

These players **enable ECs to operate technically and financially**, by managing grid access, energy flows, and billing systems.

3. Associations – Support and Capacity Building: these groups **advocate for**, **educate**, and **assist** energy communities, especially during early stages.

- **VVSG (Association of Flemish Cities and Municipalities):**
  - Supports local governments in launching and managing EC initiatives.

    - Helps municipalities integrate ECs into their sustainability and energy transition strategies.
- **REScoop Vlaanderen:**
    - Promotes renewable energy cooperatives across Flanders.
    - Offers expertise and tools to help citizens and groups set up ECs.
    - Encourages democratic ownership and participation in renewable energy production.
- **Flux50:**
    - A collaborative platform for innovation in the energy sector.
    - Connects businesses, universities, and public institutions to support research and development.
    - Drives forward new technologies and business models that can be adopted by ECs.

These associations **lower the barriers to entry** for communities, especially citizen-led groups, by offering expertise, advocacy, and capacity-building support.

Economics of Energy Sharing

In the Flanders region, end consumers have the option to select from a range of tariff contracts, including fixed, variable, or dynamic options:

1. **Fixed Tariff Contracts:**
    - Price remains constant for 1, 3, or 5 years
    - **Advantage**: Shield against market volatility
    - **Disadvantage**: price dips

2. **Variable Tariff Contracts:**
    - Adjust periodically based on market conditions
    - Follows trends in wholesale energy prices

3. **Dynamic Tariff Contracts:**
    - Prices change **hourly**, reflecting real-time wholesale market
    - **Advantage**: potential saving during low-price hours
    - **Disadvantage**: Exposes users to price volatility. In rare cases, **prices can become negative**, forcing producers to pay to inject electricity into the grid.

The type of tariff contract affects not only consumption costs but also how surplus electricity is fed into the grid. Under dynamic feed-in contracts, producers may receive zero or negative compensation during grid oversupply. Therefore, timing and tariff selection are critical for both cost savings and earnings from excess generation.

The electricity bill in Flanders consists of three main components: energy, grid costs (including both transmission and distribution), and taxes and charges. While individual self-consumption allows for full savings across all three components of the bill, energy sharing affects only the energy part, as imposed by Articles 7.2.1 and 7.2.2 of the Energy Decree.

There are no incentives on grid component of the energy invoice. In 2023, EnergyVille, on behalf of the Flemish Regulator, conducted an economic analysis to evaluate how ECs impact the grid and to determine whether a reduction of grid costs was addressable. The result indicated that for the cases studied (mostly residential participants with similar consumption patterns in Flanders), the benefits for the grid were insufficient to warrant a reduction. This lack of financial support negatively impacts EC expansion in the region, affecting the development of positive business cases in the long term.

Moreover, except for P2P, where energy prices can be set based on mutual agreements, shared energy in Collective Self Consumption (CSC) and ECs cannot be sold between participants, resulting in a non-favourable context in comparison with other European countries. To bypass this issue, a monthly fee can be charged as a service of the EC, proportional to the quantity of energy shared.

Another problem related to energy sharing is the presence of administrative costs for sharing. Energy suppliers impose annual fees ranging from 24 € to 150 € per year for each participant, a fee for each kWh of energy shared, or a mandatory condition to adopt dynamic contracts. Alternatively, surpluses can be injected into the grid receiving a remuneration based on the contract with the energy supplier. The available options are mentioned in the previous section. Current Flemish legislation has not introduced any incentives for energy sharing.

Despite growing interest from citizens, SMEs, and building owners in forming ECs, their implementation is perceived as too complex both in terms of variety (CSC, REC, CEC, etc.) and effort, resulting in a slow uptake of EC initiatives.

Category	Key Points
Tariffs	Fixed, variable, and dynamic – each with pros and cons
Billing	Only self-consumption reduces full bill; sharing reduces only energy part
Energy Sharing	Technically possible but economically limited by admin fees and no direct energy sales
Incentives	None currently available; no financial motivation for EC expansion
Barriers	Finance, regulation, market, tech, and governance complexity hinder progress

Table 1: Economic Highlights Belgium

Spain's economic framework

Spain offers a more advantageous setup, communities can achieve full savings on grid costs in addition to the energy component, which substantially increases the financial attractiveness of participation. The framework allows dynamic allocation mechanisms and recognizes community-led configurations, though it also introduces a higher degree of administrative complexity.

Energy Community Stakeholders

Spain lacks a single, dedicated regulatory authority for Renewable Energy Communities (RECs), resulting in fragmented governance and challenges in coordination. ECs are supported by a mix of national institutions, regional authorities, municipalities, and energy market actors, all of which influence the feasibility, pace, and scalability of EC projects.

Institutions play a fundamental role in regulating, supporting, and facilitating exchanges of information with ECs and stakeholders. The most important institutions include:

- **Ministry for the Ecological Transition and the Demographic Challenge (MITECO):**
  - responsible for Spain's national energy policy and transition strategy.
  - Defines legal frameworks and national plans supporting decarbonization and decentralized energy models.
- **National Commission for Markets and Competition (CNMC):**
  - Regulates the electricity and gas markets, ensuring fair pricing and competition.
  - Monitors energy company practices to prevent monopolistic behaviour—though enforcement is slow.
- **Institute for Energy Diversification and Saving (IDEA):**
  - Manages and distributes **funding mechanisms** (e.g., subsidies, grants, technical assistance) that are essential for EC formation and infrastructure.

- **Autonomous Communities (Regional Governments):**
    - Can issue region-specific grants, fast-track administrative processes, and simplify permitting.
    - Their role creates a highly regionalized landscape, meaning support for ECs varies significantly across Spain.
- **Municipalities:**
    - Play a role in shaping local regulatory frameworks, urban energy planning, and providing infrastructure access.
    - Often act as facilitators or even participants in ECs through public buildings or land use.

The absence of a centralized EC regulator creates uncertainty, uneven implementation, and jurisdictional overlaps.

Energy sector players provide essential services and collaborate with ECs by facilitating energy distribution and market operations. The most relevant actors include:

- **TSO: Red Eléctrica de España (REE):**
    - Manages Spain's national high-voltage electricity transmission system.
    - Ensures grid stability and approves access for new generation assets, including ECs.
- **DSOs (Distribution System Operators)** such as:
    - Endesa Distribución
    - i-DE Redes Eléctricas (Iberdrola group)
    - E-Redes Distribución (Naturgy group)

Their roles are to operate and maintain medium/low-voltage grids needed for EC operation and to handle connection approvals, data exchange, and load balancing.

- **Energy Retailers**, dominated by a few large players: **Endesa**, **Iberdrola**, **Naturgy**, **Repsol** (together hold majority market share) and the functions are:
    - Sell electricity to consumers.
    - Often reluctant to support ECs as they threaten traditional centralized business models.

Spain's energy market is heavily dominated by a few large incumbent energy companies. These players hold significant market and lobbying power, and see the decentralization driven by ECs as a threat to their position. As a result, they may resist reforms, slowing down the energy transition.

This resistance is compounded by bureaucratic and administrative inefficiencies:
- Communication between DSOs, energy suppliers, and consumers is slow and complex.
- Administrative processes are not digitized and hard to navigate.
- Grid access procedures, particularly for larger installations and Collective Self-Consumption (CSC) projects, are lengthy and burdensome.

While procedures are improving for small self-consumption setups (≤15 kW), larger or collective projects often face delays of 6 months to 2 years just to complete connection and activation.

Economics of Energy Sharing

Energy contracts in Spain vary according to different perspectives. Since June 2021, consumers have been free to choose between:

1. **Regulated Market (PVPC) – Dynamic Pricing:**

- Prices vary hourly, based on wholesale market rates, determined by the TSO.
- Beneficial for consumers active during off-peak hours but subject to price volatility.

2. **Free Market:**

- Prices are fixed or customized by electricity suppliers.
- Options include indexed, fixed 24-hour rates, or personalized tariffs.
- Offers price stability, less affected by market swings.

As a result, the regulated market is more beneficial if the main consumption is during off-peak hours, while the free market offers great stability regardless of market variations.

The electricity bill in Spain consists of three main components:

- **Energy Costs**: cost of electricity consumed.
- **Grid Fees (Access Tolls)**: charges for using the distribution and transmission network and split into variable terms (energy used) and fixed terms (contracted power).
- **Taxes and surcharges**, that complete the total cost of the bill.

In terms of remuneration, the RD 244 guarantees a full saving of grid fees and energy costs on self-consumed energy. In addition, shared energy is now considered as self-consumed in the incentive framework governing CSC, making the Spanish support scheme very favourable. Therefore, even in this configuration, neither grid fees nor energy costs are paid on shared energy. On the other hand, concerning RECs, a dedicated energy sharing framework has not been specifically established. Energy produced cannot be sold between participants of ECs and, therefore, no energy costs, grid fees, and taxes can be associated with it. To bypass this issue, a monthly fee can be charged as a service of the EC, which is associated with energy despite not being an electricity bill itself.

Under this legislation, there are two options for non-consumed energy:

1. **Feed into the grid** for remuneration.
2. **Anti-discharge device** to block injection.

If surpluses are injected into the grid, they can either be sold to the market or compensated by a supplier through discounts in the monthly electricity bill. If the installed capacity of the renewable generation system is:

- **Installations < 100 kW**:
  - Can be compensated by suppliers through **bill discounts**.
  - Monthly bill reflects **net energy use**, using **lower prices for exported energy**.
  - Net balance **cannot be negative** → extra generation is forfeited.

- **Installations > 100 kW**:
  - Must register as a **generator** to sell on wholesale market or via contract.
  - Involves **additional admin** work, taxes, and grid fees.

Numerous incentives and programs have been implemented to support CSC in Spain, such as the CE-Oficinas, a specific program designed to promote ECs. In addition, other programs developed by IDAE are:

- **CE-Oficinas**: awareness and promotional program for ECs.
- **CE-Aprende**: education and identification of potential EC partners.
- **CE-Planifica**: project planning support.
- **CE-Implementa**: financial support for implementation, which funded 73 EC projects, benefitting ~95,000 people.

Although the CE-Implementa funding scheme has strengthened the role of RECs, significant barriers remain. For example, since the program only covers 60% of the budget, many projects that had been selected had to return part of the funds as they are unable to match the amount by other funding sources or own funds.

To reduce administrative costs, the National Energy and Climate Plan highlights the need to simplify procedures related to local EC projects. To support and empower the processes to establish these communities, MITECO launched stimulus packages as part of its PRTR14, approved in June 2021. These initiatives aim to promote the development of ECs through top-down strategies and bottom-up models. The former involves the agreement between large energy companies and municipalities to create shared self-consumption projects. In this model, members pay a monthly fee in exchange for a percentage reduction in their electricity bills, benefiting from lower risks and therefore greater financial backing. In the latter, partners initiate the creation of the EC and try to involve new entities, such as municipalities or nearby businesses. These models typically have greater initial uncertainty, and they receive less financial support. In general, there is sufficient budget available and self-consumption is being actively promoted, but the absence of a feed-in tariff or premium results in a lack of financial stability. Consequently, when European funds and subsidies are depleted, installation rates tend to decrease since users prefer to wait for aid programs to be introduced, even due to recent lower energy prices and higher interest rates trends.

Category	Details
Energy Market Options	- **Regulated Market (PVPC):** Hourly prices, wholesale-linked, good for off-peak usage but volatile. - **Free Market:** Fixed/custom prices, stable.
Electricity Bill Components	- **Energy Costs:** Based on consumption. - **Grid Fees (Access Tolls):** Fixed + variable (contracted power + usage). - **Taxes & Surcharges.**
Remuneration under RD 244	- Full exemption from grid fees and energy costs for self-consumed/shared energy. - Shared energy treated as self-consumed in CSC.
RECs & Energy Sharing	- No framework for intra-EC energy sales. - Monthly service fee allowed, not considered an electricity bill.
Surplus Energy Options	- **Feed into Grid:** Sold or compensated via bill discounts. **Anti-discharge Device:** Prevents grid injection.
Surplus Compensation Rules	- **<100 kW:** • Supplier discounts. • Lower price for exports. • Net bill can't be negative → extra energy forfeited.
	- **>100 kW:** • Must register as generator. • Sell via market/contract. • Subject to admin, taxes,

Table 2: Economic highlights Spain

Portugal's economic framework

In Portugal, energy communities can save specifically on CIEG (Costs of General Economic Interest). They are part of the network access charges, used to finance the country's energy and sustainability policies. While the legal foundation supports shared energy and recognizes the right to self-consumption, the lack of standardized economic mechanisms and DSO-mediated allocation tools means that internal distribution and compensation require ad hoc arrangements, adding a layer of uncertainty for the participants in an EC.

Energy Community Stakeholders

Portugal does not have a specific authority in charge of regulating ECs, as is the case in other countries. Additionally, there is no regulatory body dedicated to monitoring the compliance of the transposition of EU directives on ECs. Despite this, institutions with different competencies contribute to shaping the landscape of ECs:

1. **Energy Services Regulator (ERSE)** is the entity responsible for regulating the Portuguese energy market. Its duties include:
    - establishing grid access tariffs and energy supply tariffs, as well as tariffs for self-consumption and energy sharing
    - establishing the conditions for RECs and CECs to participate in energy markets.
2. **Energy Agency (ADENE)** is a public body that promotes energy efficiency and sustainability. In terms of its links with ECs:
    - Offers technical guidance for forming and managing RECs and CECs.
    - Develops digital tools and conducts technical studies to optimize:
        - Collective self-consumption (CSC)
        - Energy management (EM)
    - Assists municipalities and private companies in shaping decarbonization strategies linked to local EC development.
    - Acts as an intermediary between policy-making and local action.
3. **Directorate General for Energy and Geology (DGEG)** is the government agency responsible for energy and mineral resources policy. Functions include:
    - Issuing permits for setting up RECs/CECs and installing renewable energy infrastructure.
    - Establishing the legal framework for:
        - Individual self-consumption
        - CSC systems
    - Monitoring and regulating the technical connection of EC assets to the RESP (Public Electricity Service Network).
    - Integral in shaping the compliance and licensing environment for ECs.

The existence of these entities serves to mitigate the necessity for a designated central authority. Nevertheless, the absence of such an authority gives rise to a legislative framework characterized by regulatory lacunae and ongoing development. For example, no clear distinction exists between CSC and ECs.

Regarding energy players, the management of the transmission network belongs to Redes Energéticas Nacionais (REN), while the distribution network is mainly managed by E-REDES, even if other small operators oversee the low voltage grid. The most important suppliers are EDP Comercial, Endesa, Iberdrola, Galp Power, and Goldenergy.

Economics of Energy Sharing

Energy contracts in Portugal vary according to different perspectives. The first major distinction is between:

1. **Free market**, where prices are set by the energy supplier and customers can further choose to have a fixed, variable, or dynamic price, depending on their needs and consumption. Additionally, a categorization based on tariffs reveals further distinctions, with tariffs classified as simple, bi-hourly, or tri-hourly, each corresponding to varying prices according to the time of day
2. **Regulated market**, where prices are set by the ERSE.

In general, the electricity bill in Portugal consists of three main components:

- **Energy cost**: cost of electricity consumed
- **Network access tariffs**: they are established by ERSE and reflect costs for energy infrastructure and collective services, paid by all consumers. They depend on the level of tension and are composed of:
    - Reactive and active energy prices
    - CIEG costs that correspond to charges used to finance energy and environmental policy measures, which constitute a collective, social, and general interest effort and range from 0,0060 €/kWh to 0,1262 €/kWh, depending on the voltage and the consumption pattern of the consumer.
- **Taxes and charges.**

The CIEG charges corresponding to self-consumed electricity supplied through the RESP may be deducted, in whole or in part, from network access tariffs by order of the Government member responsible for the energy sector, to be issued by September 15 of each year, following consultation with ERSE.
The portion of CIEG to be deducted must consider the benefits for the system provided by self-consumption production, as well as the absence of disproportionate burdens on the long-term financial sustainability of the SEN (National Electric System).
In June 2020, a law was published stating that individual and CSC schemes are exempted from paying a portion of the electricity tariff. Specifically, individual self-consumers are exempted from paying 50% of the CIEG, while ECs are fully exempted from paying the CIEG for the first 7 years. A recent ordinance has extended this full exemption also for individual self-consumption. This exemption for individual self-consumed energy guarantees a full saving of grid fees and energy costs. Regarding shared energy, it permits a saving of energy costs and CIEG. The same applies also to ECs, where energy transactions can be invoiced (in contrast with other EU countries like Spain and Belgium). When surpluses are not shared but injected into the grid, remuneration varies depending on the contract with the energy supplier. A common rate on the market is around 0.07 €/kWh, but there are no fixed tariffs. The Decree-Law 85/2022 exempts VAT on surpluses injection for an installed capacity generating revenue up to 1,000 € per year.

National effort is represented by the measures that the government tried to apply to support energy players. In June 2022, the national government launched a call to support the establishment of RECs and CSC initiatives funded through the Recovery and Resilience Plan (PRR). This program aims to promote electricity generation from renewable sources at the community level, including RECs and CSC. The supported measures are expected to achieve a 30% reduction in primary energy use in the involved buildings and an increase in renewable energy generation capacity of 93 MW (35 MW in residential buildings, 28 MW in public buildings of the central administration, and 30 MW in service sector buildings). Both individual and collective promoters of REC and CSC initiatives are eligible for funding. The maximum funding limit is 500,000 € per community initiative and 200,000 € per generation unit (including storage). The Environmental Fund is active, providing subsidies for rooftop PV installations under the PRR. Separate calls are available for individual units on one side and CSC and ECs on the other. It is thus possible to install PV systems with or without storage and receive an 85% reimbursement of the investment from the State, up to a maximum limit of 2,500 € per project.

Aspect	Details
CIEG Costs	Between 0,0060 €/kWh and 0,1262 €/kWh
CIEG Exemptions	Full for ECs (7 years) and individual self-consumers
Self-Consumption Remuneration	Full saving on energy costs & grid fees

Surplus Energy Injection	Market-based (~0.07 €/kWh); VAT exempt up to 1,000 €/year revenue
Invoicing	Possible for shared energy transactions (unlike Spain/Belgium)
PRR Support	Grants up to 500,000 € (community) / 200,000 € (unit); 93 MW capacity targeted
Environmental Fund Support	Up to 2,500 € per PV project; 85% cost reimbursement

Table 3: Economic highlights Portugal

IMPACTS OF NATIONAL TRANSPOSITION ON BUSINESS MODELS

The transposition of EU directives into national regulatory frameworks significantly influences the development and operation of ECs. Indeed, interpretation and implementation at the national level introduce variations that shape the BMs adopted in different countries. These regulatory differences affect key aspects such as participation, eligibility, legal form, governance structure, geographical proximity, energy generation technology, and financial viability of projects. This section aims to discuss how transpositions impact on ECBMs, generalizing information coming from the study of the three selected EU countries analysed in the previous section: Belgium (Flanders), Spain, and Portugal. Table 4 compares the main differences between these countries' regulatory frameworks. By comparing them, the critical ways in which national transpositions influence ECBMs are highlighted. Understanding these impacts is essential for designing effective EC strategies and assessing the potential for replication and scalability across different jurisdictions.

Regarding the eight configurations cited in the section "Types of Energy Community Business Model", none of the three analysed national frameworks directly limits their adoption. This suggests that these configurations can serve as general starting points to set up a community based on participants' characteristics and local opportunities. However, some legislative constraints may influence their feasibility, such as specific conditions concerning P2P energy sharing and asset ownership. For example, in Flanders, legislation imposes that P2P transactions must be either one-to-one or many-to-one, but not one-to-many. Therefore, challenges arise in a scenario where multiple EC members sell energy to the EC manager, as it would not be possible for the manager to sell that energy back to the other members. Similarly, if member A sells energy to member B without passing through the EC manager, it could not sell energy to player C. This situation poses difficulties in P2P configurations in Flanders, even if no specific rules forbid their adoption. Regarding third-party configurations, the EC definition requires that the community owns its assets, causing potential conflicts with its adoption. In contrast, Portugal allows third-party ownership of assets, enabling a wider set of configurations.

	Belgium (Flanders)	Spain	Portugal
EC regulator	Yes, VREG	No	No
Energy sharing timeframe	15 minutes	1 hour	15 minutes

Participants constraints	Maximum number of participants (100 members) Members can join only one form of energy sharing Large enterprises allowed in CECs, but not in control	No	Large enterprises allowed in CECs, but not in control Role of municipalities limited due to ancillary legislation
Proximity criteria	Flanders (entire region)	Consumption production distance < 5 km, same cadastral reference, same transformer substation for LV	2 km for LV, 4 km for MV, 10 km for HV, 20 km for VHV
Asset ownership	RECs must own the assets CECs must use existing assets	EC must have ownership rights on its assets	Assets can belong to third parties
Energy sharing value	Savings only on energy component Energy must be shared for free	Full saving of energy and grid fees if EC within 2km, partial saving of grid fees if established within 5km; Energy must be shared for free	Savings on energy component and CIEG; Energy shared can be invoiced

Table 4:Main differences between Flanders, Spain, and Portugal regulatory frameworks

National transpositions impact both participation and the choice of the EC typology, and in turn the related governance and control. Furthermore, eligibility and proximity criteria significantly affect the composition of community members. A key aspect regards the inclusion of large enterprises, whose participation opens the possibility to include a greater number of potential participants, as well as to increase EC's performances due to their high and stable consumption, enabling a larger amount of energy shared. Whereas they are excluded for participating in a REC, according to EU directives they should be able to participate in a CEC, even though in Portugal and Flanders there are some limits on their participation – they cannot be in a decision-making position but act only as a participant. Regarding proximity, while in Flanders there are no restrictions as long as producer and consumer are located in the region, Spain and Portugal impose stricter conditions, limiting broader community participation.

In a virtual environment, more flexible proximity constraints could increase the number of members and improve the scalability of EC projects. In addition, the Flemish framework imposes the setup of a CEC in case of already existing installations. This condition impacts the governance and control of the community by allowing more flexible constraints. Limitations on power capacity or technology limit the resources that can be adopted into an EC. Some technologies like batteries or wind turbines could be excluded, strongly impacting the potential of ECBMs. Indeed, greater production diversity and the ability to use energy across different time frames enhance CSC leading to higher environmental and economic benefits. National transpositions also have a strong economic impact. The valorisation mechanism of shared energy, along with additional costs or incentives, influence cost and revenue structures of EC projects. The first key aspect is the effect of shared energy on electricity bills. Each of the analysed countries has a different situation, ranging from a full savings of costs per each kWh exchanged to a saving of only the energy component. Since the Flemish region limits energy sharing savings to the energy part of the bill, it results in the least favourable place to do energy sharing. Portugal allows additional reductions on some components of grid fees. Spain results as the most favourable framework allowing full savings on shared energy since the higher the amount of savings for each kWh shared, the higher the positive impact on the project. Additionally, extra costs related to the infrastructure (grid access), specific requirements (smart meters), or mandatory administrative fees (supplier fees) reduce the economic benefits of the projects. Conversely, the presence of incentives on energy sharing, such as feed-in premiums, or on CAPEX, increase revenues and/or lower the investment amount, strengthening business cases.

CONCLUSIONS

As demonstrated throughout this deliverable, the development of a business model for an energy community, particularly in industrial contexts, cannot be reduced to a set of predefined archetypes. Rather than fitting communities into fixed categories, the WESHARE approach proposes a more flexible and operational methodology: identifying all relevant dimensions and outlining the range of implementation choices available for each.

These dimensions, ranging from participant structure and asset ownership to financial models, data governance, and ancillary services, allow for a modular composition of business models tailored to the specific needs, capacities, and regulatory conditions of each context. This is particularly important in the case of Industrial Energy Communities (IECs), where production schedules, investment thresholds, and governance preferences differ significantly from citizen-led initiatives.

The combination of these dimensions is further constrained or enabled by national and regional factors. As shown, while the EU sets a common legal foundation, the actual economic frameworks diverge widely: from full grid savings in Spain to energy-only savings in Flanders to partial CIEG-related savings in Portugal. Such variability demands context-sensitive design and a strong understanding of local constraints and opportunities.

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