MASTER IN INDUSTRIAL ENGINEERING

FINAL PROJECT

ANALYSIS OF BUSINESS MODELS FOR EMERGING ACTORS IN THE ELECTRICITY SYSTEM: ENERGY COMMUNITIES

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Declaro, bajo mi responsabilidad, que el Proyecto presentado con el título

Análisis de los modelos de negocio de los agentes emergentes del sistema eléctrico: las comunidades energéticas

en la ETS de Ingeniería - ICAI de la Universidad Pontificia Comillas en el

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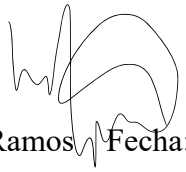

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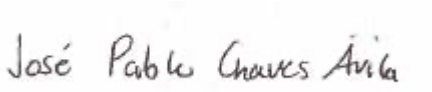

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ANÁLISIS DE LOS MODELOS DE NEGOCIO DE LOS AGENTES EMERGENTES DEL SISTEMA ELÉCTRICO: LAS COMUNIDADES ENERGÉTICAS

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RESUMEN DEL PROYECTO

Este proyecto tiene como objetivo identificar los aspectos fundamentales para la integración de las comunidades energéticas en los actuales mercados eléctricos. Para ello, se analizan modelos de negocio de comunidades energéticas implementadas en otros países, destacando la identificación de los actores clave y sus roles en los mercados energéticos. Además, se proporciona una visión general del marco regulatorio vigente para las comunidades de energía en España y se verifica si los modelos de negocio analizados cumplen con dicha regulación.

Palabras clave: Comunidad Energética, Regulación Española, Modelo de Negocio.

1. Introducción

El sector eléctrico mundial está experimentando una profunda transformación provocada por la electrificación, la descarbonización, la descentralización, la digitalización y la integración de fuentes de energía renovables y recursos energéticos distribuidos [1]. Este cambio presenta desafíos y oportunidades al mismo tiempo: mejorar la seguridad energética, reducir la dependencia de suministros externos y avanzar hacia un futuro sostenible y resiliente. En este contexto, las comunidades energéticas han surgido como actores fundamentales. Es por ello que esta tesis busca nuevas posibilidades para su implementación y desarrollo en España.

2. Definición del proyecto

La premisa de este proyecto consiste en adaptar e incorporar modelos de negocio de comunidades energéticas exitosos en otros países, con el objetivo de lograr un panorama energético más resiliente, sostenible y orientado localmente. Las comunidades energéticas son agrupaciones de individuos, empresas y entidades locales que colaboran para producir, gestionar y consumir energía de manera colectiva y eficiente. Estas comunidades no solo promueven el uso de energías renovables, sino que también fortalecen la autonomía energética local y fomentan la participación activa de sus miembros en la transición hacia un sistema energético más sostenible [2]. Existen varios tipos de comunidad energética: autoconsumidores renovables que actúan conjuntamente, comunidades de energía renovable, consumidores activos renovables que actúan conjuntamente, comunidades de energía ciudadana y redes de distribución cerradas.
A continuación, se ilustra un sistema característico de una comunidad energética:

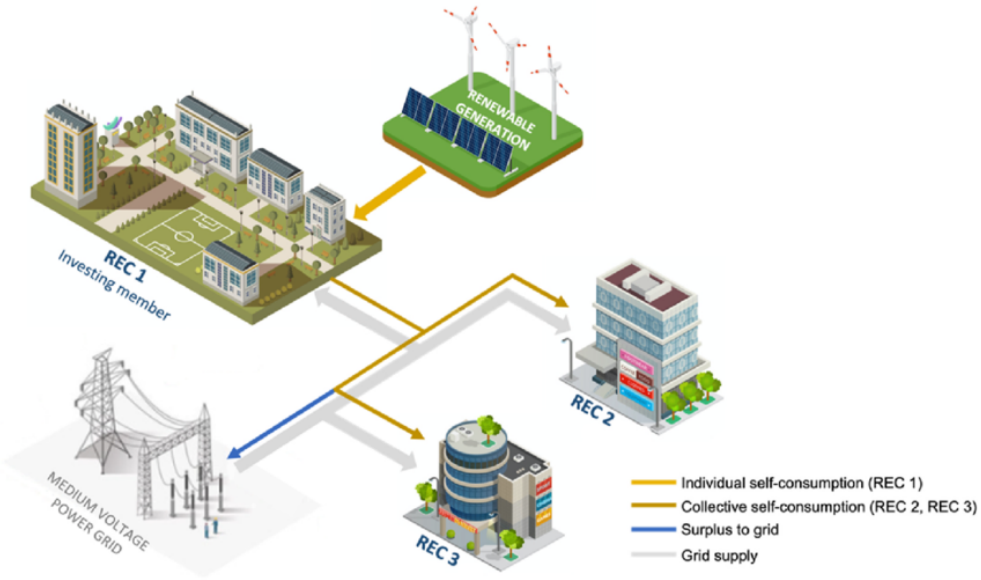

Figura 1: Esquema típico comunidad energética [3]

La imagen muestra un esquema típico de una comunidad de energética en la que varios edificios comparten energía producida por fuentes renovables y venden los excesos a la red. En la parte superior de la imagen, se observan paneles solares y turbinas eólicas que generan energía renovable para la comunidad. En la sección identificada como REC 1, los edificios participan en el autoconsumo individual, utilizando la energía que ellos mismos producen. Las secciones REC 2 y REC 3, por otro lado, participan en el autoconsumo colectivo, compartiendo la energía generada entre varios edificios. La energía excedente, que no se consume dentro de la comunidad, se vende a la red eléctrica, un proceso indicado por flechas que llevan la energía desde REC 2 y REC 3 hacia la red. Además, los edificios pueden recibir suministro de la red eléctrica externa cuando es necesario, representado por flechas que van desde la red hacia REC 2 y REC 3.

3. Descripción del modelo/sistema/herramienta

3.1. Análisis de los modelos de negocio

Para hacer el análisis de los modelos de negocio de comunidades energéticas en diferentes países que se eligieron, se hizo una comparación de cada una de las partes del modelo CANVAS, es decir, segmentos de mercado, propuesta de valor, canal, relación con el cliente, fuentes de ingresos, actividades clave, recursos clave, socios calve y estructura de costes. Se pudo comprobar que la gran mayoría de los modelos de negocio compartían ciertos factores clave, tales como: la participación activa de los usuarios de la comunidad energética fue un factor común; los usuarios no solo consumen energía, sino que también participan activamente en la toma de decisiones y en la gestión de la comunidad, promoviendo un sentido de pertenencia y responsabilidad compartida. Otro factor fue la interacción con la red eléctrica; los modelos fomentan una interacción fluida y eficiente con la red eléctrica, lo que permite una mejor integración de la energía renovable y una mayor estabilidad del suministro. También se observó una buena comunicación efectiva

con los responsables políticos y las autoridades reguladoras; las comunidades energéticas colaboran con los responsables políticos y reguladores, lo cual es crucial para asegurar un entorno normativo favorable y acceder a posibles subvenciones y apoyos. Finalmente, la venta del excedente de energía fue otro factor clave; la capacidad de vender el excedente de energía generada no solo aporta ingresos adicionales, sino que también contribuye a la eficiencia energética global y a la sostenibilidad.

3.2. Análisis regulatorio

Para llevar a cabo el análisis regulatorio, se verificó el cumplimiento de los requisitos, derechos y obligaciones establecidos en el Real Decreto que regula las comunidades de energías renovables, publicado por el Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO) el 21 de abril de 2023. Mediante este análisis regulatorio, se comprobó que, debido a la falta de información completa y detallada, no fue posible verificar el cumplimiento de todos los artículos de la regulación. Sin embargo, a pesar de estas limitaciones, se pudo determinar que cualquiera de los modelos de negocio estudiados tiene el potencial de cumplir con la regulación española con una adaptación adecuada. Esta adaptación implicaría ajustes específicos en cada modelo para alinearse en su totalidad con los requisitos legales, garantizando así el cumplimiento de las normativas vigentes y la optimización de sus operaciones dentro del marco regulatorio español. La capacidad de estos modelos para adaptarse sugiere que, con las modificaciones pertinentes, podrían no solo cumplir con la legislación, sino también aprovechar las oportunidades y beneficios que esta regulación ofrece a las comunidades de energías renovables en España.

4. Recomendaciones

Del estudio realizado se señalan aspectos específicos como la participación activa de los miembros de la comunidad en decisiones de inversión en proyectos energéticos, permitiéndoles involucrarse en el desarrollo y gestión de iniciativas sostenibles y compartir los beneficios económicos resultantes. También es crucial el desarrollo me mercados locales para gestionar los desequilibrios entre la producción y la demanda de energía local. La cooperación efectiva con los responsables políticos y las autoridades reguladoras, especialmente con la CNMC, puede facilitar la adaptación de las comunidades energéticas a las normativas actuales y apoyar su participación activa en el mercado energético. Finalmente, la venta del excedente de energía a otras comunidades energéticas, en lugar de a la red, podría ofrecer más beneficios, permitiendo acuerdos de colaboración más directos y flexibles, y fortaleciendo la autonomía energética local y el desarrollo de sistemas energéticos descentralizados y resilientes. Sin embargo, resulta clave un sistema de tarifas y precios que no generen subsidios cruzados entre los agentes que estén en una comunidad energética y otros que no. Unas tarifas y precios eficientes son clave para evitar las subvenciones cruzadas entre los agentes de la comunidad y los que no participan en ella.

5. Conclusiones

En conclusión, la transición del sector eléctrico hacia un modelo más sostenible y descentralizado presenta tanto desafíos como oportunidades significativas. Las comunidades energéticas se perfilan como actores clave en este cambio, ofreciendo una vía para mejorar la seguridad energética, reducir la dependencia de suministros externos y avanzar hacia un futuro más sostenible y resiliente. La adaptación e implementación de modelos de negocio de comunidades energéticas exitosos de otros países en España no solo es factible, sino que también es una estrategia prometedora para avanzar hacia un futuro energético más sostenible, resiliente y participativo. Las comunidades energéticas, con el apoyo adecuado y las adaptaciones necesarias para contar con los aspectos tratados en las *Recomendaciones*, pueden desempeñar un papel crucial en la transición energética de España.

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ANALYSIS OF BUSINESS MODELS FOR EMERGING ACTORS IN THE ELECTRICITY SYSTEM: ENERGY COMMUNITIES

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ABSTRACT

This project aims to identify the fundamental aspects for the integration of energy communities in the current electricity markets. For this purpose, business models of energy communities implemented in other countries are analyzed, highlighting the identification of key players and their roles in the energy markets. In addition, an overview of the current regulatory framework for energy communities in Spain is provided and it is verified whether the analyzed business models comply with such regulation.

Keywords: Energy Community, Spanish Regulation, Business Model.

1. Introduction

The global electricity sector is undergoing a profound transformation driven by electrification, decarbonization, decentralization, digitalization, and the integration of renewable energy sources and distributed energy resources [1]. This shift presents dual challenges and opportunities: enhancing energy security, reducing reliance on external supplies, and advancing towards a sustainable and resilient future. Within this context, energy communities have emerged as pivotal actors.

2. Project definition

This project's premise is to adapt and incorporate successful energy community business models from other countries in order to achieve a more resilient, sustainable and locally oriented energy landscape. Energy communities are groupings of individuals, businesses and local entities that collaborate to collectively and efficiently produce, manage and consume energy. These communities not only promote the use of renewable energy, but also strengthen local energy autonomy and encourage the active participation of their members in the transition to a more sustainable energy system [2]. There are several types of energy communities: jointly-acting renewable self-consumers, renewable energy communities, jointly-acting renewable active consumers, citizen energy communities and closed distribution networks.

A representative system of an energetic community is shown below:

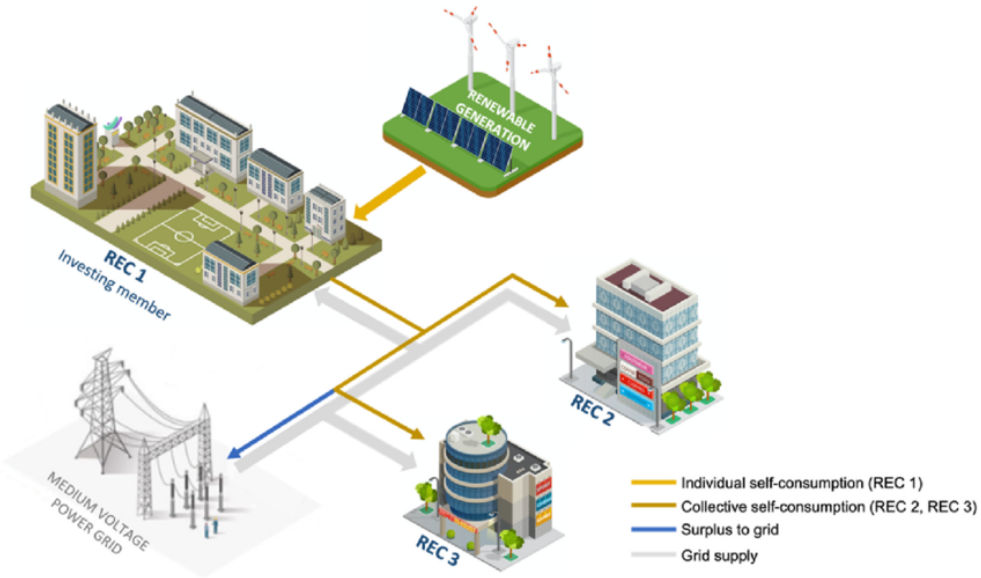

Figure 1: Typical energy community layout [3]

The image shows a typical scheme of an energy community in which several buildings share energy produced from renewable sources and sell the excess to the grid. At the top of the image, solar panels and wind turbines generate renewable energy for the community. In the section identified as REC 1, buildings participate in individual self-consumption, using the energy they produce themselves. The sections REC 2 and REC 3, on the other hand, engage in collective self-consumption, sharing the generated energy among several buildings. The excess energy, which is not consumed within the community, is sold to the electrical grid, a process indicated by arrows that direct the energy from REC 2 and REC 3 to the grid. Additionally, the buildings can receive supply from the external electrical grid when necessary, represented by arrows going from the grid to REC 2 and REC 3.

3. Description of the model

3.1. Analysis of business models

In order to analyze the seven energy community business models in different countries that were chosen, a comparison was made of each of the parts of the canvas model, i.e. market segments, value proposition, channel, customer relationship, revenue sources, key activities, key resources, key partners and cost structure. It could be seen that the vast majority of the business models shared certain key factors, such as: the active participation of the users of the energy community was a common factor; users not only consume energy, but also actively participate in the decision making and management of the community, promoting a sense of belonging and shared responsibility. Another factor was interaction with the electricity grid; the models encourage smooth and efficient interaction with the electricity grid, which allows for better integration of renewable

energy and greater stability of supply. An effective communication with policy makers and regulatory authorities was also observed; energy communities colaborate with policy makers and regulators, which is crucial to ensure a favorable regulatory environment and access to potential subsidies and support. Finally, the sale of surplus energy was another key factor; the ability to sell surplus energy generated not only brings in additional revenue, but also contributes to overall energy efficiency and sustainability.

3.2. Regulatory analisis

To carry out the regulatory analysis, compliance with the requirements, rights and obligations established in the Royal Decree regulating renewable energy communities, published by the Ministry for Ecological Transition and Demographic Challenge (MITECO) on April 21, 2023, was verified. Through this regulatory analysis, it was found that, due to the lack of complete and detailed information, it was not possible to verify compliance with all articles of the regulation. However, despite these limitations, it was possible to determine that any of the business models studied have the potential to comply with the Spanish regulation with an appropriate adaptation. This adaptation would involve specific adjustments to each model to fully align with the legal requirements, thus ensuring compliance with current regulations and optimization of their operations within the Spanish regulatory framework. The ability of these models to adapt suggests that, with the appropriate modifications, they could not only comply with the legislation, but also take advantage of the opportunities and benefits that this regulation offers to renewable energy communities in Spain.

4. Recommendations

From the analysis carried out, certain aspects such as the active participation of community members in investment decisions on energy projects, allowing them to be involved in the development and management of sustainable initiatives and to share the resulting economic benefits. Also crucial is grid connection to manage imbalances between local energy production and demand. Establishing an effective cooperation with policy makers and regulatory authorities, especially the CNMC, can facilitate the adaptation of energy communities to current regulations and support their active participation in the energy market. Finally, selling surplus energy to other energy communities, rather than to the grid, could offer more benefits, allowing for more direct and flexible collaboration agreements, and strengthening local energy autonomy and the development of decentralized and resilient energy networks. Efficient tariffs and prices are key to avoiding cross-subsidies between agents within the community and those not participating in it.

5. Conclusions

In conclusion, the transition of the electricity sector towards a more sustainable and decentralized model presents both significant challenges and opportunities. Energy

communities emerge as key players in this change, offering a way to improve energy security, reduce dependence on external supplies and move towards a more sustainable and resilient future. Adapting and implementing successful energy community business models from other countries in Spain is not only feasible, but also a promising strategy for moving towards a more sustainable, resilient and participatory energy future. Energy communities, with the right support and necessary adaptations to comply with the features mentioned in *Recommendations*, can play a crucial role in Spain's energy transition.

6. References

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1. Introduction

In the contemporary context, energy dependence has emerged as a transcendental challenge that directly affects approximately 70% of the total energy demand in Spain [1]. This worrying reality is manifested in significant imports of a considerable amount of energy from various suppliers, with Nigeria, Libya and Algeria being the three main supplier countries [2]. This situation of dependence on other countries is not only a purely economic phenomenon, but also poses a significant vulnerability for the country's energy stability and security.

This has been seen with the conflict between Russia and Ukraine, which has led to an increase in energy price inflation in many European Union (EU) countries [3]. The invasion of Ukraine has also had an impact on the pattern of energy imports for the entire EU. While the health crisis resulting from COVID-19 reduced the EU's external dependence on third countries due to the decrease in energy demand, without significant changes in the main suppliers, the invasion of Ukraine by Russia resulted in a considerable reduction in imports of energy products from that country.

Furthermore, the global electric power sector is experiencing a substantial transformation on a global scale, propelled by factors such as electrification, decarbonization, decentralization, digitalization and the incorporation of renewable energy sources and distributed energy resources [4]. This global shift presents both challenges and opportunities to improve energy security and stability, reduce dependence on external supplies, and advance towards a more sustainable and resilient future. This transformation of the global electricity sector provides an opportunity for energy communities to emerge and grow. They were formally recognized in the European Union's legislative framework with the Clean Energy for All Europeans package adopted in 2019 with the objective of promoting renewable energies and achieving climate goals [5]. This was followed by the launch of the European Green Deal, with the aim of achieving climate neutrality by 2050 using EU funds by local and regional authorities and increasing the execution of EU-funded sustainable projects in European local communities [6]. Later, in 2021, the EU Commission introduced the Fit for 55 package in which the main objectives were to achieve a 55% reduction in greenhouse gases, to achieve a 42.5% share of renewable energies in the energy mix and to reach an energy efficiency of 39% [7].

These communities can play a critical role in addressing the challenges mentioned before. By fostering the integration of renewable energy sources and distributed energy resources at the community level, energy communities contribute to a more resilient, sustainable and locally driven energy landscape. Through collaborative efforts and shared resources, these communities empower people to actively participate in the energy transition, promoting a more inclusive and environmentally friendly approach to energy generation and consumption [8].

1.1. Objectives and methodology

The main objective of the thesis is to analyze possible business models, using the canvas tool, for energy communities, including the identification of relevant actors and roles in energy community markets (e.g. consumer, producer, prosumer, aggregator, local market operator,

local grid operator, DSO), the analysis of current and future trends in value proposition, key activities, key resources, cost structure and revenue streams to define for each actor a general model of local market participation. In addition, this project will also review the state-of-the-art research projects and scientific literature on services and products relevant to energy communities. Both energy services and systems products are of interest.

The approach to tackle the activities outlined in the project involves the following steps [9]:

1. The first step is the identification of the regulation applicable to the Energy Communities (EU and Spain) which is done in *Section 2.2*.
2. The second step is the systematic literature review of scientific publications and project reports concerning Energy Communities which is divided into three different steps.
    a. Data search and selection: identification of a set of documents concerning the Business Model of Energy Communities which is presented in *Section 3*.
    b. Data extraction: identification of the business model canvas elements for the energy communities from the identified documents done in *Section 4*.
    c. Data analysis: identification of actor categories and regulatory analysis of the identified business models in *Section 5*.
3. For the final step, the formalization of recommendations concerning deploying the identified BM for energy communities in the Spanish context is provided in *Section 6.*

2. State of the art

2.1. Energy communities

Energy communities are groups of energy consumers and/or producers that organize themselves to collectively generate, consume and share energy. These communities seek to promote the transition to a more sustainable, decentralized and participatory energy system. There are different types of energy communities depending on the geographical location, the scale and size, the participant and consumption profile and the available technology [10]:

- Jointly-Acting Renewable Self-Consumers (JARSC): Potential members include households or non-household entities. Participation of these members is limited to final consumers, unless non-households consider it a secondary activity. Geographical boundaries encompass the same buildings or multi- apartment blocks. Only renewable energy sources are utilized. Activities involve generation, self-consumption, storage, and potential sale of electricity, either aggregated or separately. The focus is exclusively on electricity as the energy carrier.

- Renewable Energy Communities (REC): Participation in the renewable energy community (REC) is voluntary and open to individuals. It must be constituted as a legal entity, allowing for physical persons to join. The REC operates autonomously, free from government control, and is managed by its shareholders or members. Geographical boundaries require members to be in proximity to renewable energy projects. Potential members include individuals, small and medium-sized enterprises (SMEs), local authorities, and municipalities. The primary aim of the REC is to generate environmental, economic, or social benefits for its shareholders or local community members rather than solely focusing on financial gains. The community exclusively deals with renewable energy and accepts all types of energy carriers.

- Jointly-Acting Renewable Active Consumers (JAAC): Member activities within the community must primarily involve being end-users; however, the sale of energy cannot serve as their main commercial or professional pursuit. Engagements include consumption, storage, generation, and the potential sale of electricity, either in combined form or separately. Members also partake in energy efficiency programs and flexibility schemes. The community operates within confined geographical boundaries and focuses exclusively on electricity as the energy carrier, strictly dealing with renewable energy sources.

- Citizen Energy Communities (CEC): The participation in this initiative is open and voluntary, requiring members to form a legal entity. The community is controlled by its shareholders or members and welcomes natural persons, small enterprises, local authorities, and municipalities as potential members. Its primary aim is to generate environmental, economic, or social benefits for its shareholders or local community members, prioritizing these over financial gains. Activities encompass various aspects such as generation, distribution, supply, consumption, aggregation, storage, energy efficiency services, EV charging services, local energy distribution, intra-member

energy sharing, and other related services. The community focuses solely on electricity as the energy carrier, restricted to this type but inclusive of all forms of electricity as outlined in the Directive.

- Closed Distribution Networks (CDN): The activities of community members primarily encompass industries, commerce, and technical or safety-related services, with occasional inclusion of households. Geographical boundaries are restricted to confined areas within industrial, commercial, or shared service sites. The involved activities mainly revolve around distribution, EV charging services, and storage. The energy carrier exclusively involves electricity, while the community deals with all forms of energy.

2.2. Regulation of energy communities

Although the establishment of energy communities is beneficial, it's crucial to consider regulations as they define the opportunities and limitations within which the business models can operate to implement them.

The first time that energy communities were included in any European directive was in December 2018, in Directive 2018/2001 of the European Parliament and of the Council, under the name of renewable energy communities, with the aim, as the name implies, of promoting the use of energy from renewable sources. Furthermore, it is in June 2019 when Directive (EU) 2019/944 of the European Parliament and the Council amends Directive 2012/27/EU to redefine the general regulatory framework applicable to the electricity system, promoting the empowerment of the end consumer of electricity. This is when citizen energy communities appear, placing the consumer at the center of the new electricity model, allowing the users of these communities to take part in citizen participation and cooperation projects, creating the figure of the pro-consumer.

In parallel with the Directives explained above, other measures have also been imposed at the regional level. Through the Royal Decree 900/2015 that regulates the administrative, technical and economic conditions of the modalities of electricity supply with self-consumption and production with self-consumption it developed for the first time the previsions included in the Law 24/2013, of the Electricity Sector, in which Article 9 regulates the self-consumption of electric energy. Later, with Royal Decree-Law 15/2018 that established urgent measures for energy transition and consumer protection, it was possible to greatly encourage self-consumption and modify the Spanish regulation with the objective of benefiting the producers and consumers involved in this activity. This implied the approval of Royal Decree 244/2019 through which the administrative, technical and economic conditions for the self-consumption of electric energy are regulated, therefore abolishing Royal Decree 900/2015. It is at this time that collective self-consumption appears and surplus supply begins to be allowed.

In addition, the transposition of the previously mentioned Directive (EU) 2018/2001, makes Article 6 of Law 24/2013 to be amended by Article 4 of Royal Decree-Law 23/2020, which approves measures in the field of energy and other areas for economic reactivation.

It is by transposing Articles 2.8, 2.9, 2.16, 2.19, 2.20, 3.3, 15.1, 15.3 and 22 of Directive (EU) 2018/2001 of the European Parliament and of the Council, as well as Articles 2.7 and 16 of Directive (EU) 2019/944 of the European Parliament and of the Council establishing the regulatory framework for the Royal Decree that will be used to verify compliance of the business models that will be analyzed below in *Section 3*.

The reason for choosing this regulation is that it complies with the principle of necessity as it is indispensable for the transposition of Directive 2018/2001 of the European Parliament and of the Council. It also conforms to the principle of proportionality by containing essential regulations to meet the established objectives of the Directive, without imposing unnecessary charges. In addition, it ensures legal certainty by being consistent with the legal and regulatory provisions on which it is based. It complies with the principle of transparency, having gone through the public consultation and hearing procedures, and clearly defines its objectives in the Regulatory Impact Analysis Report. Finally, it is consistent with the principle of efficiency by avoiding imposing superfluous administrative burdens [11].

Regulation of energy communities may vary depending on the jurisdiction and country concerned. In Spain in particular, the main objective of these regulations was to encourage the creation and operation of energy communities to achieve an energy transition towards a more sustainable system. It is essential to analyze the business model and check the feasibility of energy communities while considering regulations. Some key aspects of this regulatory framework were as follows [1]:

- Legal Recognition: Legal provisions were considered to define and recognize energy communities.
- Citizen Participation: The regulatory framework encourages citizen participation in energy generation and consumption, allowing communities to make collective decisions.
- Distributed Generation: The framework facilitates distributed energy generation, allowing communities to generate electricity from renewable sources.
- Compensation: The regulations address compensation for energy generated and the possibility of sharing economic benefits within the community.
- Grid Connection: The regulations establish requirements and procedures for connecting community generation facilities to the grid.

2.3. Business model canvas

A business model is a tool prior to the business plan that allows to clearly define what the project is going to offer to the market, how it is going to be carried out, to who is going to be sold, how is going to be sold and how you the income is going to be generated [12].

For this particular study, the business model canvas is used to collect in an organized way all the information of each of the business models under study in order to facilitate their subsequent analysis and comparison. The business model canvas is a visual technique that facilitates the creation of innovative and competitive business models [13]. This approach gives us the ability to summarize and examine on a single page, the various elements that

ensure the economic viability of companies. The canvas model is divided into nine different parts, which are customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure. Figure 1 shows the structure of the Business Model Canvas [14].

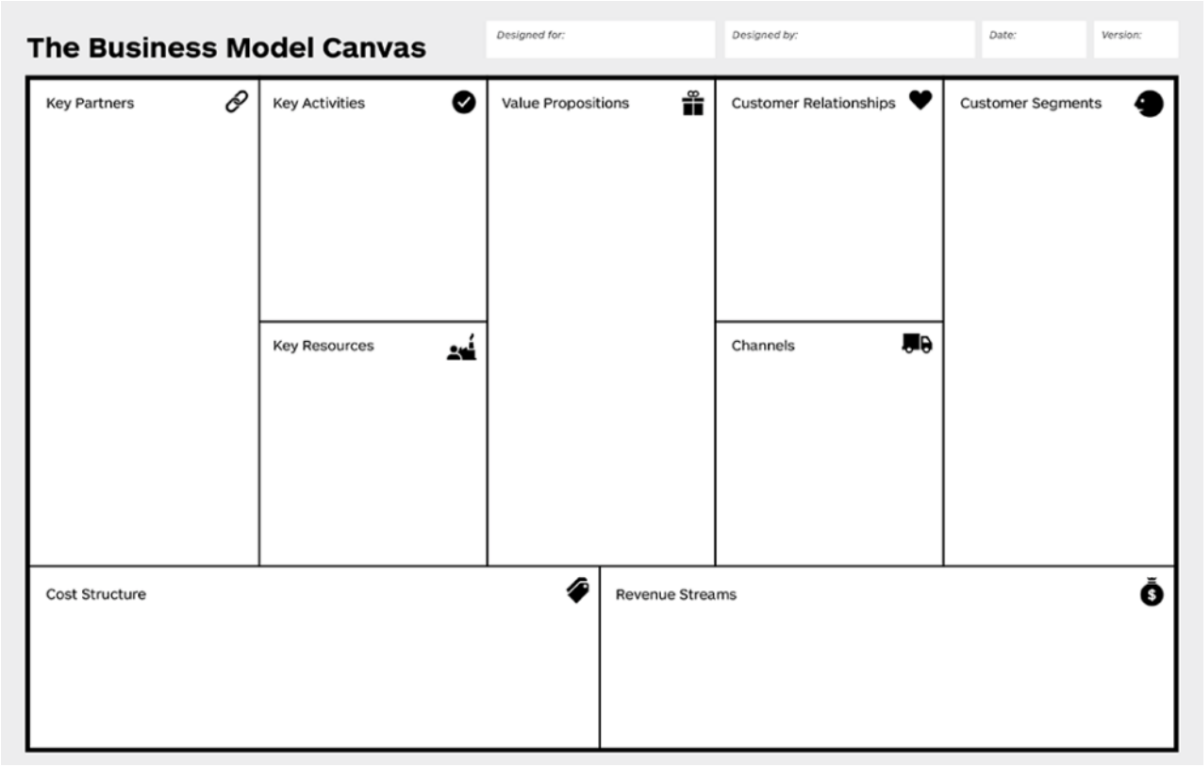

Figure 1. Structure of the Business Model Canvas [14]

This mode of representation has several advantages as a versatile tool that drives strategic clarity, effective collaboration and adaptability in an ever-changing business environment.

3. Description of business models

This section provides a description of the 7 business models of the energy communities to be analyzed, explaining their functioning and the most relevant information of each one of them.

3.1. Model 1: Citizen-led renovation Klimaatpunt Pajottenland & Zennevallei/ Pajopower: “BENOvation coach” (Belgium)

3.1.1. Description

Klimaatpunt is an energy cooperative in the Pajottendland and Zennevallei region. It started as a foundation in 2009 as a mechanism to make local people aware of energy efficiency and sustainable renovations. Its main objective is to support and achieve sustainable development in the region. The first activities they were involved in were focused on the installation of solar panels and heat pumps. This initiative took the name of Benovation and its main objective was to provide guidance to households for energy saving and sustainable renovation practices. Currently, Pajopower carries out projects in public institutions such as sports centers, schools and swimming pools in which it installs solar panels in addition to other initiatives that contribute to energy efficiency such as the installation of LED streetlights.
This cooperative, Pajopower, was born in 2014 from the above-mentioned foundation and was named Klimaatpunt Pajottenland & Zennevallei in 2019. The cooperative has a focus on local climate projects while the foundation operates as a regional energy agency offering awareness-raising services to citizens, municipal authorities and public and private companies on energy saving, renewable energy and electric mobility.
The 'Benovation' service, focusing on energy efficiency advice and assistance, is under the framework of Klimaatpunt. This service was developed in collaboration with the province of Flemish Brabant and other regional organizations to cover the whole province. Initially, they started with collective purchasing schemes for renovation materials and sustainable energy solutions, attracting residents from all over the province.

The main purpose of the organization is to accelerate the transition to a climate-neutral society by 2050. Their main focus will be the energy and mobility sectors in the Pajottenland and Zennevallei areas and they will need contributions from the municipality, local organizations and province to accomplish it.

The business model proposed by Klimmatpunt focuses on offering specialized advice to carry out sustainable home renovations at a reduced price. It relies on the support of partners such as Energiek Wonen.be as well as municipalities, and thus provides services such as renovation plans, detailed installation assessments, connections with contractors and the option to take part in collective purchasing. The main resources at its disposal are mainly established partnerships and staff. The value proposition is that through the "Benovation" service, homeowners receive personalized assessment for the integral renovation of their home at a reduced price. This service includes a summary of the home's desires, needs and financial resources; an evaluation of the home's energy efficiency, humidity, safety and health; a customized renovation plan with a 3D preview and an estimate of the cost per square meter;

the option of contacting a selected contractor; and the opportunity to enroll in a group purchasing program for insulation materials, windows, solar photovoltaic panels and/or heat pumps with no waiting list. Revenues mainly come from utility fees paid by households, system operator fees as well as payments from municipalities. The relationship with beneficiaries is through a service model open to all residents, and costs are limited to staff salaries and overhead. In the participating municipalities, renovation assessment is either €100 or €150 all taxes included. If households implement one or more of the recommended measures, they receive a refund of €100. In non-participating municipalities, the advisory costs €250, with a rebate of €125 for implementing one or more measures. In addition, the Flemish government and the district system operator offer small grants to encourage the implementation of renovation measures. This approach seeks to generate environmental, economic and social benefits for the community [15].

3.2. Model 2: People Powered Retrofit – "Carbon Co-op" (United Kingdom)

3.2.1. Description

The Carbon Co-op team had been renovating a large number of homes in the Greater Manchester area for a long period of time when they realized that the projects, they were undertaking were not making enough of an impact to slow climate change. This is why they decided to change the approach from 'top-down' to 'bottom-up' because the first model, despite achieving progress by incentivizing shallow renovation measures, was not achieving the emissions reduction target it had set out to reach. With the new 'bottom-up' model, in order to make renovations more thorough, 'people-powered retrofit' was created, in which owners and suppliers would collaborate on renovations, which would generate more trust in carrying out the renovations and therefore incentivize more people. But there was another obstacle, as the organization did not have enough professional contractors who could carry out such renovations. To do so, Carbon Co-op partnered with small, local contractors specialized in maintenance and home improvement. In addition, an open-source ICT software was designed for home decision making and home energy assessment.
The UK national government is supporting this initiative through a call for proposals funded by BEIS (Department for Business, Energy and Industrial Strategy). This department funded several projects to show its support towards an energy transition that looks at efficiency and sustainability, and to test the effectiveness of localized approaches involving community intermediaries and small contractors. This pilot is based on an initial investigation with a subsequent 6-month development period and a final implementation phase of approximately 2 years.

The cooperative's main objective is to assist households to combat environmentally harmful carbon emissions by providing energy services and advocacy. 'People-powered retrofit' involves the owners themselves leading the renovation of the home to make it more energy efficient. Its primary target is owner-occupied buildings willing to undertake a total home renovation.

The service offered by Carbon CO-op is People Powered Retrofit, focused on sustainable home renovation, together with the collaboration of several partners. The main activities it

undertakes include generating awareness of sustainable renovation options, providing advice and coordination for renovation, selecting contractors and suppliers, planning and design, developing and enhancing support tools (such as the Home Retrofit Planner), and facilitating replication of the model. Key resources include partners, staff, IT tools and contractors.
The main value proposition is to guide and support households in sustainable renovation, with a focus on household decision making. The relationship with beneficiaries involves inviting customers to join and actively participate in the local energy transition. Communication channels include community events, word of mouth, and collaborations with community groups and volunteers. Beneficiary segments include climate change pragmatists, climate change idealists, civic-minded retirees and optimistic technologists. The cost structure involves staff, overhead and freelancer services, while revenues come from household fees, consultancies, trainings, social franchise fees and an initial government grant. Financial sustainability is based on the participation of 100-150 households per year, with a target annual turnover of €300,000-350,000 [16].

3.3. Model 3: Energy Communities “Tipperary Cooperative” (Ireland)

3.3.1. Description

This community started with the aim of reducing the economic and social decline in the Tipperary area. Their first action was a pilot project that was carried out in 2011 in the Drombane/Upperchurch area whose goal was job creation and economic maintenance by boosting the economy of the area. After realizing the heavy dependency on fossil fuels needed for home heating, it was concluded that research into energy efficiency would be of importance and would therefore be prioritized. This would both help local residents save money and stimulate economic activity in the area.
It all started with the formation of the 'Energy team' which, together with a group of university students, created a survey on the energy consumed and used in the area. Through this survey, the inhabitants of the area were made conscious of the benefits of being energy efficient and of the different subsidies offered by the government to finance activities that contribute to this objective. In the survey, one of the things that was revealed is the cost of fuel consumption in the Tipperary area, at €1 million. The second task carried out was the search for homeowners in the area willing to renovate their homes with the help of these government subsidies to achieve better energy efficiency. As a result, in 2014, the first projects were carried out by volunteers from the area, a hired project manager and a community development professional. As these projects were successfully completed, Energy Communities Tipperary Cooperative was formed in 2015.

Its main objective is local development through energy efficiency and renewable energy production. Its mission statement is "Making the energy transition benefit local communities".

Energy Communities Tipperary Cooperative (ECTC) operates in the Pajottendland and Zennevallei region and its main focus is the coordination of sustainable renovation projects in homes and commercial buildings. Its main partners include the Sustainable Energy Authority of Ireland (SEAI), Tipperary Energy Agency, North Tipperary Development Company and Clann Credo. ECTC is based on the philosophy of being as lean as possible, managing projects

according to available funding and contracting the necessary expertise through tenders. It provides project management and coordination services, conducts energy audits, secures grants, selects contractors and provides quality assurance. Its key resources are community volunteers, a paid project coordinator, government grants and local contractors. The value proposition focuses on coordinating comprehensive home renovation, improving living conditions, saving energy and reducing greenhouse gas emissions. The relationship with beneficiaries involves communication through its website, social networks, community events and partnerships with contractors. Beneficiary segments include households, communities, churches, assisted living facilities, and commercial businesses. Revenues come primarily from the sale of carbon credits, government subsidies and household payments, which go towards construction costs. ECTC seeks to generate social, environmental and economic benefits for the community [17].

3.4. Model 4: The Austrian case (Austria)

3.4.1. Description

The proposed business model for the energy community is distinguished by its integrated approach, allowing participants to maintain their individual energy suppliers to provide for the residual demand that cannot be supplied by the energy community. The main value proposition consists of offering a combination of strategic services, including effective energy community planning, procurement of surplus electricity, provision of shortage electricity for full load coverage, with special options made for "green" electricity, and implementation of a robust billing system using ex post electricity allocation algorithms.

Some of the channels through which the value proposition of this business model is communicated include a dedicated hotline for immediate customer consultations and the regular communication of information about new possibilities, highlighting billing options. Diversified customer segments include energy communities, individuals and small/medium-sized companies. The cost structure includes staffing costs for energy community experts, software development costs, and continuous costs related to constant progress in improving the software.

The main sources of revenue are through single payments for the planning of each individual energy community, regular payments for the provision of residual electricity to cover the load, revenue from the sale of surplus electricity, and regular payments for the comprehensive management of the billing process. In addition, there is the possibility of extra revenue by offering flexibility options in the supply of electricity, providing an opportunity for higher revenues compared to individual contracts. This model not only aims to optimize costs for participants, but also attempts to minimize organizational complexity by providing a single point of contact for all services, bringing efficiency and convenience to users.

3.5. Model 5: Third-Party-Owned Business Model (China)

3.5.1. Description

The Third-Party-Owned business model for distributed PV power generation was developed in the United States and has been adopted in China as an innovative solution to overcome the financial barriers associated with the adoption of solar power systems. What is remarkable about this business model is that customers, mainly disadvantaged households and urban/rural residents, can access clean solar energy with low initial costs.

The value proposition of this model is that customers do not need to make significant investments or assume operational risks. Instead, third parties take care of repairs and maintenance of the solar energy collection system, making the investment comparable to purchasing an insurance policy. This feature is attractive to customers because it minimizes risks and costs. Direct sales channels, advertising and online presence allow companies to reach out to customers. They offer in-person consulting services to inform purchase and lease options, establishing long-term relationships backed by power purchase and lease agreements that can last up to twenty-five years. Some of the partners highlighted include manufacturers, wholesalers, banks, grid companies and financial institutions. Collaboration with these partners will ensure quality of the equipment, financing, and stable connections to the grid. Key resources include established relationships with local governments for subsidies and technical support. Key activities focus on the sale of electricity and leasing of solar energy collection systems. The costs associated with construction, marketing, and regular repair and maintenance costs guarantee the continuous functioning of the system. Revenue sources are generated by selling electricity at a reduced price to customers, as well as by selling the surplus to the grid. Furthermore, the companies receive government subsidies calculated based on the total energy generation.

In summary, this model offers an affordable and sustainable solution, contributing to the adoption of solar energy and benefiting both customers and the environment [18].

3.6. Model 6: Energy management contract business model (China)

3.6.1. Description

The business model known as "Energy Management Contract" (EMC) has its main focus on implementing distributed solar power generation (DSPV) projects through energy management contracts. They were first originated in developed Western countries in the 1970s, and this approach has gained popularity in China, especially for industrial and commercial customers.

The value proposition of the business model is that the energy service companies invest, build and maintain solar power plants at customers' facilities, allowing them to use electricity at lower prices for a period of 20 years. This contributes to energy efficiency, reducing operating costs and encouraging the use of clean energy, benefiting customers such as industrial, commercial, schools, hospitals, and hotels. The model is supported by channels such as sales

teams that establish partnerships through conferences and forums with economic development zones, and the government who can recommend this model to public institutions and companies.
Customer relationships involve establishing direct contacts through contracts that agree on specific targets for energy-saving projects over a 20-year period. Maintaining strong, long-term relationships is essential, so frequent events will be organized on a regular basis to report on project progress and share energy saving benefits.
In terms of key activities, end-to-end management of solar power plants, including licensing documentation, government approvals, design, construction, operation and maintenance, is essential, as well as contract management with each client. Key partners include manufacturers and wholesalers, industrial park management committees and business leaders, as well as financial institutions, design-build firms, insurance companies and utilities. Key resources include strong relationships with management committees and business leaders, as well as collaborations with financial institutions, design-build firms, insurance companies and government agencies.
In terms of cost structure, expenses are divided into initial construction of solar power plants, operating and management costs, including salaries, maintenance, insurance and financial costs, along with waste disposal and depreciation of solar equipment.
Revenue sources come from the sale of electricity to industrial and commercial enterprises, additional revenue from the sale of surplus electricity to the grid, central and local government subsidies, and tax benefits according to government policies. This model was designed to address financial and operational challenges for businesses by facilitating the adoption of solar energy without significant initial costs, while contributing to energy efficiency and emissions reductions [18].

3.7. Model 7: Host-Owned business model (China)

3.7.1. Description

In the "Host-Owned" business model, customers are responsible for building and owning their own distributed solar power (DSPV) plants, capturing the associated benefits. Energy service companies facilitate the installation and maintenance of the systems, allowing customers to generate electricity for their needs. They can choose to sell all the electricity generated to the grid or consume it internally and sell the surplus. This model offers customers savings in electricity costs, revenue from the sale of surplus, and environmental contributions by using clean solar energy.

The main customer segments include households with interest in environmental protection and the ability to pay, in addition to small and medium-sized enterprises with advantages in developing DSPV projects. Farmers with sufficient roof space are also considered.
Energy service companies use traditional and online channels to reach customers, including sales people, advertising, home fairs, exhibitions, conference marketing, and presence on online platforms such as search engines, specialized websites, and official app accounts that offer messaging services and free calls.

The customer relationship is crucial in breaking down barriers to awareness of renewable energy technologies. Direct contact is established prior to purchase, and long-term relationships are maintained through after-sales services and online contacts.
Key activities include providing comprehensive services, from pre-purchase consultation to system design, installation, grid connection support, monitoring and maintenance. It also sells related components and offers consulting and qualification services.
Key partners are manufacturers and wholesalers of PV systems, as well as electric utilities for grid connection. The government is also a crucial partner by providing subsidies through the utility company.
Key resources include relationships in the local market, with government, customers, communities, financial institutions and social resources. Strong technical resources are required to guarantee the quality of the installation.
The cost structure is focused on market expansion to sell PV equipment, with costs associated with promotion, channels, customer information capture, vendor salaries, installation, repair, maintenance, and component storage.
The main sources of revenue come from the sale of PV systems, with additional income from installation, repair, and maintenance. Income is also generated by offering consulting services and training in PV system operation. This model aims to encourage clients to become owners of their solar energy generation, promoting sustainability and reducing dependence on traditional sources [18].

4. Analysis and comparison of business models

For the following analysis, each of the nine parts of the business model canvas structure will be analyzed, i.e., customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure. For each of the nine sections, the similarities and differences between the seven business models under study will be named and presented in a clearly structured table after each of the sections.

4.1. Value proposition

This section describes the commonalities and differences among the value propositions of the analysis BMs. Table 1 provides the overview of the comparison of the analyzed BMs' value propositions.

4.1.1. Common features

- Considering the objectives of all the business models studied, they all have in common the **improvement of energy efficiency and the promotion of sustainable practices**. This requires the implementation of measures to reduce energy consumption in order to minimize environmental impact. In one way or another, all models seek this transition to a clean and sustainable energy system, some of them through the complete renovation of homes, others by improving the management of available resources and others through the installation and development of solar energy generating facilities using photovoltaic panels.

- Another aspect presented in Models 1, 2, 3, 6, 5 and 7 in the value proposition is **integral coordination**. This involves providing a guidance service to customers from start to finish, at every stage, to ensure a more successful experience. This will be key to keep customers informed of the possible alternatives available to them so that they have a clear view of each option and can make decisions with a clear understanding of their specific needs and goals.

- **Active customer participation** is presented in Models 1, 2, 3, 5 and 7. Rather than offering predefined solutions, many of these approaches involve collaboration and joint decision-making with customers. Whether it is choosing specific renovation measures, participating in collective purchasing programs for materials, or deciding on the management of energy generated, direct involvement of customers in implementing sustainable practices is encouraged.

4.1.2. Differences

- The main difference that can be observed is in the **social and community approach** as opposed to the approach of large companies. In Model 2, there is a community approach, with the objective of developing a market for home renovation through the construction of local networks, thus reducing emissions and promoting local

employment. Model 6, on the other hand, is aimed at industrial parks and large companies, with the objective of carrying out large-scale solar energy projects.

Generalized value proposition	Analyzed BMs						
	Model 1: BENOvation coach	**Model 2: Carbon Co-op**	**Model 3: Tipperary Cooperative**	**Model 4: The Austrian case**	**Model 5: Third-Party-Owned**	**Model 6: Energy management contract**	**Model 7: Host-Owned**
Promotion of renewable energy sources	Sustainable renovation of houses with PV panels installation	Installation of PV panels to reduce carbon emissions	Retrofitting of homes to improve efficiency by installing PV panels among other solutions	Generating and sharing renewable energy	Lease solar PV systems	Installation, operation and maintenance of PV systems that will cause energy consumption and emissions reduction	Installation of PV systems to protect the environment, reduce carbon emissions and gas pollution
Improvement of energy efficiency and the promotion of sustainable practices	Sustainable renovation of houses with efficiency improvement through insulation upgrades	Guiding and supporting clients from start to finish in the sustainable renovation of their home	Decrease of GHG emissions and savings on energy expenditure. Coordination of every phase of the renovation	Installation of smart meters	Customers are offered PPAs in order to get PV power	Interactions with government entities, project management through ESCOs, and the integration of sustainable energy solutions	The company provides installation, maintenance and repairs for the PV systems
Active customer participation	Opportunity to join a collective purchasing plan for PV, insulation materials and windows	Customers become members of Carbon Coop and become involved in the local energy transition	Participation and empowerment of citizens in the project	Not included in the value proposition	Customers buy PV power through PPA	The only activity customers do is make room for the PV panels	Customers can install their own PV panels and can sell the excess energy
Social and community approach	Not included in the value proposition	Local empowerment	Not included in the value proposition	Not included in the value proposition	Not included in the value proposition	Targeted to commercial and industrial enterprises	Not included in the value proposition

Table 1: Comparison of value propositions

4.2. Key activities

This section describes the commonalities and differences among the key activities of the analysis BMs. Table 2 provides the overview of the comparison of the analyzed BMs' value propositions.

4.2.1. Common features

- One of the activities that stands out in several of the business models explained is the offer of services related to **sustainable renovation and advice**. In Model 1, Klimaatpunt offers advice for the sustainable renovation of homes under the name "Benovation" while in Model 2 it has a service called "People Powered Retrofit". In both cases, focused on advice and guidance in renewable renovation processes. Models 3 and 7 are also involved in comprehensive project management, coordination and technical advisory services, addressing sustainable renovation from various perspectives, such as energy efficiency improvements and upgrades of existing systems.

  Offering these types of activities demonstrates the commitment to the goal of achieving greater energy efficiency, sustainability and the reduction of greenhouse gas emissions. Through counseling, the availability of these activities can help participants make conscious decisions on how to improve the energy efficiency of their homes or buildings, while sustainable renovation contributes directly to the mitigation of environmental impact, such as the reduction of CO2 emissions [19] and radioactive wastes [20]. In addition, these activities can encourage awareness and community involvement in the transition to cleaner energy sources and more sustainable practices.

- **Project management and coordination** are presented as one of the fundamental elements for the implementation of these projects. In Model 3, project management and coordination services are incorporated, highlighting the importance of an efficient organizational structure for the accomplishment of shared objectives. In Model 6, management focuses on solar photovoltaic (PV) power plants, which involves taking care of government-approved licensing documents for project implementation; approval documentation for environmental and grid connection assessment; project investment, design and construction of photovoltaic (PV) plants; project exploitation, operation, management and maintenance. Finally, in Model 6, one of the main activities that is mentioned is the management of the PV power stations, encompassing obtaining licenses and approval documents from government authorities at various levels for project implementation; obtaining approval for environmental and grid connection assessments; managing project investment, design and construction of PV power plants; overseeing project operation, administration and maintenance; and covering all associated costs along the way.

- One of the key activities that are present in several of the models and that is also a fundamental part is the generation of **awareness and education** about energy use. It can be seen that in Model 1 one of the activities carried out is "Awareness and education" and in Model 2 this activity is integrated in the "People Powered Retrofit" service.

  These initiatives are aimed to inform the citizens about the possible practices that can be carried out to make housing more efficient and sustainable. Awareness and education are two essential activities to encourage adoption and participation in cleaner and more sustainable energy activities.

- Another activity that is repeated in Models 4, 5, 6 and 7 is the **connection to the grid**, specifically in models involving photovoltaic power generation. This connection allows the users of the energy communities to sell the surpluses they generate, thus contributing to a more sustainable energy distribution, and even generating profits for the participants. Another advantage of this connection is the easy access that can be achieved to public services and incentive programs.

- In addition, **government incentives** are also a factor that recurs in several of the models, specifically in Models 1, 2, 3, 5 and 7.
  These include direct subsidies, reimbursement programs or preferential financing programs that will be offered to those who implement the sustainable measures of each model. The advantages offered by these types of collaborations and their incentives are the reinforcement of the economic viability of each initiative and the motivation for the participation of clients.

4.2.1. Differences

One of the main differences between the activities performed in the business models under study is the **scope of the activities**. In Model 1, the main activities focus on providing advice for sustainable mobility, sustainable renovations and climate awareness. Model 2 focuses on supporting and helping to renovate homes to improve their sustainability, including project planning tasks up to the selection of contractors. In Model 3, the main activity is project management for the installation of renewable energy systems and energy efficiency improvements. Model 4 focuses on the purchase and generation of electricity, updating billing mechanisms, and staff training. In Model 5, the main focus is on leasing and sales of solar photovoltaic systems, as well as marketing and maintenance services. In Model 6, the tasks of integrated PV power plant management, such as maintenance, operation and planning, are carried out. Finally, Model 7 offers comprehensive services to PV system owners, including installation, consulting and maintenance.

- Lastly, some business models have disparate **financial approaches**. In Model 5, some of the financing options are power purchase agreements (PPAs) and leases, allowing customers to benefit from solar energy without having to assume the initial investment. On the other hand, in Model 7, the benefit that customers can obtain by

selling the energy generated or even self-consumption is highlighted, providing financial flexibility to customers.

Generalized key activities	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Sustainable renovation and advice	Making recommendations and offering sustainable renovation of homes	Advise on key aspects of the renovation service to reduce their home carbon emissions	Perform upgrades to buildings by installing renewable energy systems	Not a key activity	Not a key activity	Not a key activity	Consultation prior to the purchase of PV panels
Project management and coordination	Providing advice for sustainable mobility, sustainable renovations and climate awareness	Supporting and helping to renovate homes to improve their sustainability	Management and coordination services as one of the main activities	Purchasing and generation of electricity, updating billing mechanisms, and staff training	Leasing and sales of solar PV systems, as well as marketing and maintenance services	Managing the PV power plants as a key activity	Provide clients with a photovoltaic panel systems and its installation, repair and maintenance
Awareness and education	Sustainable homeownership awareness events for homeowners	Community events where people learn about energy efficiency in the home	Not a key activity	Not a key activity	Not a key activity	Not a key activity	Not a key activity
Energy sale	Not a key activity	Not a key activity	Not a key activity	To either sell or buy electricity with other energy communities	Since one of the main activities is to sell the excess electricity generated to the grid	An evaluation of the network connection is mentioned	Possibility to sell and buy electricity from the grid
Government incentives procurement	Cashback if advice provided is implemented and an extra incentive from the Flemish government	Grants from UK government	Public subsidies for homeowners: about 35% for all homeowners, up to 85% for lower income homeowners, up to 50% for community buildings and about 30% for commercial buildings.	Not a key activity	Subsidies for the sale of surplus energy and reduction of energy costs for consumers	Not a key activity	Direct subsidies per kWh generated (CNY 0.42/kWh)
Financial approaches	Not a key activity	Not a key activity	Not a key activity	Not a key activity	PPA and leases	Not a key activity	Selling the energy generated or self-consumption

Table 2: Comparison of key activities

4.3. Key resources

This section describes the commonalities and differences among the key resources of the analysis BMs. Table 3 provides the overview of the comparison of the analyzed BMs' value propositions.

4.3.1. Common features

- One of the main similarities in terms of key resources is that all models take into account the fundamental importance of **collaboration with specialized and professional personnel**. For a successful implementation of the business models explained above, consultants, development coordinators, renovation consultants and experts in various fields are necessary.

  Having specialized personnel is a great advantage, not only because they have extensive knowledge of the subject matter due to their extensive experience, but also because they offer great operational efficiency. Professionals can perform their tasks quickly and efficiently, thus achieving a reduction in time and costs necessary for the completion of their tasks with high quality.

4.3.1. Differences

- The main difference lies in the approach to **ownership and implementation of measures**. Model 1 is more focused on offering personalized advice to homeowners to improve energy efficiency. The implementation of the suggested measures is the responsibility of the homeowners, although they are guided and presented with the different options in detail so that the renovations are carried out correctly. In contrast, in Model 5, the option of purchasing solar PV without the need for a large investment, through power purchase agreements (PPAs) and leasing modes, is considered. Direct ownership of solar power systems is not essential for customers, as third parties take care of installation, maintenance and repair. Finally, in Model 7, customers have the option to install solar panels on the roofs of their homes and decide whether they want to sell all the electricity generated or consume until their demand is met and sell the surplus.
  This presents a more direct and decentralized approach compared to models focused on home renovation.

Generalized key resources	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Specialized professional personnel	Involvement of advisors	Involvement of assessors	Project development coordinator	Experts in the renewable energy field	Banks and financial institutions	Banks and financial institutions	Excellent technical and human resources to install the PV system
Ownership and implementation of measures	Implementation of the suggested measures is the responsibility of the homeowners	Not included in the key resources	Not included in the key resources	Not included in the key resources	Direct ownership of solar power systems is not essential for customers, as third parties take care of installation, maintenance and repair	Not included in the key resources	Customers decide whether they want to sell all the electricity generated or consume until their demand is met and sell the surplus

Table 3: Comparison of key resources

4.4. Customer segments

This section describes the commonalities and differences among the customer segments of the analysis BMs. Table 4 provides the overview of the comparison of the analyzed BMs' value propositions.

4.4.1. Common features

- First of all, a factor that is repeated in each of the business models studied except Model 6, is that they have **homeowners** as a segment. This is why we can see a common interest that is increasingly present in improving the sustainability and energy efficiency of homes, as well as a greater awareness and interest in reducing the environmental impact among all. In addition, by working with homeowners, these models can impact long-term energy consumption practices and contribute to the creation of more environmentally conscious and committed communities.

- Another common factor among some models is targeting **people with low income or households at risk of energy poverty**. For example, in Model 5, which targets specific customers such as rural residents and disadvantaged households, recognizing the existing disparities in access to energy services and seeking to address the particular needs of these segments of the population. This orientation not only reflects an ethical approach to service delivery, but also recognizes the quality-of-life benefits that can be gained by utilizing and implementing sustainable practices. By providing affordable and accessible energy solutions to these segments of the population, these business models contribute to closing the energy gap and promoting social and environmental justice in access to vital resources. Furthermore, by prioritizing disadvantaged segments, these models also become essential in promoting energy poverty alleviation and in building resilience in the face of energy and climate challenges.

- A customer segment in several models, specifically in Model 3 and 4, is the **participation of public and private entities**. This reflects that the energy communities are pushing for the energy transition regardless of the nature of the sector, public or private. Some of the public entities that are present in the models are government agencies, municipalities and provinces; and the private ones include from small and medium-sized companies to large corporations. This diversity of customers demonstrates that energy community business models are designed to address the needs and concerns of all types of stakeholders, from individual consumers to government entities to commercial enterprises. Furthermore, this inclusion of public and private entities fosters collaboration and knowledge sharing among different stakeholders, which can drive the widespread adoption of sustainable energy practices and the creation of a more resilient and equitable energy ecosystem.

Generalized customer segments	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Homeowners	Residential homeowners	Households interested in the activities performed	Normal households and communities	Households that want to be part of an energy community	Underprivilege households including township and urban residents	Not included in the customer segment	High income households
People with low income or households at risk of energy poverty	Not included in the customer segments	Not included in the customer segments	Households receiving fuel subsidy	Not included in the customer segments	Underprivilege households	Not included in the customer segments	Not included in the customer segments
Participation of public and private entities	Municipal and provincial governments	Not included in the customer segments	Churches and commercial businesses	Small, medium and large enterprises	Industrial and commercial enterprises	Industrial and commercial enterprises	Small, medium sized enterprises

Table 4: Comparison of customer segments

4.5. Customer relationships

This section describes the commonalities and differences among the customer relationships of the analysis BMs. Table 5 provides the overview of the comparison of the analyzed BMs' value propositions.

4.5.1. Common features

- First, a factor repeated in Models 2 and 3 is the **active participation of clients**. In both models, an attempt is made to involve members in the respective initiatives, thus fostering a collaborative and participatory relationship. Furthermore, thanks to the collaboration of customers, awareness of the need to adopt measures that contribute to energy efficiency and the importance of commitment to sustainable practices is promoted.

- Another common aspect of the client relationship is **end-to-end coordination**, which can be seen in Models 1, 2, 3, 4, 5, 6 and 7. All models recognize the importance of providing service to clients throughout the entire life of the project, from initial assessment to implementation of measures, to ensure a successful experience. This coordination is beneficial because it contributes to the optimization of resources by ensuring efficient use of time, money and personnel.

- The **importance of long-term relationships** also features several models, specifically Models 5, 6 and 7. Whether through long-term power purchase agreements, energy management contracts or building a relationship of trust, all recognize the need for a sustainable connection with customers.

4.5.1. Differences

- Model 1 uses an open service model for all customers, without an affiliate program. Instead, its main focus is on the direct service offered through Pajopower, which shows that relationships are based more on service than on active member participation.

  On the other hand, in Model 5, the need to acquire long-term contacts with customers is emphasized, since the power purchase agreements offered by the business model are long-term. Contrasting it with Model 3, it can be seen that in this business model the interactions with households are mostly limited to the stage of the works within the renovation.

  The particularity of the relationships with customers of Model 6 and what makes it different from the other models is that they establish direct contacts with the companies through energy management contracts, which makes it essential to establish a long-term relationship.

Generalized customer relationships	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Active participation of clients	Not included in the customer relationships	Customers partake in the installation of PV panels	Membership model for a citizen led community	Not included in the customer relationships	Not included in the customer relationships	Not included in the customer relationships	Not included in the customer relationships
Coordination from start to finish of the project	Including PV system sales, installation, repairs, maintenance, energy consulting, and PV system operation training	Integrates different services and opportunities in energy-related activities and community participation in the cooperative	During the other stages of the renovation process, community energy teams are involved. This implies a coordination of activities where different actors from households, community energy teams and possibly others are involved.	Throughout the whole lifetime of the project	Ongoing, long-term coordination is needed to ensure that customers are satisfied and well-served throughout the duration of contracts, highlighting the importance of comprehensive and continuous customer relationship management	Need for continuous coordination and regular communication to ensure that agreed objectives are met and customers are satisfied throughout the life of the contract	Involves management and coordination of multiple stages of the service, from pre-sales to after-sales support
Long-term relationships	Just during the construction stage	Not included in the customer relationships	Limited to the construction stage	Not included in the customer relationships	Because PPAs usually last from 20 to 25 years	Since duration of energy management agreements usually lasts 20 years	Direct engagement through personalized calls helps gather preferences, provide project guidance, and assess roof conditions, reducing costs and building trust.

Table 5: Comparison of customer relationships

4.6. Channels

This section describes the commonalities and differences among the channels of the analysis BMs. Table 6 provides the overview of the comparison of the analyzed BMs' value propositions.

4.6.1. Common features

- One of the factors that are repeated in all the proposed business models, except for Model 2, is the use of **social networks and web pages** to interact with the audience and in turn to capture future potential consumers and users of the services offered in each business model. Nowadays, it is essential to have a digital presence to make people aware of the services offered and to communicate in an easy and effective way with customers.

- Another common factor that can be seen in Models 1, 2, 3, 4 and 6 is **community involvement**. To connect with potential customers and achieve greater diffusion, local events, word of mouth and presentations are used as channels. On the other hand, in Model 7 they also use community engagement but through events such as fairs and exhibitions, so they focus more on promotion and demonstration of services.

  These activities establish tangible platforms through which direct interaction between members of the energy communities is achieved, which is key to generating trust in the services offered and building solid relationships.

- Another channel that is present in all business models from Model 1 to Model 7 is **collaborations and partnerships**. These partnerships are with a number of different associations, depending on the model, such as business partners, provincial organizations, community groups, municipal organizations, and even industrial parks. This channel is critical to maximizing the reach and impact that energy communities can achieve with each of their initiatives. In addition, by establishing these partnerships, it is possible to leverage additional resources, expertise and even extensive networks of contacts that can lead to new market opportunities in the future.

4.6.1. Differences

- One of the main differences between business model channels is the **geographic reach**. A clear difference can be observed between the methods of reaching customers. First, in Model 5, direct, in-person interactions with users are prioritized, so sales representatives physically travel to each customer's location. In this way, sales representatives can offer personalized service and advice to each customer based on

their needs. This technique is very effective especially when seeking to reach local customers and establish good relationships with them.

On the other hand, Model 4 uses online platforms instead of face-to-face interactions. According to this model, by making use of websites to promote and inform about the services offered, social networks and other platforms, it is possible to attract a more diverse and wider audience, reaching people from other geographic locations, which would not be possible in a direct and face-to-face manner. In addition, the audience that currently makes most use of social networks is young, so they may be more receptive to innovative and sustainable energy solutions.

This difference in geographic reach can directly influence marketing and promotional strategies. Those models that rely on local sales representatives may have an advantage in terms of establishing personal relationships and building trust with local customers. In contrast, energy communities with an online presence may benefit from a broader reach and greater visibility, but may face additional challenges in building strong relationships and communicating effectively through digital channels.

- Another major difference is the **approach to customer service**. In some models, such as Models 6 and 7, more importance and priority are given to customer service by offering personalized or comprehensive services. In contrast, other business models, such as Model 5, focus more on maintenance and marketing to achieve customer satisfaction and efficient operation of PV systems.

Generalized channels	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Social networks and web pages	Social networks and websites of the partners of "Climate Network Flemish Brabant"	Not included in the channels	Through websites	Through their own website	E-commerce platforms and enterprise websites	Through enterprise websites	Specialized E-commerce websites such as taopv.cn
Community involvement	Local events, whether by connecting with ongoing events or by hosting events focused on home renovation	Community events and word of mouth	Word of mouth and presentation at community events	Word of mouth	Not included in the channels	Through conferences and forums	Fairs and home exhibitions
Collaborations and partnerships	Schools	Municipalities and community buildings	Partners like contractors	Component manufacturers	Third party companies	Government, to promote and recommend the product	With private stores to incentivize customers understanding
Geographic reach	Locally	Locally	Locally	Regional scope	Territorial reach	Territorial reach	Territorial reach
Approach to customers	Not included in the channels	Not included in the channels	Not included in the channels	Not included in the channels	Direct engagement, education, and accessibility across multiple channels	Strategic and multifaceted, focusing on partnership development, government endorsement, and online promotion	Customized attention and education on the products and services of energy service companies

Table 6: Comparison of channels

4.7. Key partners

This section describes the commonalities and differences among the key partners of the analysis BMs. Table 7 provides the overview of the comparison of the analyzed BMs' value propositions.

4.7.1. Common features

- Collaboration with **manufacturers and wholesalers** is a common element in several business models analyzed. In Model 1, this collaboration has a strong focus on providing integral energy efficiency services, such as insulation, window upgrades and solar energy systems, to residents. In Models 5 and 6, energy saving service companies rely on partnerships with manufacturers and wholesalers to purchase equipment that is essential for the construction and operation of solar power plants. In a similar way, in Model 7 (Host-Owned Business Model), owners who build and operate their own solar power plants need direct collaboration with manufacturers and wholesalers to acquire the necessary components. Collaborating with manufacturers and wholesalers as key partners makes logical sense and can be highly beneficial for the different business models related to solar energy. These partners play a crucial role in providing access to high-quality equipment, essential components and the expertise needed for the successful implementation of solar power projects.

- Another aspect to analyze is the **relationship will the DSO in order to establish a grid connection**. This feature is found in Models 5, 6, 7. Grid connection and the relationship with DSOs and utilities are generally defined by regulation and standardized at the country level. When an energy community does not own the electric grid, it has to use the public grid and, in this case, requires the Distribution System Operator (DSO) to provide advanced features that are more complex than those offered to non-energy community customers. On the other hand, when the energy community has its own grid, it needs a connection point to the public grid operated by the DSO in order to integrate and distribute energy efficiently. In the three models mentioned above, the energy community does not own the grid, and therefore it requires to establish a relationship with the DSO of each Member State in China, for all of the cases. This collaboration allows companies to take advantage of the existing infrastructure of the existing power grid to efficiently integrate the generated solar energy. Connecting to the grid facilitates the distribution and sale of the generated electricity, either to the grid in its totality or as surplus.

- The **relationship with policy makers and regulatory authorities** appears as a repeated factor in several business models focused on sustainable energy (Models 1, 2, 3, 5 6, 7). In these models, collaboration with government entities is fundamental to guarantee financing, access subsidies and receive crucial support. In Model 1, Klimaatpunt partners with municipalities to offer services to residents at reduced prices, and in Model 3, the Sustainable Energy Authority Ireland is the main source of funding through grants for sustainable renovations. For Model 2, these relationships

are established with Electricity Northwest, that manages regional electrical infrastructure, advising Carbon Co-op on energy projects; Ecology Building Society, promoting eco-friendly construction and influencing energy policies; and Green Growth supports Greater Manchester businesses, shaping sustainable energy strategies. Similarly, in Models 5, 6 and 7, the relationship with government and the grid company is key to ensure viability and support through policies and subsidies that promote solar power generation.

- Another remarkable similarity, which is fundamental for the implementation of a business model, is the **association with different entities**. In Models 1, 2 and 3, partnership with municipalities, provinces, contractors and similar organizations is highlighted as one of the main resources. In addition, in Models 3, 4, 5, 6 and 7, one of the most crucial elements is the collaboration with regional agencies, governmental organizations and different companies in the sector.

  What would be achieved through these collaborations would be to expand the scope of the project, reaching new communities, customers and markets, thus increasing awareness of sustainability and the existence of these projects. In addition, thanks to these collaborations, all regulatory processes, including licenses, permits and all necessary approvals, could be expedited and facilitated by being directly supported by these institutions. Lastly, the relationship with governmental entities may imply an opportunity for funding or subsidies when carrying out the project, and may be beneficial mainly to deal with the initial costs, usually of high value.

4.7.1. Differences

- The main difference between all the business models analyzed is primarily reflected in the **strategic focus** and the **target audience**. Models 1 and 2 focus on services for residents and municipalities, highlighting the importance of collaborations with contractors and municipalities to provide energy efficiency solutions to households. On the other hand, Models 3 and 7 take a community and cooperative approach, where collaboration with local partners, governments and community organizations is essential. These models aim to encourage community involvement in sustainable initiatives, promoting citizen participation.

  In contrast, Models 4 and 5 focus on the PV infrastructure and supply chain. Here, collaboration with manufacturers, wholesalers and grid operators is crucial to guarantee the quality and availability of PV equipment, as well as to guarantee effective connection to the grid. These models are more oriented towards the provision of services along the renewable energy supply chain.

  Model 6, however, is targeted towards large companies and industrial parks. Its focus is on collaborating closely with industrial parks and large corporations to implement

large-scale solar power plants. Here, collaboration with manufacturers, financial institutions and the government is important to carry out larger projects.

Generalized key partners	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Manufacturers and wholesalers	Provision of comprehensive energy efficiency services, such as insulation, window upgrades and solar energy systems to residents	Not included in the key partners	Not included in the key partners	Not included in the key partners	Provide the participating companies with the necessary materials for photovoltaic equipment	To obtain the required material for the PV systems	Wholesalers of PV systems to provide customers with the needed components
DSO (for grid connection)	Not included in the key partners	Not included in the key partners	Not included in the key partners	Not included in the key partners	Does not own the grid and needs access from DSO	Does not own the grid and needs access from DSO	Does not own the grid and needs access from DSO
Relationship with policy makers and regulatory authorities	Municipalities and District System Operator Fluvius	Electricity Northwest, managing regional electrical infrastructure; Ecology Building Society, promoting eco-friendly construction; and Green Growth agency, shaping sustainable energy strategies	Sustainable Energy Authority Ireland for grant funding	Not included in the key partners	Grid company	Government and grid company	Grid company
Association with different entities	Local and municipal associations: municipalities and constructors	Local and municipal associations: charity	Local and municipal associations and regional: local contractors ;and sectoral associations: regional agency and social investments fund	Regional and sectoral associations	Regional and sectoral associations: grid and insurance company	Regional and sectoral associations: Government and grid company	Regional and sectoral associations: Grid company
Strategic focus and the target audience	Households and municipalities	Residents and municipalities	Local partners, governments and community organizations	PV infrastructure and supply chain	PV infrastructure and supply chain	Not included in the key partners	Local partners, governments and community organizations

Table 7: Comparison of key partners

4.8. Cost structure

This section describes the commonalities and differences among the cost structure of the analysis BMs. Table 8 provides the overview of the comparison of the analyzed BMs' value propositions.

4.8.1. Common features

- One of the aspects that is repeated in Models 1, 2, 4, 6 and 7 is **personnel costs**. In all of them, these costs represent a large part of the operating costs. Included in these are the salaries of contractors and employees, which are key to carrying out each of the services offered. Examples of this can be seen in Model 2, where 5 or 6 people are hired to deliver its community-driven renovation approach. In Model 7, on the other hand, energy service companies invest in hiring salespeople and technical staff to sell and install solar energy equipment.

- Another cost that can be seen in some of the models, specifically in Models 5 and 7, are **advertising and marketing costs**. These are crucial in attracting new customers and expanding the business. These expenses include investment in advertising campaigns, participation in industry events, different promotions in sales channels and digital marketing strategies to achieve greater visibility of the different services offered and thus attract new customers.

- Finally, **installation and construction costs** are present in Models 5, 6 and 7. These expenses are used to purchase new materials and equipment, and all the labor necessary for their assembly and installation, in this case, of photovoltaic solar panels in different locations. In addition, within this cost category can also be found the costs for site preparation and integration with the present infrastructure that is already in place

4.8.2. Differences

- One of the differences that can be observed is related to the **personnel costs** mentioned above. While in Models 1, 2, 4, 6 and 7 personnel costs are an important part of the cost structure, in Model 3, it is mainly based on volunteers, which means that these types of costs are almost entirely reduced.

Generalized cost structure	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Personnel costs	Staff costs: employed staff and freelancers	5-6 staff members are involved in providing the service	No personell cost, services are provided by volunteers	Staff costs	Not included in the cost structure	Staff wages for the operation and management of the PV power plants	Salaries of salespeople
Advertising and marketing costs	Not included in the cost structure	Not included in the cost structure	Not included in the cost structure	Not included in the cost structure	Marketing costs to promote the TPO model	Not included in the cost structure	Promotion cost to expand the market and sell equipment
Installation and construction costs	Not included in the cost structure	Not included in the cost structure	Not included in the cost structure	Not included in the cost structure	PV systems construction expenses	Construction of photovoltaic power plants, purchase of equipment and its installation	Installation, repairs and maintenance, including maintenance costs of the PV system hardware and brackets, solar inverters and grid connection distribution boxes

Table 8: Comparison of cost structure

4.9. Revenue streams

This section describes the commonalities and differences among the revenue streams of the analysis BMs. Table 9 provides the overview of the comparison of the analyzed BMs' value propositions.

4.9.1. Common features

- One of the revenue streams that is present in several of the models is **solar panel offerings**. This feature is present in Models 5 and 7. In Model 5, they lease their PV systems and charge the user to earn some money. On the other hand, in Model 7, the main source of revenue is the sale of PV systems together with the installation and maintenance.

- Another revenue stream that is repeated in Models 2, 3, 5 and 6 is **grants and initial funding**. In these cases, organizations receive these grants for the development and implementation of different services. These funds provide a crucial initial boost and support the long-term financial viability of the projects, especially during the initial stages of operation. In Model 2, the energy community receives a grant from the government to boost these projects in the early stages. Model 3, also used grants provided by the government for the sustainable renovation of the households. In Model 5, the members of the energy community received grants from the local and the central government according to the total power generated of CNY 0.42/kWh. Lastly, in Model 6, the receive grant from the government depending on the output of the PV plant of CNY 0.42/kWh.

- Finally, another common feature that can be detected in Model 4 and 6 is the **sale of electricity**. In Model 4, if they have excess electricity that they are not going to use, they have the possibility to sell it to other communities to make some income. In addition, if they lack electricity, they can purchase it from other energy communities at a better price than the conventional suppliers. In Model 6, the main source of revenue is the sale of the electricity generated by the energy community to industrial and commercial enterprises. Furthermore, they can sell the excess to the grid at the local reference price for desulfurized coal-fired thermal power.

4.9.2. Differences

- One aspect that is present in some of the business models studied, but varies in each of them, is a type of **fee**, as explained hereinafter. They can be found in Model 1 and 2. In Model 1, the households that want to participate and want to renovate their homes, pay a small fee to the community. In addition, the district system operator Fluvius also pays a fee to the community for each of the renovation advice provided and for the firsts measures implemented. On the other hand, in Model 2, every household needs to pay a fee if they want to take part in the project. They also have a

consultancy fee for advising local authorities in other locations since they also want to implement the same service. Another fee that they have is the training fee, to train the participant that will be implementing the service. And lastly, a social franchise fee to whoever wants to replicate it.

Generalized revenue streams	Analyzed BMs						
	Model 1: BENOvation coach	Model 2: Carbon Co-op	Model 3: Tipperary Cooperative	Model 4: The Austrian case	Model 5: Third-Party-Owned	Model 6: Energy management contract	Model 7: Host-Owned
Solar panels offering	Not included in the revenue streams	Not included in the revenue streams	Not included in the revenue streams	Not included in the revenue streams	Lease PV systems	Not included in the revenue streams	Sell PV systems
Grants and initial funding	Not included in the revenue streams	Carbon Co-op receives an initial government grant to help developing the service	Initial funding from the local community	Not included in the revenue streams	Subsidies of CNY 0.42/kWh provided by the central government, in line with the total production of photovoltaic power plants.	Subsidies of CNY 0.42/kWh provided by the central government, in line with the total production of photovoltaic power plants.	Not included in the revenue streams
Sale of electricity	Not included in the revenue streams	Not included in the revenue streams	Not included in the revenue streams	Sell excess to other energy communities	Not included in the revenue streams	Sell to industrial and commercial enterprises or to the grid	Not included in the revenue streams
Fees	From homes and the district system operator	Household fees, consultancy fees, training fees and social franchise fee	Not included in the revenue streams	Not included in the revenue streams	Not included in the revenue streams	Not included in the revenue streams	Not included in the revenue streams

Table 9: Comparison of revenue streams

5. Compliance of the analyzed Energy Communities BMs with the Spanish regulation

This section classifies the BMs analyzed in section 4 according to the different legal figures for energy communities defined by the EU regulation, as described in section 2.1. The aspects considered for the regulatory analysis are geographical scope, the scale and size, the participant and consumption profile and the available technology. Furthermore, the compliance with the current Spanish regulation for energy communities is studied.

This section of the study aims to see whether it would be possible to implement these ideas of energy communities in Spain.

According to the Royal Decree regulating renewable energy communities published by the Ministry for Ecological Transition and Demographic Challenge (MITECO) on April 21, 2023, there are a series of requirements, rights and obligations that must be fulfilled depending on the type of energy community in question [21].

Out of all the different articles that compose the Royal Decree, a classification has been made to determine which articles to analyze for compliance and which ones to exclude. This selection was influenced by the lack of detailed information on the BMs.This will depend on the type and quality of information provided in the descriptions of the various business models. Many of the available models focus on general practices without going into the specific operational, legal and technical details required by the Royal Decree. Without this detailed information, it is difficult to fully evaluate compliance with regulations. As a result, direct application of these models to the Spanish framework without additional contextual information may result in inaccuracies or incomplete assessments. Therefore, only articles for which sufficient information exists will be applied to carry out a complete and precise evaluation.

The main difference between the articles that have been applied and the ones that were not lies in the topics covered. The articles that have been covered provide an overview of the basic and fundamental elements of the rights, formation and structure of energy communities. On the other hand, the list of articles that have not been checked elaborates further on the details of such an energy community, such as the specific rights and obligations of individual members, community autonomy and administrative procedures to ensure regulatory compliance and transparency in community operations.

In order to verify compliance with regulations, the business models analyzed in Section 4 were then classified according to the legal figures defined by EU regulations, taking into account the specific characteristics of each model. This classification is done in Table 10.

Type of energy community	Business model canvas
Renewable Energy Communities (REC)	1.- BENOvation coach
	3.- Tipperary Cooperative
	4.- The Austrian case
	7.- Host-Owned
Citizen Energy Communities (CEC)	2.- Carbon Co-op
	5.- Third-Party-Owned
	6.- Energy management contract

Table 10: Classification of the different energy communities according to geographical location, the scale and size, the participant and consumption profile and the available technology

5.1. Spanish regulation on Renewable Energy Communities

5.1.1. Analyzed articles

This section lists the articles of the Royal Decree developing the figures of renewable energy communities that will be considered to check whether business models of this type comply with them, and these business models will be listed below [11].

Article 3. Definition of renewable energy community

Article 3.1 defines a renewable energy community as a legal entity characterized by open and voluntary membership. This community is autonomously and effectively regulated by its partners or members, who are typically natural persons, SMEs, or local authorities such as municipalities. These partners or members must be located near the renewable energy projects that the community owns and develops. The primary objective of a renewable energy community is to provide environmental, economic, or social benefits to its members or the local areas in which it operates, instead of pursuing financial gain. Furthermore, groups or associations of individuals, SMEs, or local authorities can also be part of these communities, as long as they adhere to the same conditions and their staff and financial limits do not exceed those stipulated for SMEs.

Article 3.2 states that renewable energy communities can adopt any legal form recognized within the legal system, provided they possess their own legal personality. It is essential that these legal forms comply with the requisites stated in this chapter, ensuring that the community's structure and operations are compatible with the stipulated regulations.

Article 3.3 specifies that the bylaws of renewable energy communities, which are the internal regulations governing the community's operations, must comply with the applicable regulations for the chosen legal form. Additionally, these bylaws must incorporate the principles and requirements outlined in this chapter. The corporate purpose stated in the

bylaws must align with the definition of renewable energy communities, ensuring consistency with the community's objectives and regulatory framework.

Article 4. Requirements applicable to renewable energy communities.

4.1.- Renewable energy communities have to meet the following requirements:

Article 4.1(a) outlines the requirements for renewable energy communities. According to this article, a renewable energy community must consist of at least five partners or members. This regulation aims to promote the formation and operation of community-based initiatives focused on renewable energy generation. By stipulating a minimum number of participants, the article encourages collective action and shared responsibility in advancing sustainable energy practices within communities.

Article 4.1(b) defines the concept of a renewable energy community is founded on open participation. According to this provision, a renewable energy community must allow any natural or legal person, whether public, private, or public-private, to become a member provided they meet the relevant criteria. Importantly, the article prohibits imposing unjustified or discriminatory limits or conditions on membership. This requirement ensures inclusivity and equal opportunity for all interested parties to participate in renewable energy initiatives. By fostering an open participation framework, Article 4.1(b) supports diverse stakeholder engagement and encourages broad-based involvement in community-driven renewable energy projects.

Article 4.1(c) outlines key provisions regarding membership in renewable energy communities. It stipulates that membership in such communities must be both voluntary and free. This means that individuals or entities interested in joining a renewable energy community may do so without any financial obligation or coercion. Furthermore, the article ensures that any member or partner has the right to leave the community at any time. This freedom is subject to the rules and procedures established for joining and leaving, as well as the terms specified in the community's bylaws and relevant regulations. These provisions guarantee autonomy and choice for participants, enabling them to engage or disengage from renewable energy initiatives in accordance with their preferences and circumstances.

Article 4.1(f) highlights the expected benefits of renewable energy communities for their members and the local areas they serve. According to this provision, renewable energy communities are recognized for their potential to deliver environmental, economic, and social advantages. These benefits are primarily achieved by directing the economic gains they generate towards specific purposes. While the main focus is on reducing energy costs for members, communities are encouraged to also invest in activities aligned with their mission, such as environmental enhancements in their operational areas or fostering social development within local communities. By emphasizing the allocation of economic benefits for these purposes, Article 4.1(f) emphasizes the impact that initiatives for renewable energy will have on the global economy can have beyond mere energy production. It promotes a sustainable approach that integrates economic prosperity with environmental stewardship

and social well-being, thereby contributing positively to the broader community and regional development goals.

Article 5. Rights and obligations of renewable energy communities.

5.1.- Renewable energy communities, under the terms provided for in the applicable sectorial regulations, have the right to:

Article 5.1(a) specifies the rights of renewable energy communities within the framework of applicable sectorial regulations. According to this provision, renewable energy communities are granted several rights, including the authority to engage in the production, consumption, storage, and sale of renewable energy. These activities encompass various forms of renewable energy, with a particular emphasis on the ability to enter into contracts for purchasing renewable electricity. By affirming these rights, Article 5.1(a) supports the operational autonomy of renewable energy communities. It empowers them to participate actively in the renewable energy market, facilitating their role as generators and consumers of clean energy. Moreover, the provision aligns with broader energy sector regulations to ensure that communities can contribute effectively to the transition towards sustainable energy practices.

Article 5.1(b) outlines another right granted to renewable energy communities within the framework of applicable sectorial regulations. Specifically, it affirms the community's entitlement to share the renewable energy generated by its production units among its members. This sharing mechanism enables members to benefit collectively from the renewable energy produced within the community. For this right to be exercised, the community must adhere to the conditions stipulated in the article and ensure that members' rights and obligations, particularly as consumers of energy, are maintained. This ensures transparency and fairness in the distribution and utilization of renewable energy resources within the community.

Article 5.1(c) grants renewable energy communities the right to access all relevant energy markets directly or through aggregation, without facing discrimination. This provision highlights the community's ability to participate fully in energy markets, leveraging their collective resources and capacities to engage in trading and transactions. By ensuring non-discriminatory access, the article promotes fair competition and equal opportunities for renewable energy communities in the energy sector. It allows communities to explore various market avenues for selling surplus energy, procuring supplies, or participating in renewable energy certificate trading, among other activities.

Article 5.1(d) grants renewable energy communities the right to act as representatives of consumers for the purpose of collective self-consumption, subject to the necessary authorizations being received. This provision acknowledges the community's role in facilitating collective self-consumption arrangements, where members jointly consume the renewable energy generated within the community. To exercise this right, renewable energy communities must obtain appropriate permissions from relevant authorities or stakeholders. This ensures that the community can effectively manage and distribute renewable energy among its members for self-consumption purposes.

Article 6. Rights and obligations of the partners or members of renewable energy communities.

Article 6.1 ensures that final consumers, which include domestic consumers, have the right to participate in renewable energy communities without losing their inherent consumer rights or obligations. This provision prohibits imposing unjustified or discriminatory conditions or procedures that could hinder consumer participation in these communities. Moreover, the article emphasizes inclusivity by stating that participation in renewable energy communities should be accessible to all consumers, regardless of their income level or vulnerability. This includes ensuring that low-income households and vulnerable groups have equal opportunities to engage in community-based renewable energy initiatives. However, for private companies, their participation in renewable energy communities should not constitute their primary commercial or professional activity. This provision aims to maintain the community-driven nature of renewable energy initiatives while allowing businesses to participate in a supportive role.

Article 6.2 ensures that consumers participating in renewable energy communities are eligible to equal and non-discriminatory treatment. This provision emphasizes fairness and equity in the treatment of all members within the community, regardless of their background or status. The article mandates that all consumers involved in renewable energy communities should receive equal access to benefits, opportunities, and resources available through their participation. This includes access to renewable energy production, consumption, savings on energy costs, and any other benefits derived from community activities. By promoting equal treatment, Article 6.2 aims to foster trust, cooperation, and solidarity within renewable energy communities. It reinforces principles of fairness and inclusivity, ensuring that all members can contribute to and benefit from community-driven renewable energy initiatives on an equitable basis.

Article 6.3 affirms the rights of partners or members within a renewable energy community, specifically regarding their ability to voluntarily withdraw from the community. This provision ensures that partners or members can exercise their right to leave without facing unjust penalties or restrictions, subject to any specified timeframes or notice requirements outlined in the community's bylaws. Additionally, the article addresses the potential consequences of leaving the community, particularly concerning the recovery of investments or contributions made by departing partners or members. It specifies that the conditions for recovering investments should be clearly defined in the community's internal operating rules, bylaws, or similar documents. By guaranteeing these rights, Article 6.3 promotes transparency and accountability within renewable energy communities. It supports the autonomy of individual members while providing clarity on the procedures and conditions under which they can exit the community without undue financial or procedural burdens.

Article 7. Facilitating framework.

7.1.- In order to encourage and facilitate the development of renewable energy communities, the public administrations, in the exercise of their respective competences, shall ensure that:

Article 7.1(a) addresses the role of public administrations in promoting the development of renewable energy communities by ensuring a supportive regulatory environment. Specifically, it mandates that public administrations, within their respective competencies, take measures to eliminate unjustified regulatory and administrative barriers that may hinder the establishment or operation of renewable energy communities. This provision underscores the importance of streamlining regulatory processes and removing unnecessary bureaucratic hurdles that could impede community-driven renewable energy initiatives. By doing so, public administrations facilitate easier access to permits, licenses, and other regulatory approvals necessary for community projects. The aim of Article 7.1(a) is to promote a more conducive regulatory framework that encourages the growth and sustainability of renewable energy communities. It reflects a commitment to supporting local initiatives aimed at advancing renewable energy deployment while ensuring that administrative procedures do not unnecessarily obstruct or delay community-driven efforts.

Article 7.1(b) highlights the role of public administrations in promoting and facilitating the development of renewable energy communities by ensuring collaboration between distribution system operators (DSOs) and these communities. Specifically, it mandates that public administrations, within their respective jurisdictions, encourage DSOs to cooperate with renewable energy communities. This cooperation is aimed at facilitating energy transfers within renewable energy communities. It involves enabling the seamless integration of renewable energy sources into the distribution grid, ensuring efficient energy distribution and management within the community. By supporting this collaboration, Article 7.1(b) supports the operational flexibility and reliability of renewable energy communities. It acknowledges the importance of infrastructure support and technical cooperation from DSOs in optimizing energy transfers and grid management, thereby enhancing the overall effectiveness of community-based renewable energy initiatives.

Article 7.1(c) emphasizes the role of public administrations in promoting and facilitating the development of renewable energy communities through regulatory and capacity-building support. It mandates that public administrations, within their respective competencies, provide assistance to public authorities aimed at facilitating the creation and operation of renewable energy communities. This support encompasses regulatory guidance and capacity-building initiatives designed to empower public authorities in their efforts to establish and manage renewable energy communities. It includes technical assistance, training programs, and the dissemination of best practices to enhance the administrative capacity of authorities involved in promoting community-based renewable energy projects. Furthermore, Article 7.1(c) emphasizes the importance of enabling public authorities to participate directly in renewable energy communities. This involvement can range from providing funding support to actively engaging in community initiatives, thereby fostering collaboration between governmental bodies and local communities in advancing sustainable energy transitions.

Article 7.2 emphasizes the need for public administrations to consider the specific characteristics of renewable energy communities when designing support schemes, while adhering to Community rules on state aid. This provision ensures that renewable energy communities are given equal opportunities to compete for support alongside other market participants. By acknowledging the unique attributes of renewable energy communities, such

as their community-driven nature and local benefits, Article 7.2 encourages the development of support mechanisms that cater to their specific needs. This may include tailored financial incentives, regulatory frameworks, or administrative support aimed at levelling the playing field for communities engaged in renewable energy projects. Furthermore, the article underscores the importance of compliance with EU regulations on state aid, ensuring that any support provided to renewable energy communities is in line with competition rules and promotes fair market conditions.

5.1.2. Analysis of the regulatory compliance for the analyzed Renewable Energy Communities

The following table shows the symbology to be used to check compliance with the Royal Decree selected:

Symbol	Meaning
✓	It complies with the regulation
✓	It may comply with the regulation but more information is required
?	Lack of information
✗	It does not comply with the regulation

Table 11: Symbols used to check regulation compliance

Next, in Table 12, we will verify whether the business models of Renewable Energy Communities comply with each of the articles of the Spanish regulation explained in Section 5.1. In addition to indicating with the symbols described in Table 11, a column of comments has been added on the right where an explanation of the symbol choice will be provided. These comments will be accompanied by a number (1) (3) (4) (7), referring to the corresponding business model.

Article	Model 1 (1)	Model 3 (3)	Model 4 (4)	Model 7 (7)	Comments
3.1	✓	✓	✓	✓	(1)(3)(4)(7) Participation is voluntary and provides environmental, social or economic benefits

3.2	✓	✓	✓	✓	(1)(3)(4)(7) All of them are associations or cooperations with rights and obligations.
3.3	✓	?	?	?	(1) They operate under recognized legal forms and comply with Belgian regulations for foundations, associations and cooperatives. (3)(4)(7) There is insufficient information as to whether the community's bylaws comply with the regulations in force that correspond to its specific legal form.
4.1-a)	✓	✓	✓	✓	(1)(4)(7) As long as there are more than 5 members (3) Between 300 and 500 household per energy community
4.1-b)	✓	?	✓	?	(1)(4) It allows membership to any natural or legal person, whether public, private or public-private, without imposing unjustified or discriminatory restrictions or conditions (3)(7) There is insufficient information to verify that no unjustified or discriminatory restrictions or conditions are imposed
4.1-c)	✓	?	?	?	(1) Participants are free to leave the community if they wish, as there is no membership. (3)(4)(7) There is no data to know if the participants are free to leave the communities
4.1-f)	✓	✓	✓	✓	(1)(3)(4) The profits produced are used to reduce energy costs and improve the environment since the adoption of renewable energies, such as PV panels, directly contributes to the reduction of the carbon footprint and environmental improvement in your region. (7) Economic and environmental benefits are demonstrated but there is insufficient information to confirm full compliance with the principle of allocating economic benefits to generate environmental, economic and social benefits.
5.1-a)	?	?	✓	✓	(1)(3) It is not possible to confirm whether they are entitled to produce, consume, store and sell renewable energy, in

					particular through renewable electricity purchase and sale contracts since their activities are focused on advisory services for the sustainable renovation of dwellings (4)(7) They are allowed to produce, consume, store and sell renewable energy, in particular through renewable electricity purchase and sale contracts
5.1-b)	?	?	✓	✓	(1)(3) It is not possible to verify if it is possible to share, within the renewable energy community, the renewable energy produced by the production units owned by the renewable energy community (4)(7) Is aligned with the ability to share the renewable energy produced within the community, provided that legal requirements are met and the rights and obligations of community members as consumers are maintained.
5.1-c)	✓	✓	✓	✓	(1)(3)(4)(7) All of them are allowed to access all appropriate energy markets
5.1-d)	?	?	✓	✓	(1)(3) Since the information provided does not directly address this specific capacity to act as a representative in collective self-consumption, the information provided does not directly address this specific capacity to act as a representative in collective self-consumption. (4)(7) They can act as representatives of the consumers for the realization of collective self-consumption.
6.1	✓	✓	?	✓	(1)(3)(7) It ensures that participation in these communities is accessible to all, including low-income or vulnerable households. (4) It is not mentioned whether vulnerable households can take part of it.
6.2	?	?	?	?	(1)(3)(4)(7) It is not mentioned if all participants will be entitled to equal and non-discriminatory treatment.
6.3	✓	✓	✓	✓	(1) Members are free to leave but it is not clearly specified in the document provided whether there are time and notice

					requirements for the departure of members. (3)(4)(7) It is not clearly specified whether there is a process for recovering contributions made by members who choose to leave the community.
7.1-a)	✓	?	?	?	(1) It is intended to encourage and facilitate the development of these communities. (3)(4)(7) Not enough information available to check if the requirement to remove unjustified regulatory and administrative barriers for renewable energy communities.
7.1-b)	✓	?	?	?	(1) The company collaborates with the DSO to receive tariffs for each assessment performed. However, it is not specified whether this collaboration involves the facilitation of energy transfers within renewable energy communities (3)(4)(7) DSO is not mentioned.
7.1-c)	?	?	?	?	(1)(3)(4)(7) More detailed research or specific additional information on activities in relation to policies and support for public authorities in the context of renewable energies would be required.
7.2	?	?	?	?	(1)(3)(4)(7) More information is needed on how they design and manage their support schemes and how they ensure that renewable energy communities can compete fairly for that support.

Table 12: Regulation compliance for renewable energy communities

5.1.3. Articles not applied

The following are the articles, along with brief descriptions, that have not been verified for compliance due to unavailable information but are included in the Regulation:

<u>Article 4. Requirements for renewable energy communities</u>

Regarding the parts of Article 4 that could not be checked, it emphasizes the importance of maintaining autonomy and preventing undue influence within these communities, particularly by ensuring that no single member or partner holds a dominant position in decision-making processes. Additionally, it sets clear criteria for defining the locational proximity of community members to energy projects, which ensures that benefits are directed to those directly impacted by the initiatives.

Article 5. Rights and obligations of renewable energy communities.

In the case of Article 5, it outlines the rights and obligations of renewable energy communities, emphasizing regulatory compliance for entities engaged in supplying energy or providing aggregation services. It mandates fair treatment and non-discrimination of these communities in market activities, along with the right to utilize energy assets contributed by members or users for collective benefit

Article 6. Rights and obligations of the partners or members of renewable energy communities.

Furthermore, Article 6 guarantees the participation of all partners or members in community decision-making processes as defined in the community's bylaws. It also subjects community members involved in the electricity sector to the rights and responsibilities stipulated in national electricity sector laws, ensuring legal compliance and operational transparency

Article 8. Responsible declaration and list of renewable energy communities.

Lastly, Article 8 focuses on regulatory monitoring and transparency, requiring renewable energy communities to submit a responsible declaration of compliance before commencing activities. This declaration serves to verify adherence to regulatory requirements, supported by documentation that may be requested by competent authorities for verification purposes. The publication of a regularly updated list of compliant communities on the Ministry's website further enhances transparency and accountability in the sector.

5.2. Spanish regulation on Citizen Energy Communities

5.2.1. Analyzed articles

This section lists the articles of the Royal Decree developing the figures of citizen energy communities and citizen energy communities that will be considered to check whether business models of this type comply with them, and these business models will be listed below [11].

Article 9. Definition of citizen energy community

Article 9.1 defines a citizen energy community as a juridical entity that is formed on the basis of voluntary and open participation. The control of the community is exercised by its partners or members, who can be individuals, local authorities such as municipalities, or small enterprises. The primary aim of such a community is to provide environmental, economic, or social benefits to those members and the local area where it operates, above and beyond generating financial profit. This article stipulates that both natural and legal persons can become partners or members of a citizen energy community, always subject to compliance with the conditions specified in the Royal Decree for the legitimate formation of these communities.

Article 9.2 allows citizen energy communities to take any legal form recognized by the legal system that grants them legal status. This flexibility ensures that communities can choose a legal structure that best suits their needs while ensuring compatibility with the requirements outlined in this chapter of the regulation. By permitting various legal forms, such as associations, cooperatives, or limited liability companies, the article facilitates the establishment of citizen energy communities with distinct organizational structures. These structures must align with the regulatory standards set forth in the chapter, ensuring that communities operate in compliance with legal requirements while pursuing their objectives of providing environmental, economic, or social benefits to their members and localities.

Article 9.3 mandates that the bylaws of citizen energy communities must adhere to the regulations applicable to their chosen legal form. Additionally, these bylaws must incorporate the principles and requirements stipulated in the current chapter of the regulation governing citizen energy communities. This requirement ensures that the governance structure and operational guidelines outlined in the bylaws align with legal standards specific to the community's legal form, whether it be an association, cooperative, or another recognized entity. Moreover, the corporate purpose defined in the bylaws must be consistent with the definition and objectives of citizen energy communities as outlined in the regulatory framework.

Article 9.4 specifies that the field of action of citizen energy communities is restricted solely to the electricity sector. This limitation ensures that these communities focus exclusively on activities related to the production, consumption, distribution, and management of electricity within the regulatory framework provided. By limiting their operations to the electricity sector, citizen energy communities are required to comply with all relevant laws, regulations, and standards applicable to electricity generation, distribution, and consumption. This includes adhering to licensing requirements, grid connection regulations, and market participation rules that govern their activities within the sector.

Article 10. Requirements applicable to citizen energy communities.

Article 10.1 stipulates that a citizen energy community must be composed of at least five associates or members to be recognized as such under the regulation. This requirement ensures that these communities are formed with sufficient participation and collective governance, fostering diversity of perspectives and equitable decision-making among the partners or members. By mandating a minimum number of participants, Article 9.5 aims to promote robust community engagement and sustainability in the operation of citizen energy initiatives. This threshold also supports the community's ability to effectively manage its activities, responsibilities, and obligations within the electricity sector, as outlined in the regulatory framework.

Article 10.2 defines the principle of open participation for citizen energy communities, emphasizing that participation should be accessible to any natural or legal person, whether they are of public, private, or public-private nature, provided they meet the applicable requirements. The article prohibits the imposition of unjustified or discriminatory limits or

conditions on membership. This principle ensures inclusivity and fairness within citizen energy communities, allowing diverse stakeholders to contribute to and benefit from community-driven renewable energy initiatives. By removing barriers to participation based on unjustified criteria, such as arbitrary exclusions or discriminatory practices, Article 10.2 promotes transparency and equal opportunity for involvement.

Article 10.3 establishes the principle that membership in a citizen energy community must be both free and voluntary. This means that any individual or entity joining the community does so without enforcement, and without any financial obligation beyond what is specified in the community's bylaws and applicable regulations. Furthermore, the article ensures that members or partners have the right to withdraw from the community at any time. The process for joining and leaving the community, including any terms or conditions, must be clearly defined and transparently communicated in the community's bylaws and in compliance with relevant regulations. By guaranteeing free and voluntary membership, Article 10.3 promotes a participatory and democratic approach within citizen energy communities. It supports the principles of individual autonomy and choice, enabling members to engage actively based on their own interests and priorities in advancing the community's goals related to renewable energy and sustainability.

Article 10.6 defines the criteria under which a citizen energy community is deemed to provide environmental, economic, and social benefits to its partners or members and the local communities in which it operates. According to this article, these benefits are primarily realized when the community allocates its economic gains towards several key areas: Firstly, towards reducing the energy costs incurred by its partners or members. Secondly, towards implementing activities that align with its corporate purpose. Thirdly, towards investments that contribute to improving the local environment. Lastly, towards fostering social development within the locality or localities where the community is active. By prioritizing these allocations, the article ensures that citizen energy communities fulfill their mission of promoting sustainability and benefiting their members and the broader community. This approach emphasizes the community's role in not only achieving economic viability but also in enhancing environmental quality and social well-being through its operations.

Article 11. Rights and obligations of citizen energy communities.

11.1.- Renewable energy communities, under the terms provided for in the applicable sectorial regulations, have the right to:

Article 11.1(a) states that renewable energy communities have the right to access any organized electricity generation markets either directly or via aggregation on a non-discriminatory basis. This provision ensures that renewable energy communities can participate actively and fairly in electricity markets, whether by directly entering these markets or by aggregating their resources with other participants. By emphasizing non-discrimination, the article promotes equal access to market opportunities, enabling communities to leverage their renewable energy resources effectively.

Article 11.1(b) ensures that renewable energy communities are entitled to non-discriminatory and commensurate treatment concerning their activities, rights, and obligations within the electricity sector. It specifies that renewable energy communities must receive fair and equal treatment in relation to their roles as final customers, electricity generators, suppliers, or participants offering aggregation services. By guaranteeing non-discriminatory treatment, the article aims to prevent any unjust or preferential treatment that could hinder the community's ability to operate effectively in the market. It underscores the importance of equitable access and fair competition, thereby supporting the community's integration into the broader electricity sector.

Article 11.1(d) grants renewable energy communities the right to perform as consumers representatives in the implementation of collective self-consumption initiatives, subject to obtaining necessary authorizations. The article states that renewable energy communities have the authority to represent consumers in collective self-consumption projects, contingent upon obtaining the requisite permissions. This right enables communities to facilitate collective self-consumption, where multiple consumers jointly use energy generated from renewable sources. By acting as representatives, communities can advocate for and coordinate such initiatives on behalf of participating consumers, ensuring compliance with regulatory requirements and optimizing the benefits of renewable energy generation.

Article 12. Rights and obligations of the partners or members of citizen energy communities.

Article 12.1 guarantees that all consumers, including households and private companies, have the entitlement to join a citizen energy community without facing unfair barriers or discriminatory conditions. This includes maintaining their existing rights and responsibilities as consumers. However, it specifies that for private companies, participation should not constitute their primary commercial or professional activity. This article aims to ensure equal opportunities for all consumers to engage in community-driven renewable energy initiatives. It emphasizes transparency and accessibility within citizen energy communities, promoting a diverse and inclusive approach to sustainable energy practices.

Article 12.4 ensures that all consumers participating in a renewable energy community receive fair and equitable treatment. It emphasizes the principle of non-discrimination, stipulating that consumers involved in the renewable energy community must be treated equally and without bias. By guaranteeing equal treatment, the article aims to prevent any unfair advantages or disadvantages that could arise based on consumer characteristics such as size, type, or location. This ensures a level playing field for all participants within the community, promoting transparency, trust, and effective collaboration in renewable energy initiatives.

Article 12.5 ensures that partners or members of a citizen energy community retain the right to withdraw from the community freely, subject to any timeframes and notice requirements outlined in the community's bylaws. Specifically, it states that partners or members of a citizen energy community can exit the community without facing undue restrictions, provided they adhere to the specified timelines and notice procedures as defined in the community's bylaws. Additionally, standard regulations governing electricity sector supplier changes apply in these cases. By affirming this right, the article supports individual autonomy and choice within

citizen energy communities. It ensures that members can manage their participation according to established procedures while complying with regulatory standards applicable to electricity supply arrangements.

5.2.2. Analysis of the regulatory compliance for the analyzed Citizen Energy Communities

The following table shows the symbology to be used to check compliance with the Royal Decree selected:

Symbol	Meaning
✓	It complies with the regulation
✓	It may comply with the regulation but more information is required
?	Lack of information
✗	It does not comply with the regulation

Table 13: Symbols used to check regulation compliance

Next, in Table 14, we will verify whether the business models of Citizen Energy Communities comply with each of the articles of the Spanish regulation explained in Section 5.1. In addition to indicating with the symbols described in Table 13, a column of comments has been added on the right where an explanation of the symbol choice will be provided. These comments will be accompanied by a number (2) (5) (6), referring to the corresponding business model.

Article	Model 2 (2)	Model 5 (5)	Model 6 (6)	Comments
9.1	✓	✓	✓	(2)(5)(6) It is an entity that promotes open and voluntary participation, controlled by the local community, and focuses on providing environmental and social benefits.
9.2	✓	?	?	(2) Its structure as a Community Benefit Cooperative Society provides the necessary legal personality and is compatible with the principles and requirements of citizen energy communities. (5)(6) It would be necessary to obtain additional information on the specific

				legal structure and governance of energy service companies
9.3	✓	✓	✓	(2)(5)(6) It would be necessary to review the local laws and regulations that apply in your jurisdiction
9.4	?	✓	✓	(2) It would be necessary to verify whether it is involved only in the generation, distribution or management of electricity, excluding other forms of energy (5)(6) Activities are limited to the electricity sector, specifically to PV systems
10.1	✓	✓	✓	(2)(5)(6) As long as there are more than 5 members
10.2	✓	?	?	(2) It is aligned with the principle of open participation described (5)(6) The principle of open participation is not described
10.3	?	?	?	(2)(5)(6) Freedom to leave the energy community is not discussed
10.6	✓	✓	✓	(2) Since it helps to reduce carbon emissions (5) It helps reduce gas pollution and carbon emissions (6) It helps reduce electricity cost and promotes the use of clean energy while reducing emissions
11.1-a)	?	?	?	(2)(5)(6) The relationship with the electricity markets is not known
11.1-b)	✓	?	?	(2) Any customer interested in the initiative can participate (5)(6) Although the main users are mentioned, there is no mention of who may participate
11.1-d)	?	?	?	(2)(5)(6) Insufficient information is provided to indicate that energy service companies act as consumer

				representatives to facilitate collective self-consumption
12.1	✓	✓	✗	(2)(5) Everyone including domestic consumers can participate (6) The model is clearly designed for industrial and commercial customers and does not address the participation of domestic consumers in a citizen energy community.
12.4	?	?	?	(2)(5)(6) Equal and non-discriminatory treatment is not mentioned
12.5	?	?	?	(2)(5)(6) The freedom to leave the community is not mentioned

Table 14: Regulation compliance for citizen energy communities

5.2.3. Articles not applied

The following are the articles, along with brief descriptions, that have not been verified for compliance due to unavailable information but are included in the Regulation:

Article 10. Requirements applicable to citizen energy communities.

Article 10.4 stipulates that a citizen energy community must maintain autonomy regarding its members or partners. This requirement prohibits any single member or partner from possessing more than 51% of the voting power, and it restricts configurations in the bylaws or internal documents that could grant dominant decision-making positions to certain members over others.

Article 10.5 addresses the effective control of citizen energy communities, mandating that they be controlled by individuals, small businesses, or local authorities. It specifies that entities other than natural persons, small companies, or local authorities cannot hold majority voting power exceeding 51%, nor can they possess the authority to appoint or dismiss a majority of the management body members.

Article 11. Rights and obligations of citizen energy communities.

In Article 11.1(c), citizen energy communities are granted the right to fair, proportionate, and transparent procedures and charges, including registration, licensing, and non-discriminatory cost-reflective network access tariffs. This ensures their equitable contribution to overall system cost sharing in accordance with EU Regulation (EU) 2019/943.

Article 11.2 enables citizen energy communities to exercise rights over the energy assets of their members or users that have been sold, transferred, or contributed to the community, aligning with the community's operational needs and objectives.

Article 12. Rights and obligations of the partners or members of citizen energy communities.

For Article 12, which addresses the rights and obligations of partners or members of citizen energy communities, it establishes that all participants have the right to engage in community decision-making as outlined in their bylaws, thereby ensuring autonomy and effective control as stipulated in this chapter. Furthermore, it guarantees that consumers maintain all their rights and obligations as final electricity consumers under Law 24/2013 and its implementing regulations. It also permits individual or collective self-consumption under the conditions specified in Royal Decree 244/2019, and authorizes citizen energy communities to act as representatives of consumers, subject to appropriate authorization under current regulatory frameworks.

Article 13. Relationship of Citizen Energy Communities

Regarding Article 13, which concerns the relationship of citizen energy communities with competent authorities, it specifies that the Directorate General for Energy Policy and Mines will regularly publish and update on the Ministry for Ecological Transition and Demographic Challenge website a list of citizen energy communities that have submitted a responsible statement confirming compliance with the requirements outlined in this chapter, pursuant to Article 10. Additionally, the competent authority may request necessary documentation from interested parties to verify compliance within the scope of granting aid or benefits derived from the citizen energy community status. Any changes affecting the data in the original responsible statement must be communicated by the interested party within one month of occurrence, accompanied by the corresponding responsible statement. This regulatory framework also recognizes the autonomy of autonomous communities to establish additional lists or registers of citizen energy communities operating within their respective jurisdictions, enhancing local oversight and regulatory monitoring.

6. Conclusions and recommendations

Based on the analysis of the BMCs of several energy community initiatives in Europe and the examination of their potential compliance with the Spanish regulation, one recommendations can be provided, as in the following. These recommendations are intended to provide a guide to improve and facilitate the implementation and management of energy communities in Spain, based on the lessons learned from the international models analyzed. In the European context, energy communities have an essential role to play in achieving the energy transition objectives that have been set. Some of the reasons why they are key are that they enable the decentralization of energy production [22], the democratization of energy [23], reduce the carbon footprint and offer economic advantages.

The most important aspects of the sections of the business model canvas analyzed in *Section 4*, which would be essential for the implementation of these models in Spain, are presented below. It is crucial to note that all these essential aspects comply with Spanish regulations.

- Firstly, a key aspect to highlight from the different value propositions of the models would be the **active participation** of the users of the energy community. As can be seen in Models 1, 2, 3, 5 and 7 where this aspect is present, user participation brings with it many benefits, both for individuals and for the community as a whole. Users obtain more empowerment and autonomy over their energy consumption, allowing them to access lower and more stable energy tariffs, which reduces their energy costs. It also encourages the adoption of sustainable practices and improves environmental awareness, contributing to the reduction of the carbon footprint. This participation promotes social inclusion, strengthens the community and can generate additional income to support local economic development. Through democratic and transparent management, users have a voice in energy decisions, which better reflects their needs and ensures access to government subsidies and support. Ultimately, active participation in these communities educates and raises awareness among users about the impact of their energy decisions, creating a strong base for a more just and sustainable energy future.

  The first recommendation is to incentivize and promote the active participation of the participants of the energy community. This can be done through awareness campaigns, energy education programs, and the creation of economic incentives that make it more attractive to integrate and engage citizens in their participation.

- As for the key activities, the first three business models focused exclusively on the production and internal consumption of electricity by the communities themselves, operating in a more "isolated" way and without interacting with external elements of the community. In contrast, Models 4, 5, 6 and 7 not only generated electricity for their own consumption, but also actively interacted with entities and services external to the community, such as energy companies, government institutions and electricity markets. This **interaction with the exterior** allows communities not only to sell surplus

electricity generated, contributing to the stability and security of energy supply, but also to access electricity from the grid in case of insufficient internal generation, which ensures greater flexibility and reliability in energy supply, optimizing resource management and facilitating the integration of renewable energy sources into the electricity system.

For communities, being connected to the grid brings with it a series of important benefits as previously mentioned, although this implies respecting the requirements established by the regulatory bodies and the DSO; and the increase in costs that this brings with it.

- In addition, in relation to key partners it is key to have an **effective communication with policy makers and regulatory authorities**. This can be found in all of the studied business models. It is essential that energy communities work with policy makers and regulators to ensure regulatory compliance and facilitate the development of policies that favor renewable energy sharing, improved energy efficiency and the reduction of energy poverty. The goal of this engagement is to overcome any inessential regulatory barriers, such as restrictions on energy sharing, that make it difficult for energy community business models to take hold. By encouraging a constructive relationship with government entities, energy communities can advocate for regulatory frameworks that support sustainable energy initiatives. This collaboration is crucial to accessing the financial resources, grants and institutional support necessary for the viability and growth of energy communities. In addition, a proactive engagement strategy involves participating in regulatory consultations, contributing to policy dialogues, and gaining regulatory expertise to effectively navigate and influence policy-making processes. This approach not only helps energy communities comply with regulations, but also promotes an enabling environment for broader societal benefits, such as reduced emissions and improved energy efficiency.

  The third recommendation would be to establish a good relationship with the authorities. To achieve this, it is essential that communities proactively engage in dialogue and public consultation in the formulation of energy policies. This can be done by participating in working groups, forums and conferences organized by regulatory authorities. In addition, it would be recommended that energy communities acquire regulatory knowledge to interact effectively and constructively with policy makers.

- Finally, another aspect that seems to be key for the energy community to be successful is the **sale of the excess energy** as a revenue stream. Although it is only found in Models 4 and 6, it provides an additional source of revenue that can be reinvested in the community to improve energy infrastructure and reduce energy costs for its members, guaranteeing greater financial stability and a reduction in dependence on external subsidies. In addition, selling surplus energy encourages the production of renewable energy and contributes significantly to the reduction of carbon emissions, supporting the transition to a more sustainable economy. Also, by providing clean and

affordable energy to the local community, it strengthens the local economy and creates a more resilient and self-sufficient community.

The last recommendation will be to encourage members of the energy communities to sell their excess generation, although it is preferable to diversify the sources of income in order to have greater financial stability.

As for what has been extracted from the analysis in *Section 5*, it has not been possible to verify compliance with all the articles of the Spanish regulation since the information available on these business models was not sufficient. However, in all cases, the models analyzed present characteristics and principles that, a priori, seem to be favorably aligned with the objectives and guidelines established by the regulations in force. With some specific adjustments and the adequacy of certain operational and administrative aspects, each business model could become fully compliant with the regulatory requirements established for energy communities in Spain. This suggests that, with proper adaptation, these models have great potential to be effectively implemented within the Spanish legal framework.

it is clear that a greater push is needed to promote all the initiatives that favor the development of activities that promote the exploitation of energy communities, seeking greater flexibility, facilitating the first phases of projects where having the necessary requirements for connection and start-up imply barriers to entry, higher costs or lengthy periods of time.

In conclusion, all the business models that have been studied could be implementable in Spain. In this case, regarding all the features mentioned above, it is not necessary to change Spanish regulations, as they currently allow for all the aspects described: active participation of members of the energy community, local flexibility markets, establishing a good relationship with policy makers and regulatory authorities, and sale of excess energy as a revenue stream.

Ideally, of the four aspects highlighted it would be interesting to focus on these specific ones:

- Active participation of members of the energy community, particularly in investment decisions in energy projects: allowing participants not only to become directly involved in the development and management of sustainable initiatives, such as the installation of renewable infrastructure or energy efficiency programs, but also to share in the resulting economic benefits, such as savings in energy costs and potential revenues from the sale of surplus energy. This participation not only strengthens the sense of community and shared responsibility, but also diversifies financial risks and promotes greater adoption of sustainable energy practices over the long term.
- Local flexibility markets for managing imbalances between local energy production and demand.
- Establishing an effective communication with policy makers and regulatory authorities, in the case of Spain, in particular with the CNMC. This entity regulates and supervises the electricity market and other related areas, ensuring compliance with

regulations and promoting fair competition in the energy sector. Maintaining a good relationship with the CNMC could facilitate the understanding and adaptation of energy communities to current regulations, as well as influence the development of policies that support the active participation of these communities in the energy market.

- Sale of excess energy as a revenue stream, in particular to other energy communities, as it can bring more benefits that selling it to the grid because selling directly to other communities allows for more direct and flexible collaboration agreements, potentially obtaining more favorable prices and creating long-term relationships that promote the financial and operational stability of the communities involved. In addition, this approach can help strengthen local energy autonomy and foster the development of decentralized and resilient energy networks. Efficient network charges and price signals are key to avoiding cross-subsidies among community members and those who are not.

Therefore, given that none of the analyzed business models contained these four key elements, they would need to be modified to incorporate them along with some potential regulatory changes that could also be introduced to boost energy communities further.

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ANNEX A: BMC

Klimaatpunt Pajottenland & Zennevallei/
Pajopower: "BENOvation coach"

Key Partners

- Energiek Wonen.be: platform for contractors that can deliver roof and wall insulation, window improvements, solar PV, and heating.
- Municipalities: Klimaatpunt has partnered with eight municipalities to offer their service at a reduced price to residents.
- District System Operator Fluvius: Klimaatpunt receives fees from the DSO for each assessment done and the first two measures implemented by households.
- Energiehuis 3Wplus and Energiehuis IGO: provide loans for sustainable renovations to vulnerable households
- 'Benovatie' providers in adjacent regions: three other organizations (Energiehuis 3Wplus, Energiehuis IGO and Kringwinkel Hageland) provide a similar service in other regions of the province.

Key Activities

Klimaatpunt offers the following activities:
- 'Benovation' (contraction of 'better' and 'renovation') advice.
- Social renovations.
- Sustainable mobility.
- Climate Neutral Strategy.
- Awareness and education.

Key Resources

- Staff: renovation assessors/advisors.
- Partnerships with municipalities, contractors, the province, and other organizations providing similar services.

Value Propositions

Through the 'Benovation' service homeowners receive a tailor-made advice for whole house retrofit at a reduced price. The advice includes:
1. A writeup of the households wishes and needs and financial means.
2. An assessment of the dwelling looking at energy efficiency, humidity, safety and health
3. A tailor made plan for (stepwise) renovation of the home including a 3D rendering and cost estimation per m2
4. The possibility to connect with a selected contractor
5. The possibility to join a collective purchase scheme for insulation materials, windows, solar PV, and/or heat pumps (continuous offer, no waiting list).

For households in non-participating municipalities the cost of the advice is 250 euro's, with households implementing one (or more) of the advised measures getting 125-euro cashback. An extra incentive for homeowners to implement renovation measures comes from the Flemish government and the district system operator who give a small subsidy to households for the implementation of measures.

Customer Relationships

Klimaatpunt uses a service model, meaning that it is open to all residents within their area of operation. Klimaatpunt does not have a membership structure, but interested households can become members of Pajopower.

Channels

- Municipal and Provincial outlets
- Social media and websites from partners of "Climate Network Flemish Brabant"
- Local events: either connecting to existing events or organizing events dedicated to home renovation
- Schools

Customer Segments

Resident homeowners.

Cost Structure

The costs for this service are limited to the staff costs and a little overhead. A 'benovation coach' does on average 100 consults/assessments per year. Klimaatpunt uses both freelancers and employed staff. With a 50 euro per hour average wage rate, they are currently running a small surplus.

Revenue Streams

Klimaatpunt has three revenue sources: households, municipalities, and the district system operator through the 'Burenpremie' (Neighborhood Premium, part of the Flemish implementation of the Energy Savings Obligation). 1. Households pay a small fee for the service (see value proposition) 2. Some municipalities pay Klimaatpunt 100 or 150 euros to offer the service at a reduced price to residents in their area as to promote energy efficiency 3. Klimaatpunt receives a fee from the district system operator Fluvius for each renovation advice given, and for the first and second measures implemented by households. This allows them to offer the service for a very small fee. They need to get at least 350 euro in revenue per advice done to continue operations. In the future Klimaatpunt will no longer ask municipalities for a contribution since they will now receive a fixed fee for the DSO for each renovation advice given. They will ask a type of 'warranty' of 100 euro per advice from the municipality, but if the household ends up implementing one or more of the advised measures, they will pay out this warranty to the household. With this new system they will be able to offer the service in all municipalities at a lower price, which they expect will lead to more demand. Since in the past they have seen much higher demand in municipalities where they offered the service at a lower price.

People Powered Retrofit – Carbon Co-op

Key Partners

• Carbon Co-op: client engagement, service design, social marketing
• URBED: data analysis and mapping, supply chain development, retrofit/architectural design, and quality assurance
• Fieldwork studio: graphic design and website building
• Short work: evaluation of the approach with the homeowners (quality control, and how homeowner experienced the service and the works); Eventually Carbon Coop wants to do the evaluation inhouse.
• Cumbria Action for Sustainability: a charity that is on the advisory group, Carbon-Coop is also working with them to replicate the approach in the Cumbria region.
• Quantum Strategy and Technology: engineering and community energy consultancy helping with replication of the approach.
• Arc4: part of advisory group, retired constructor providing technical advice.
• Electricity Northwest: (distribution network operator): on the advisory board and involved in other Carbon Coop projects
• Ecology Building Society: on the advisory board
• Green Growth business support agency: on the advisory board, a municipal agency involved in providing business support, economic development and training to the private sector in Greater Manchester.

Key Activities

Carbon Co-op's People Powered Retrofit service involves raising awareness, providing advisory services, sourcing materials, and selecting contractors for sustainable home renovations. It includes planning, developing IT tools, and facilitating replication with other organizations through training, collaboration agreements, and network development.

Key Resources

• Staff: 5-6 staff members at Carbon Coop are involved in delivering the PPR.
• Partners: both the key partners listed above as well as freelance assessors, coordinators and architects that Carbon Coop works with.
•Contractors: specially selected and trained to deliver retrofit works and in receipt of specialist training and support.
•ICT tools: the ICT tools facilitate delivery of the service.
• Membership: membership involvement is crucial.
• Reputation: the reputation as a citizen-led, trusted, non-profit service is of great importance in getting both new members and customers for the retrofit service.

Value Propositions

The main value proposition of People Powered Retrofit to households is guiding and supporting them from beginning to end through the sustainable renovation of their home. In doing this, the decision-making power always lies with the household. The service supports and simplifies the decision making (see renovation journey) by guiding households through the different stages and options that are available. In the end, it is the household that has a contract with contractors and Carbon Co-op provides a Retrofit Coordinator to help manage the renovation. For communities as a whole the value proposition is a better developed market for home retrofits due to network building, lower emissions, local employment, increased awareness on energy efficiency and climate change (which is a co-benefit of participation in community energy initiatives).

Customer Relationships

Customers of the People Powered Retrofit are invited to become a member of Carbon Coop and become actively involved in the local energy transition. For example, as part of the 'Greater Manchester Local Energy Market (GMLEM) which focusses on developing 'energy master plans' for different neighborhoods and the Powershaper service that offers a local flexibility and demand response platform for householders. Since most retrofits they do include the installation of solar PV partaking in the Powershaper is a logical next step for many.

Channels

• Community events
• Word-of-mouth
• Through network of community (energy) and volunteer groups
• Local public services i.e. advice services linked to municipalities and community buildings such as community activity centers, libraries, information hubs etc.

Customer Segments

Carbon Co-op's mapping identified profiled households in moderately deprived areas, slightly older and wealthier than neighbors. These homes are located in ethnically non-diverse or higher-educated suburbs, avoiding areas with low educational qualifications. This led, roughly, to the following customer segments:
• 'Climate Change Pragmatists': usually people in their 30-40's, motivated to reduce their emissions and are willing to invest some time and money in doing so. Are looking for an expert that can show them how to do that.
• 'Climate Change Idealists': different age groups, very motivated, want to achieve highest degree of emission reductions irrespective of costs
• 'Civic Minded Retirees': are motivated to contribute to society, and are looking to spend their retirement in a comfortable home
• 'Techno-optimists': are motivated by wanting to try new technologies and identify as 'innovators'. Interested in showing that they are 'eco' minded / wealthy. Willing to spend extra money on branded systems such as Tesla batteries.
• Mixed people/motivations: other customers that do not fit one of the segments, interested in renovation for a variety of reasons.

Cost Structure

Costs involved in delivering the people powered retrofit approach is:
• Staff: currently 5-6 people involved in delivering the service
• Overhead: office, IT support, administration, etc.
• Freelancers/partner services: assessment, design, and evaluation/monitoring;

Revenue Streams

Carbon Co-op operates a service where households pay fees directly to design and contractor parties for retrofit activities, avoiding Carbon Co-op as an intermediary. **Household fees** cover stages such as advisory conversations and design/project management, averaging around 2500-3000 euros per household. **Consultancy fees** are earned by advising other groups and local authorities on replicating the service. **Training fees** are charged to contractors partnering with the service. **Social franchise fees** involve an upfront cost and annual fees for groups replicating the model. Carbon Co-op also receives fees for supporting groups in using their tools and services. An **initial government grant** supported the service's development. Financial viability depends on 100-150 households joining annually, aiming for a turnover of 300,000-350,000 euros.

Energy CommunitiesTipperaryCooperative

Key Partners

1. Sustainable Energy Authority Ireland: the main source of grant funding for sustainable renovation. Funded by the national government.
2. Directors coming from local community groups/energy teams: promoting ECTC activities, enrolls residents, identifies local contractors, and explores energy generation opportunities in the community.
3. Tipperary Energy Agency: provides essential guidance to the Energy Communities Tipperary Cooperative. They contribute to project design, conduct energy audits, etc.
4. North Tipperary Development Company: community development organization using national government funds to support local activities.
5. Clann Credo: social finance organization. Providing bridging finance to span the period between paying the contractor and receiving the grant funding from the energy authority
6. Utilities: SSE Airtricity / Electric Ireland
7. Local contractors
8. Local credit unions: bridging finance for people renovating their home.
9. Community Power ECTC is a key member of Community Power, sharing a Development Coordinator and partnering on a Community Solar Project for funding under the Irish Renewable Electricity Support Scheme.

Key Activities

- Project management and coordination services
- Perform technical surveys – this is done by an external technical assessor
- Secure grant aid
- Source contractors to:

- Perform upgrades to buildings: insulation, ventilation and heat recovery systems.
- Install renewable energy systems: solar PV and solar thermal, wind, heat pumps
- Perform upgrades to heating systems: standalone solid fuel stoves, control upgrades, chimney draught excluders.
- LED lighting.

- Provide quality assurance

Key Resources

1. Volunteers from the communities. On average 4-10 volunteers are involved per local group
2. Paid project manager/development coordinator that coordinates the work, does administration, and liaises with all partners to ensure schedules and necessary standards for the government (SEAI) grants are met.
3. Grants from the national government delivered through the SEAI 4. Contractors to perform upgrades to home and heating system and install renewable energy systems. A tendering process for new contractors is done every two years by the ECTC project manager 5. Strategic support from the regional energy agency.

Value Propositions

Main value proposition from ECTC to households/beneficiaries: the coordination of all aspects of a sustainable home renovation. A one-stop-shop service. The value proposition from the renovation itself is:

- Improved living conditions: warmer, healthier, and more energy efficient houses - Savings on energy spending through both increased awareness on energy use and the improved energy efficiency
- Reduced GHG emissions to communities ECTC also offers the following social and environmental value:
- Job creation at local level: both directly through the renovation projects and indirectly through improved spending power through savings on imported fuel.
- Reduced energy poverty
- Reduced GHG emissions
- Possible investments in community projects: the sales of carbon credits through the Energy Efficiency Obligation scheme generates revenue that can be invested in the community
- Social benefits through empowerment and participation of citizens: for example, in the first Drombane/Upperchurch project an increased willingness of the residents to tackle community issues was noticeable.

Customer Relationships

The service serves households and the community (commercial and public buildings). They are thinking about building a membership model to make the governance model not only community led but also directly citizen led. Currently ECTC is in contact with the households only during the works stage (implementation of renovation measures). During the other stages (see renovation journey) the community energy teams are involved.

Channels

- Website
- Social media (local groups)
- Presentations at community events
- Word of mouth
- Through partners (including contractors)

Customer Segments

- Households: 'regular' & those receiving fuel allowance (eligible for more grant support)
- Communities (community buildings)
- Churches
- Assisted living dwellings
- Commercial businesses

Cost Structure

Given that ECTC is mainly volunteer run the costs are limited. The costs include:
- Wage costs for inhouse project developer
- Cost of drafting the technical application for the grant funding from SEAI
- Cost of recruiting/tendering for Technical Assessors
- Cost of recruiting/tendering for local contractors

Volunteer hours: both the people and board at ECTC and at the local energy teams many people are doing work on a voluntary basis. For example, just the board invests over 240 hours per year (10 board members, with 12 two hour meetings).

Revenue Streams

ECTC is largely a volunteer based and non-profit group. They do have some revenues, with the main source being the sales of Carbon Credits. Household payments and government grants also go through ECTC, but all of these are invested into the renovation works. Recurring:
- Carbon credit sales (revenues go to project manager + investment into community)
- All Grants and payments go through ECTC; The homeowner pays ECTC, ECTC pays for Technical Assessor and the contractor. Once works are complete and validated, we sell the energy savings Carbon credits (White Certs under the EEOS) to an Energy Supplier with which we have agreed a price per kWh.

One off:
- Interreg funding: also used to cover wage costs of project manager
- Start-up funding from local community

The Austrian case

Key Partners

1. Grid operators for data provision
2. local institution (f.e. officials of municipalities) for promotion

Key Activities

- Electricity purchase or generation for end-customers
- Stay on top of recent developments and react accordingly
- Continuously develop sophisticated billing mechanism (f.e. by developing ex-post electricity allocation algorithms)
- Regular training of employees – fast changes in the field of ECs

Key Resources

Personnel resources:
- Experts in the field of Ecs, the modelling of Ecs as well as regulatory background
- Software developers
- Important: especially own personnel for Ecs to speed administrative processes

Value Propositions

Combination of offers:
- Ec planning
- Purchasing surplus electricity
- Providing missing electricity for total load coverage (f.e. special offers for only "green" electricity)
- Standing billing
- Sophisticated billing processes using an ex-post electricity allocation algorithm

Combination of offers smaller costs than individual services, minimized organizational effort due to a single point of contact

Customer Relationships

- EC "hotline" for immediate questions
- Regular information of newly developed possibilities (f.e. billing options)

Channels

- Own website
- Listing a website of the "Austrian coordination center for ECs"

Customer Segments

- Energy communities
- Private persons
- Small/medium enterprises

Cost Structure

- Personnel costs for Ecs experts
- Costs for software developers and software development
- Continuous costs for further developing software

Revenue Streams

- One-time payments for planning per EC (energy supplier can use the same tool for planning different Ecs in the tool is well-developed (modular development)
- Regular payments for providing residual electricity for load coverage (in case requested by the EC: entirely green electricity possible- higher revenue stream)
- Revenues for selling excess electricity of the EC including flexibility options
- Regular payments for taking care of the billing process; increased revenues in case billing processes with additional individuality is requested (applying ex-post electricity allocation algorithm)

Third party owned business model

Key Partners

- Producers of PV system
- Wholesalers of PV system
- Companies of installation and maintenance
- Banks
- Insurance companies
- Grid companies

Key Activities

- Operation and maintenance
- Lease construction and PPA
- Marketing activities

Key Resources

- Market resources
- Professional staffs
- Technical resources

Value Propositions

- No high upfront costs
- No operation and maintenance
- Green energy at a lower price
- Reduced technical risks
- Environmental protection

Customer Relationships

- Direct interactions
- Online contact forms
- Long-term relationships

Channels

- Salesman
- Advertising
- Online and offline promotion

Customer Segments

- Industrial and commercial enterprises
- Urban residents
- Township residents
- Farmers

Cost Structure

- Construction of PV system
- Marketing costs
- PPA and lease construction management costs
- Repairs and maintenance

Revenue Streams

- PPA
- PV system lease
- Central government subsidies
- Local government subsidies

Energy management contract business model

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
• Producers of PV system • Wholesaler of PV system • Banks and other financial institutions • Design, construction, insurance and bonding companies • Grid companies • Governments	• Project management • PV system installation • PV system operation and maintenance • Management of partnerships with users	• No upfront costs • No financial and operational risks • Reduced costs • Environmental protection	• Direct interactions • Online contact forms	• Industrial and commercial enterprises • Industrial parks • Schools, hospitals and hotels
	Key Resources • Existing customers • Banks and other financial institutions • Cooperation with design, construction, bonding and insurance companies		**Channels** • Salesman • Conference or talks • Promotion provided by the government • Online and offline promotion	

Cost Structure	Revenue Streams
• Construction • Operation management costs • Disposal	• Sales of electricity • Excess power sold to the grid • Government subsidies • Tax incentives

Host-owned business model

Key Partners

- Producers of PV system
- Wholesalers of PV system
- Banks
- Grid companies

Key Activities

- One-stop services
- Sales of PV system
- Installation of PV system
- After-sales services
- Repairs and maintenance

Key Resources

- Local market resources
- Professional staffs
- Brand image and reputation
- Technical resources

Value Propositions

- Flexibility
- Reduced electricity bills
- Benefit from feed-in tariffs
- Government subsidies
- Environmental protection

Customer Relationships

- Direct interactions
- Online contact forms

Channels

- Salesman
- Housing fairs and home exhibitions
- Ground promotions

Customer Segments

- High-income families
- Environmental ists
- Small and medium-sized enterprises
- Farmers

Cost Structure

- Sales costs
- Installation, repairs and maintenance
- Wages
- Inventory holding warehousing costs

Revenue Streams

- Sales of PV system
- After-sales services
- Installation, repairs and maintenance

ANNEX B: Alignment with the Sustainable Development Goals

When carrying out a project or research, it is essential to take into account the environmental impact involved and the sustainability benefits that will be generated.

Through the implementation of energy communities, one of the Sustainable Development Goals that can benefit is SDG 7 (**affordable and clean energy**), since this generally involves the production and use of renewable energy, thus achieving greater energy efficiency and environmental protection.

On the other hand, SDG 9 (**industry, innovation and infrastructure**) will also be positively affected because the installation of energy communities often involves innovations in energy infrastructure and the adoption of cleaner technologies, contributing to sustainable development in the field of energy.

In addition, another of the Sustainable Development Goals that is favored is SDG 11 (sustainable cities and communities). This is because, by facilitating local energy generation and management, energy communities can contribute to the creation of more sustainable and energy resilient communities. SDG 13 (**climate action**) is also favored since the adoption of renewable energy sources and the reduction of greenhouse gas emissions in energy communities contribute directly to mitigating climate change.

Figure 2: Sustainable development goals