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MASTER'S DEGREE IN BUSINESS ADMINISTRATION

END-OF-MASTER'S WORK

BUSINESS MODEL FOR ENERGY COMMUNITIES

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1.1 INTRODUCTION

The figure of the so-called energy communities is still to be developed in the Spanish regulation, but it could mean a revolution in the current Spanish electricity system by facilitating the participation and inclusion of citizens in an active way.

In this way, the role of citizens in the energy transition could become much more important than it has been so far, increasing their awareness of sustainability and contributing to their energy independence.

Its aim is to increase citizen participation and energy efficiency, as well as to create a sustainable environment. They can be formed with different structures, e.g. among neighbors themselves, with other communities, even with external local entities.

Among the main activities of a local energy community are:

- Generate energy from renewable energy sources.
- Providing energy efficiency services.
- Produce, supply, consume, store and potentially distribute clean energy.
- Providing electric mobility or other energy services.

Energy communities have a big focus on rural environments. Laws being developed around energy communities in Spain show how it is a rural focused tool to make energy transition possible in rural areas that don't receive as much resources. [1]

Its impact on the rural environment will include contributing to climate change, energy poverty reduction and social improvements in the community. They can become a relevant figure in the rural environment, also because of their ability to address the demographic challenge: they not only stimulate local activity and generate employment, but also reduce the energy bill and promote renewable generation, helping to generate clean and competitive environments and, thus, fix population.

1.2 WHAT IS AN ENERGY COMMUNITY?

According to the Institute for Energy Diversification and Saving (IDAE), an energy community is a legal entity made up of members who may be individuals, other associations, small and medium-sized enterprises (SMEs) or even public administrations. This society, in a cooperative manner, establishes a series of objectives to obtain energy for itself, a community or third party beneficiaries. Its main objective will be to offer energy benefits, from which environmental, economic and social benefits are derived.

The concept of energy community was first introduced in the European framework [2,3]. Later, the Spanish legislation [4] also includes the definition of renewable energy communities in a partial way, without including a legal or financial development. The following sections will focus on looking at these concepts and analyzing what they imply, defining what can and cannot be done.

1.3 CONCEPTS OF ENERGY COMMUNITIES

1.3.1 CONCEPT AND INTRODUCTION IN THE EUROPEAN COMMUNITY

The first energy community concept is included in Directive (EU) 2008/2001 of the European Parliament and of the Council of 11 December 2018 [5] on the promotion of the use of energy from renewable sources, and reads as follows:

- "Renewable Energy Community (REC)" a legal entity:
    a. That, in accordance with applicable national law, is based on open and voluntary participation, is autonomous and is effectively made up of partners or members that are located in the vicinity of the renewable energy projects owned and developed by that legal entity;

   b. whose partners or members are individuals, SMEs or local authorities, including municipalities;
   c. whose primary purpose is to provide environmental, economic or social benefits to its partners or members or to the local areas where it operates, rather than financial gain.

Shortly thereafter, in Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 [3,7] concerning common rules for the internal market in electricity and amending Directive 2012/27/EU, a new concept of energy community is defined.

- "Citizen Energy Community (CCE)": a legal entity that:
   a. is based on voluntary and open participation, with effective control exercised by partners or members who are individuals, local authorities, including municipalities, or small companies,
   b. whose primary objective is to provide environmental, economic or social benefits to its members or partners or to the locality in which it operates, rather than to generate a financial return, and
   c. is involved in the generation, including from renewable sources, distribution, supply, consumption, aggregation, storage of energy, provision of energy efficiency services or, provision of electric vehicle charging services or other energy services to its members or partners;

Even with all the rules established by the EU, the directives [3,7] are still only ways to follow, leaving incomplete definitions, giving much room to adapt the communities to the needs of each member country, which will have to establish national laws for the correct development of these projects.

While this leaves a lot of room for innovation, it also allows concepts to be used inappropriately, forgetting the ultimate goal (community development, ending energy poverty, etc.).

1.3.2 CONCEPT AND INTRODUCTION IN SPANISH LEGISLATION

Spain, is far behind many countries in Europe. The following article from "Compile" [8] describes how the legislation around energy communities has developed in EU countries. Many countries included legislation for them before 2018. Meanwhile, Spain included the figure of renewable energy communities in June 2020, in Royal Decree Law 23/2020. However, their definition was only partially included in the Spanish legislation, without entering into a legal or financial development

Although nothing has been approved for the moment, last April 20, 2023, a first draft royal decree (Draft Royal Decree developing the figures of renewable energy communities and citizen energy communities [9])was presented to properly develop the figures of renewable energy communities and citizen energy communities in the Spanish legislation.

Despite the fact that the law in force until this draft did not provide any advantage to an energy community project compared to any collective self-consumption community), this draft royal decree does provide them (self-consumption is further developed in chapter 4. as it will be one of the main advantages of energy communities).

The following points are the main advantages the new draft assures:

- Criteria of proximity for the project:

Collective self-consumption only establishes a maximum of 2000 meters to be able to belong to a self-consumption project. While with the new draft decree law of renewable communities, three new proximity criteria are established:

1- Municipalities of up to 5000 inhabitants: may belong to people who own real estate, have their habitual residence or are owners of a supply point in the municipality where the project is developed and directly adjacent municipalities (provided they do not exceed 50,000 inhabitants).

2- Municipalities with between 5,000 and 50,000 inhabitants: people who own real estate, have their usual residence or own a supply point in the municipality where the project is being developed may belong.
3- Municipalities with more than 50,000 inhabitants: may belong to persons who own real estate and have their habitual residence or are owners of a supply point within a radius of 5 km around.

In this way the Spanish government has one main objective in mind, which is to provide clean and more affordable energy to a more rural Spain. Therefore, very favorable measures in terms of proximity are provided for those municipalities that are especially small, so that it can make sense to consider a renewable community project.

- Possibility of exercising collective self-consumption as a means of economic benefit: It is necessary to mention that the communities can act as representatives of the consumers to carry out collective self-consumption.
- Apart from these two previous points, the aforementioned environmental, social, etc. benefits are maintained.

1.4 WHAT CHARACTERISTICS DIFFERENTIATE ENERGY COMMUNITIES?

Energy communities are designed to encourage the active participation of citizens in the energy transition process that is taking place, so much that any eligible natural or legal person may join. In addition, they must meet the criteria of eligibility and effective control, where directives stipulate that such control must be exercised by citizens, SMEs or local authorities. The following differ energy communities from other traditional actors:

1. Autonomy and independence: project members (citizens, micro/small/medium enterprises or local authorities) participate and exercise strategic control and direction of the energy community.

The company is controlled by the members or shareholders who participate as end users; external investors or companies that participate in the community are not in a position of control within the board.

2. Governance: internal decision making is based on democratic governance, ensuring that the "autonomy" of the community is maintained, with the model of 1 member equals 1 vote being widespread.
   In addition, energy communities lend themselves to public-private-citizen collaborations, a governance model that is still underdeveloped in Spain.
3. Purpose: To provide environmental and socioeconomic benefits and services to community project members and the local area. At all times, the feeling of concern for the community prevails, leaving profit-making purposes in the background.

1.5 CHALLENGES FACING ENERGY COMMUNITIES

The successful participation of citizens in energy communities is subject to a number of challenges, some of which are identified in this section. These challenges are social, economic, legal and administrative.

1. Social awareness. Citizen participation in these projects is fundamental, and the transformation from passive consumer to active subject in the energy supply process is presented as one of the main problems. To this end, it is essential to generate trust, since in this case the local and citizen component plays the most important role.
   To generate this trust, efficient and effective communication is very necessary.
2. Regulatory and legal challenges. Approve a legal framework without legal loopholes or contradictions, which is coherent. As with any innovation, in these early stages we are faced with an incomplete regulatory development, but necessary for a normal implementation. A good way of facing this challenge was to draft the new project which establishes a defined regulatory environment to freely develop energy communities. However, it is yet to be approved.
3. Activation of private financing, closely related to the lack of consistent regulations. The lack of a legal definition for the figure of energy communities in the Spanish

regulatory framework is a major risk, as their powers, capacities and responsibilities are not legally recognized.

4. Achieve economic benefits in addition to social benefits, such as local jobs or combating energy poverty.

1.6 ADVANTAGES OF ENERGY COMMUNITIES.

This section will present the main advantages of energy communities, how they can help society and the environment.

1.6.1 ENERGIZING RURAL SPAIN

The most rural Spain has more problems of access to clean and affordable energy through collective self-consumption since dwellings are usually more distant and the law does not allow a big distance from the consumption point.

However, the new draft decree law defines a regulatory framework whose main objective is focused on providing all possible advantages so that renewable energy communities can have a real impact in these areas.

Particularly attractive in this regard are the advantages of proximity provided by the new draft regulation. More isolated municipalities that may be dedicated to agriculture or livestock will be able to be part of common projects without a maximum distance between different members that would make the project impossible.

1.6.2 ABANDONMENT OF FOSSIL FUELS.

Energy communities actively contribute to the reduction of carbon emissions by replacing fossil fuels with clean energy.

According to Rescoop [10] (European federation of renewable energy cooperatives), half of all European citizens could be producing their own electricity by 2050, which would satisfy 45% of energy demand in the EU.

1.6.3 CONTRIBUTE TO INVESTMENTS IN CLEAN ENERGY.

Energy transition projects involving clean energy are cost-effective and don't involve a huge investment [11]. One individual installation for a single dwelling can be an investment of 5000 – 8000 € while meaning between 500 – 900 € in savings [11].

Many people would be able to invest in these projects instead of putting their savings in the bank to improve their own community, directing their money to sustainable solutions and improving their economy in the long run.

1.6.4 AWARENESS AND GENERAL SUPPORT FOR RENEWABLES.

In general, people trust projects more when they can get involved. So when large renewable energy projects emerge, they may find that local people are a major obstacle to the project. However, in energy communities, people are personally involved, so they are more likely to value the benefits and overlook the negatives. This not only contributes to community projects, but also to the acceptance of renewable energies.

1.6.5 ADDRESSING ENERGY POVERTY

One of the great advantages of energy communities is the reduction in the cost of the electricity tariff. With the funding support provided to these projects (to be discussed later), new communities can be created in areas of energy poverty and provide their members with a reduction in the tariff.

At the same time, when communities have control over the means to generate their own energy, they have greater control over costs and therefore have no reason to overcharge their members and do not demand higher prices, as the big utilities do.

1.6.6 SUPPORT OF LOCAL ECONOMIES

Although energy projects developed by external agents bring benefits to a community, community energy projects bring between 2 and 8 times more local profits than the latter

[10]. In addition, they also create jobs and can create local energy markets for non-members at a fair and stable price.

Capítulo 2. OWNERSHIP MODELS AND TYPES OF ENERGY COMMUNITIES IN SPAIN

In terms of ownership structure, the ownership structure of energy communities varies, and includes different legal forms, such as associations, cooperatives, community trusts and foundations, limited liability companies, non-profit companies, homeowners' associations or public companies.

Different collaborations between this entities can bring benefits to the community, therefore it is important to establish the different models and identify which is the most appropriate in each case.

There are four main models, which will be discussed below:

- Cooperative model - community-owned social enterprise.
- Mixed community - local public administration model.
- Mixed community-private enterprise model.
- Public-private-citizen collaborations.

2.1.1 COOPERATIVE MODEL

In the cooperative model, the community is owned by a social enterprise. Cooperatives are governed according to the system of 1 vote per member, they are voluntary and democratic.

This cooperation may entail difficulties in raising sufficient capital without any assistance, although right now part of the budget of the recovery, transformation and resilience plan is associated with this type of initiative. [15]

Lack of technical knowledge and familiarity with renewable energy can also be problematic, as it could lead to sub-optimal decision making for the community.

2.1.2 HYBRID COMMUNITY/LOCAL GOVERNMENT MODEL

When it comes to acquiring permits, planning support or the use of public land, collaboration with local authorities can be of great help and can help make the process much faster.

They can also become a good alliance by helping to reduce the risk of initial investment in projects, or by helping to secure grants or other external funding offers.

However, the local authorities' understanding of the energy communities will not be the same, and the partnership may not be as beneficial depending on the locality.

2.1.3 HYBRID MODEL COMMUNITY/PRIVATE ENTITY

Communities benefit greatly from the skills and investment capital that private entities can bring to the table. It is also easier to implement a larger scale facility, which always has more potential for returns. However, the difference in knowledge can result in a barrier in communication.

2.1.4 PUBLIC-PRIVATE-CITIZEN COLLABORATIONS.

The benefits and tasks of each are explained below:

The public sector must facilitate and promote the creation of communities as much as possible. In the first place, they must be the first to generate interest in citizens, to generate awareness of what these projects can contribute. They must also ensure a complete legal framework, which at the moment does not exist and generates a lot of insecurity when it comes to participating in projects. They must also make available to citizens all the necessary financial and legal means so that there are as few obstacles as possible.

The private sector is responsible for providing technological solutions, being in charge of the design and implementation processes. They are expected to integrate citizens into the decision-making process and to engage in the energy transition. While there is no problem with the private sector participating on a for-profit basis, their participation should never be detrimental to the common good.

Citizens are expected to take the initiative. Among the main objectives of the energy communities is citizen participation in the energy transition process, which is impossible without their own initiative. They must be the ones to turn to the public and private sectors for help, offers and advice. Once the creation of the project has been promoted, they are expected to actively participate in the decision making of the energy community and in the energy transition.

2.2 MOST COMMON TYPES OF ENERGY COMMUNITIES

As previously mentioned, associations, cooperatives or companies can be established between individuals, companies, institutions, public administrations or all of them together, as long as they belong to the same locality. Among the most common types of energy communities are:

1. Those made up of users connected to a common low voltage network. Either in a community of neighbors or in a remote locality with low population density and with difficulties to connect to the conventional network.
2. Those established for properties in horizontal property.
3. Clusters of public facilities, developed by regional or municipal public administrations and institutions.
4. Existing communities in various productive areas. In particular, from the primary sector, such as irrigation communities, agricultural and wine cooperatives gathered around shared self-consumption projects.

Looking at the most common types of energy communities in Spain, one can see the great importance they can have in a rural environment, both for individuals and for cooperatives in the primary sector.

Capítulo 3. ENERGY COMMUNITIES TODAY

Europe is a pioneer in the field of energy cooperatives compared to other developed countries. Although with much development still to come, European directives promote the promotion of these initiatives, as do independent associations, both at European and national level.

The most prominent organization at the European level is REScoop, the European Federation of Renewable Energy Cooperatives. It is responsible for providing financial and regulatory support for energy cooperatives, and already encompasses around 1,500 active associations (more than 1 million members in 12 European states) [12].

3.1 ENERGY COMMUNITIES IN RURAL SPAIN

The characteristics of unpopulated areas (size, price of land, easy access to sun and wind) make them ideal to develop renewable energy projects. In particular, wind energy and solar photovoltaic energy are gaining weight in these areas because of its economical benefits.

The Energy Communities that are being formed in rural areas are managing to reduce their electricity bills by 50% [13], thorugh the generation of their own energy and becoming largely independent of traditional marketers and distributors.

3.2 SAPIENS ENERGÍA – AN EXAMPLE OF AN ENERGY COMMUNITY IN RURAL SPAIN.

The energy community of Albalat dels Sorells has its first two facilities: on the roof of the AlternaCoop eCoworking and in a warehouse of the Agricultural Cooperative Santos de la Piedra.

AlternaCoop's was the first solar rooftop of a local energy community in the Valencian Community. It has 68.85 kWp of installed power and 23 kWp of storage, with a lithium battery. It allows supplying renewable energy to more than 60 homes, several companies and public buildings. A part of it will be destined to families of the municipality in a situation of energy poverty [14].

The CEL of Albalat is promoted by Sapiens Energía -a renewable energy energy community constituted as a cooperative-, AlternaCoop -a cooperative that works to promote shared mobility- and the town council, with the collaboration of the Agricultural Cooperative Santos de la Piedra.

The two solar roofs have received grants from the Valencian Institute of Business Competitiveness (Ivace), under the Department of Sustainable Economy and Productive Sectors of the Generalitat Valenciana, through the 'Energy Communities Program of the Valencian Community in 2020'. In the case of the one located in AlternaCoop, the aid is 52,674.05 and in the case of the Agricultural Cooperative, 36,773.75 euros.

This project is part of the 'Albalat 0.0 Strategy', which seeks to consolidate the town as a benchmark in sustainability in the Valencian Community, eliminating emissions into the atmosphere. It includes other types of measures, focused on areas such as waste management, the promotion of sustainable mobility -with electric and shared vehicles- or the IBI rebate for homes and businesses that opt for individual photovoltaic installations.

The second photovoltaic generation infrastructure of the Local Energy Community of Albalat dels Sorells has an installed capacity of 53.46 kWp. It is built in collaboration with the Agricultural Cooperative Los Santos de la Piedra. It will supply 15 small companies in the Albalat industrial park.

This project is just an example of the advantages that energy communities can bring to a cooperative. In this case it is a public – private cooperation that was able to achieve investment incentives and aid of the local government in order to help 15 SMEs reduce drastically its power bill.

With the new normative the government is looking to help rural Spanish households, agricultural or livestock SMEs, etc by taking advantage of this cooperations and making energy transition available in remote zones.

Capítulo 4. COLLECTIVE SELF-CONSUMPTION IN SPAIN

4.1 WHAT IS SELF-CONSUMPTION?

One of the key advantages that come with energy communities is self – consumption, due to its economic benefits. Therefore, it is important to establish what exactly involves self-consumption and what different modalities exist:

Self-consumption of electricity occurs when individuals or companies consume energy from production facilities close to and associated with their consumption, such as photovoltaic panels or mini-wind generators. In addition to helping to curb climate change by using renewable energies and those already mentioned, this type of consumption has other advantages for both consumers and society.

We can call a group of neighbors or companies a Solar Community if we want, but the best name, in order not to confuse us is Collective Self-consumption Communities. It must be clear that no special entity is constituted among the participants, only all of them are covered by the existing legislation of Self-consumption.

Energy communities, although they comprise a special entity among the participants, can also benefit from the existing self-consumption legislation, that is to say, they can create an energy community through collective self-consumption. To do so, they will simply have to comply with the requirements for self-consumption communities.

Any participant wishing to participate in a shared solar panel installation must meet the following requirements:

1. They must be connected to the same transformer station and the power distribution must be in Low Voltage (LV).
2. The maximum distance between the photovoltaic plant and each of the participants must be a maximum of 500 meters.
3. The production system and the participants of the shared self-consumption installation must be registered in the same cadastral reference.

4.2 TYPES OF SELF-CONSUMPTION

4.2.1 SELF-CONSUMPTION WITHOUT SURPLUS

Modality of supply with self-consumption without surplus. Corresponds to the modalities defined in article 9.1.a) of Law 24/2013, of December 26. In these modalities, an anti-spill mechanism must be installed to prevent the injection of surplus energy into the transmission or distribution grid. In this case there will be only one type of subject of those provided for in article 6 of Law 24/2013, of December 26, which will be the consumer subject.

4.2.2 SELF-CONSUMPTION WITH SURPLUS

Supply modality with self-consumption with surplus. Corresponds to the modalities defined in article 9.1.b) of Law 24/2013, of December 26[16]. In these modalities, the production facilities close to and associated with the consumption facilities may, in addition to supplying energy for self-consumption, inject surplus energy into the transmission and distribution networks. In these cases there will be two types of subjects of those provided for in Article 6 of Law 24/2013, of December 26, which will be the consumer subject and the producer.

4.2.2.1 Self-consumption with surplus subject to compensation

Surplus supply with surpluses under compensation: Those cases of supply with self-consumption with surpluses in which the consumer and the producer voluntarily choose to take advantage of a surplus compensation mechanism will belong to this modality. This option will only be possible in those cases in which all the following conditions are met:

1. The primary energy source is of renewable origin.
2. The total power of the associated production facilities does not exceed 100 kW.
3. If it is necessary to enter into a supply contract for auxiliary production services, the consumer has entered into a single supply contract for associated consumption and for auxiliary production consumption with a marketing company, in accordance with the provisions of article 9.2 of the Royal Decree.
4. The consumer and associated producer have signed a self-consumption surplus compensation contract as defined in article 14 of the Royal Decree.
5. The production facility has not been granted an additional or specific remuneration regime.

4.2.2.2 Self-consumption with surplus not subject to compensation-.

All those cases of self-consumption with surpluses that do not meet any of the requirements to belong to the modality with surpluses under compensation, or that voluntarily opt out of this modality, belong to this modality.

4.3 SELF-CONSUMPTION IN AN ENERGY COMMUNITY

Once you are familiar with the different types of self-consumption, it is necessary to choose one that best suits what you are looking for with an energy community.

The purpose of generating a self-consumption energy community is to bring together a considerable number of neighbors/members and thus lower the costs of forming a generation station and reduce the investment risk (among other reasons).

As a community involves a considerable number of members, it would not make any sense to take advantage of the self-consumption with surplus with compensation, as it has a limit on the size of the plant.

It is also not efficient to use self-consumption without surplus, since in this case the use of batteries is not taken into account, and a great deal of profit would be lost during peak production hours when there would be excess energy that would have to be disposed of.

The last option, which is best suited to the situation, is collective self-consumption with surpluses that are not subject to compensation. This modality does not have a total production power limit that will limit the size of the energy community. The excess energy, in this case, will be sold at pool price.

4.4 SAVINGS ASSOCIATED WITH COLLECTIVE SELF-CONSUMPTION WITH SURPLUSES WITHOUT COMPENSATION

To make the associated savings more understandable, a prior explanation of the different charges that make up the total electricity price to the consumer is necessary.

4.4.1 SAVINGS DETAIL

The main source of savings comes from the consumption of self-generated energy and the energy to be injected into the grid in those periods when there are surpluses. The surpluses are fed into the grid and the price set in the electricity market is obtained for this energy.

In addition to these two savings, there is also a discount on network access charges. These charges reflect a toll for accessing the grid and for the distribution of electricity. The reduced toll applies only to self-consumption of energy (kWh), in the event that self-consumers must reclaim energy from the grid, standard tolls will be applied. In the case of the tolls applied to the contracted power (kW), they remain the same.

Marketing margins and electricity system charges are also the same, as well as the taxes applied (both VAT and electricity tax).

Two models are presented below, the first one will refer to what an energy community can offer to all potential participants, while the second one will focus on the business model that a private company can take advantage of in a lucrative way, taking advantage of the savings offered by self-consumption within a community.

Capítulo 5. BUSINESS MODEL OF AN EC FROM A PRIVATE COMPANY POV

This business model focuses on a possible proposal of how a private company can take part in the energy communities in a profitable way, even though the idea of the communities is not this in the face of the members.

The main idea is the total financing of the community by the private company, which will recover its initial investment by receiving an economic compensation for the self-consumed energy (at SPOT price) and the surplus energy sold.

Knowing how self-consumption works and its associated savings, it is known that despite having to compensate this energy there will continue to be savings. When the investment is fully compensated, the private company will continue to receive part of the compensation for this self-consumed energy as interest for the risk initially taken in financing the community.

The facility will be owned by the community as stated for all ECs but the community will have these duties to the financing company.

To understand the model in depth, the explanation will be based on a canvas model.

5.1 VALUE CONTRIBUTED

Within the value provided by the company and received by the members of the community, there are two main points.

The first is financing. In the model presented, the private company will be the one to take all the risk in the investment, so that the members of the community will not have any possible initial detriment. This makes it a very attractive project, because although the installation will not provide all the savings that it would have if the members were the ones taking the risk, they will still have an economic benefit in exchange for no risk.

Secondly, there is the savings on the tariff. Community members receive in exchange for no initial investment cost a reduction in their electricity cost. Although they must initially compensate the private company for the energy self-consumed and sold to the grid, this price will be the SPOT price instead of the total price, and will be exempt from tolls and charges. In addition, when the time comes to compensate the investment, they will only have to compensate part of the self-consumed energy and will obtain the benefit of the energy injected into the grid.

More value contributed by the energy community itself include:

1. Environmental benefits due to renewable energy generation.
2. Social advancement, as consumers are no longer customers but become owners of the generation assets and shareholders in a cooperative.
3. Risk reduction, by joining a community the risks and costs are shared compared to an individual venture.

5.2 MAIN ACTIVITIES

On the one hand, the main activity of the company will be limited solely to the financing and supervision of the installation of the facilities.

On the other hand, as its own definition indicates, the main activities of the EC include generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, provision of energy efficiency services or the provision of charging services for electric vehicles or other energy services to its members or partners.

5.3 KEY RESOURCES

The essential resource that the private company must have is the availability of capital to finance the photovoltaic installation; it is the main value provided by the company and without it the business model has no place.

Also important are all the resources around how to plan the installation, all the necessary technical knowledge, knowledge about regulation, etc.

The availability of labor for the installation would be very positive as it would lower the initial investment costs. However, this could be provided by the members of the community themselves in order to create economic growth through the creation of new local employments.

Public incentives towards renewable energy generation and the creation of CE. This positive view towards renewable projects can not only help with financing but also push for the establishment of clear legal and regulatory frameworks, which are in themselves another key resource.

5.4 KEY PARTNERS

First, the technology providers. Again, the greatest value provided by the company is the financing of the project. In the case of close relationships with suppliers, the initial investment costs can be greatly reduced, since the purchase volumes are very large and are subject to discounts, which will be more attractive if the relationship with the supplier is close.

In case of not having the manpower within the organization, having partners with qualified and reliable manpower can bring both economic savings and possible mistakes made by unknown companies.

Public entities. The relationship with the public entity is key to make as easy as possible all the process from paperwork to building the installation.

5.5 RELATIONSHIPS, CHANNELS AND CUSTOMER SEGMENTS.

As mentioned above, energy communities can involve associations as well as companies or simply individuals. However, in this model, the key customers targeted are neighborhood communities. Any community of neighbors that has the necessary area to make the installation, whether the roofs of single-family homes or common areas in the case of communities of neighbors, are potential customers.

When the new draft decree law is approved, this will not be limited exclusively to neighbours at less than 2000 meters (which is the collective self-consumption max established) and the possibilities to collaborate with other close municipalities will be a reality that will improve this conditions. At the same time, when making this projects more attractive in the rural spain, land to build said projects will be much more available and affordable and therefore they will gain a lot of value.

5.6 COST STRUCTURE

Most of the costs are concentrated in the initial investment:

1. Initial investment capital in the generation plant itself (construction, purchase and installation).
2. All technical and economic feasibility studies to determine if the plant is feasible.
3. Planning and licensing costs.

And then there would be a series of minor costs that would be reduced to:

4. Maintenance or repair of the plant if necessary
5. the costs of using the public distribution network.
6. Infrastructure operation

There could be another major capital outlay if it is decided to expand or upgrade the plant.

5.7 SOURCES OF INCOME

The only source of income would be all those participating in the community, who will have to return part of the savings generated by the plant until they have fully financed the project. In this sense, two different models will be proposed:

1. Partial return of savings.

The benefit that the owners of the community will have with respect to a case without self-consumption comes from two main sources: savings in tolls, savings in energy costs and the payment of excess energy that is discharged to the grid.

In this case the participants in the community would have to return to the company the equivalent of the self-consumed energy at generator price (not including RE costs, tolls, etc.) and the benefit of the energy fed into the grid. In this way the participants would obtain savings from day one from the tolls they would be avoiding paying while they would be returning the initial investment to the company.

2. Total return of savings

In this case, the aim would be to end the financing repayment period as quickly as possible. It would involve the total return of the savings, i.e., cost of self-consumed energy, payment of excess energy discharged to the grid and payment for the tolls saved.

In this way, the community would get to return the investment of the installation in a much earlier way and reach a situation of maximum savings faster.

Once the initial investment in the plant has been repaid, the community's payment to the company would be limited to the cost of energy at the generator price until the end of the plant's life. These revenues are the ones that would be creating a profit since all the rest of the revenues are destined to supply the financing of the plant.

This second benefit is the same regardless of the initial investment return model.

5.8 CONCLUSION

In this way, the canvas model helps us to establish all the needs and benefits that the energy community can bring. Given the importance of key resources and partners, we can go back and affirm the usefulness of public-private-citizen collaborations.

The public side is key in presenting the opportunity to citizens and facilitating the entire implementation process. On the other hand, the private side is key in providing all the technical and operational expertise needed to make the generating station itself possible. Finally, the members themselves are the key to bringing the project into existence in the first place.

At this point, the only thing left to do is to check the economic viability, confirm that the EC partners will actually recover their investment and make a profit by participating in it. This will be covered in the next chapter.

Capítulo 6. CALCULATION OF THE TARIFF, SIZING OF THE INSTALLATION AND FEASIBILITY OF THE MODEL

6.1 EXPLANATION OF THE ASSUMED CASE

Before calculating the tariff and the savings that a community can make, it is necessary to establish the dimensions of the community and some assumptions of consumption and contracted power.

We will assume a community of 30 single-family dwellings with a contracted power of 3.45 kW and consuming 4500 kWh, which are common values within a 2.0TD tariff. The community will have a common installation whose kW will be defined in the sizing part after calculating the savings in the electricity tariff for each dwelling depending on the size of the installation.

Energy communities might not always include exclusively households, as it has been previously established they could also include public buildings, SMEs, agricultural collectives, etc. However, to establish a base case that will most probably be the most common and one that we have real data of, we will include in this calculations exclusively 30 dwellings.

The calculation procedure for the fixed and variable terms is explained below:

6.2 FIXED TERM

The fixed term of the bill will depend on the contracted power, which as mentioned above is 3.45kW, and is independent of whether or not we have self-consumption.

It consists of a charge for the contracted company's marketing margin and a charge associated with the access and distribution toll and charges.

6.3 VARIABLE TERM. CALCULATION PROCEDURE.

To calculate the variable term, it is first necessary to obtain two sets of data: the energy produced by solar technologies and the energy consumed by each single-family home. With these data we will be able to know the production that the installation will have (depending on its size) in each hourly segment and thus know what part of that generation will be self-consumed, what part will be sold and how much energy from the grid would be necessary.

In addition, it will also be necessary to know the energy prices. On the one hand it is necessary to know the pool price (DAILY SPOT MARKET PRICE [17]) and it is also necessary to know the final price with the sum of components (FINAL HOURLY AVERAGE PRICE SUM OF COMPONENTS [18]).

The first of these will be the price at which surplus energy is sold (if any) and which will also be the price at which the company will charge for the energy to recover its initial investment. The second is the purchase price of energy from the grid, to which must be added the distribution charges and tolls mentioned above.

6.3.1 DATA

6.3.1.1 Energy produced by solar technologies

The data provided by the Spanish system operator (Red Eléctrica España) on total solar generation in MWh, segmented by hours (since the tariff terms depend on the time of day).

These data provide the solar generation generated per MW of photovoltaic installation over a year, which we will assume will be the same in our future case. We have taken the data for the whole peninsula since we do not know where exactly the installation will be located.

6.3.1.2 Energy consumed per single-family dwelling

As in the previous case, the data provided by the Spanish system operator is used. In this case the data is a percentage of the energy consumed throughout the year (also by hours). These data, when multiplied by the average annual consumption of a single-family dwelling (which we assume to be 4500 kWh), give us the hourly consumption (CONSUMPTION PROFILES FOR BILLING PPSC TARIFF 2.0TD[19]).

It should only be noted that these data must be normalized since their sum is not exactly 100%.

6.3.2 VARIABLE TERM CALCULATIONS

Two cases must be distinguished:

In the first case, the energy generated by photovoltaic technology is greater than the energy consumed. In this case, since self-consumed energy is exempt from charges and tolls, the variable term will be negative and will correspond to the energy injected into the grid. The calculation will be as follows:

$$Surplus\ profit = SPOT\ Price * Surplus\ Energy$$

Being,

$$Surplus\ Energy = Produced\ Solar\ Energy - Consumed\ Energy$$

And the Spot price, solar energy produced and consumed, data explained above.

In the second case, more energy is consumed than is generated. To calculate this cost, the total price per kWh in that hour will be calculated and multiplied by the extra energy to be consumed from the grid:

$$Cost\ of\ Energy = (Final\ price + Charges + Transmission\ \&distribution\ Tolls) * grid\ comsumption$$

Knowing the surplus profit and the grid energy cost for each hour, we obtain the total cost of the variable term throughout the year.

In the case of the calculations of the assumed tariff without community (without photovoltaic installation) there would only be the cost of energy from the grid.

6.3.3 TAXES

Once the variable term and the fixed term are known, it only remains to apply the electricity taxes (5.11%) and VAT (21%) to obtain the total cost of the annual electricity tariff.

6.4 TOTAL SAVINGS

Knowing the cost of an electricity tariff belonging to a community and not belonging to it, the calculation of the total savings would be simple:

$$Savings = \frac{Cost\ of\ tariff\ \text{w/o}\ community - Cost\ of\ tariff\ w/\ community}{Cost\ of\ tariff\ w/o\ community}$$

For this assumption, and using the code included in the annex, the following results are obtained for costs per member, for a community of 30 members, with a 60 kW installation, and the cost it would have without it.

Total fixed (€)	133,48	133,48
Total variable (€)	781,25	394,07
Total price (€)	914,73	527,55
Total savings (€)	387,18	
Savings in %	42%	

However, not all of the savings will be obtained by the community members. As stated in the model, part of these savings will be returned to the company in order to finance the plant. As calculated in the appendix (excel 1):

Self – consumed energy value (€)	199,92
Surplus energy (€)	67,02

Therefore, out of the total 387,2 € of total savings, the value of the self consumed energy and surplus energy sent into the grid are given back to finance the project.

All in all:

$$Total\ savings = Savings - self\ consumed\ energy - surplus\ energy$$

$$Total\ savings = 387{,}18 - 199{,}92 - 67{,}02 = 120{,}96€$$

And the returned value:

$$Returned\ value = self\ consumed\ enery + surplus\ energy = 199{,}92 + 67{,}02 = 266{,}12€$$

Which adds up to an 8010 € for the whole community through each year.

This saving will always tend to grow as the size of the installation increases, since the larger the installation, the more energy it will generate for sale. However, we are not taking into account an initial investment in the plant, so the savings by themselves are not useful for sizing, which is developed in the next section.

6.5 SIZING

Since the more kW of generation installed, the higher the savings, the higher the associated investment, another way must be found to find a suitable sizing for the plant.

For this, the energy consumed from the plant will be used. As the size of the plant increases, the amount of self-consumed energy per extra kWh decreases. Therefore, you want to find a point where the savings are already noticeable and where this increase in self-consumption is in check. You want as much self-consumed energy as possible (since, from the company's point of view, it will serve to recover the investment) without forgetting the initial investment costs.

For this, through the code included in the annex, the values of self-consumed energy for plants from 30 to 100 kW (for the 30 members of the community as a whole) have been calculated, and obtained:

	Total kW installed							
	30	40	50	60	70	80	90	100
Self-consumed energy	1272,999	1592,893	1776,518	1896,506	1983,146	2045,729	2092,299	2128,526
Value of self-consumed energy	133,2109	166,8656	186,3981	199,9219	209,9342	217,3308	222,9334	227,3822

As mentioned above, at the beginning the increase in self-consumed energy is very high (more than 300 kWh between 30 and 40), a value that decreases as the plant grows. Since a balance is sought between investment and self-consumed energy, plants of between 50 and 60 kW installed would be chosen, since it is at this point that this increase begins to decrease more noticeably.

It is not an optimization, so there is no exact value that is a solution, the larger the plant the higher the return but also the risk. Since the aim is to maximize the energy consumed and minimize the risk, these are the most reasonable values.

6.6 FEASIBILITY OF THE MODEL

Once all the values have been calculated, it only remains to determine whether the investment in the plant by the private company will be profitable. To do this, it is first necessary to know the CAPEX costs required for a facility of this size.

6.6.1 PLANT COMPONENTS

75% [20] of the price of the components of an installation for a single-family house are associated with the solar panels and the solar inverter. Other costs should also be added, including the support structures, the protection panel and the legalization of the installation and, finally, the labor.

Element	Function	Cost (€)
Solar panels: 	They transform solar energy into electricity.	4 Panels of 460 W 160 - 220 € / panel Total = 720 €.
Solar inverter:	Transforms direct energy into alternating energy in order to consume it	Only 1 per installation is required They are around 1000 €.

		
Structure 	They support the solar panels, providing the inclination and orientation that they should have.	Depending on the roof structure, a different amount will be required. They are around 60 € per panel, counting that there will be structures that will support more than one .
Protection panel 	They protect the system from power surges or adverse weather conditions.	Only 1 is required They are around 130 € .
Legalization of the system	It is essential by law	300
Labor	It is specialized and essential labor	Around 600 - 1200 € .

Thus, the initial investment if all the elements were purchased separately would result:

$$CAPEX\ total = 720 + 1000 + 60 * 4 + 130 + 300 + 900 = 3290€$$

Taking into account that it will be necessary to purchase 120 solar panels and structures, 30 inverters and 30 structures, this initial investment will be much lower, since volume discounts are common and even buying the whole installation together is much cheaper. Thus we assume that at least by making the joint purchase and being a company in the sector that has agreements with suppliers is, at least, reduce this initial investment by 33%, resulting in an investment of:

$$Capex = \frac{2650 * 2}{3} = 2193{,}33€\ per\ dwelling$$

So, taking into account the 30 dwellings:

$$Capex\ total = 30 * 2313 = 65800\ €$$

Once the investment is known, it remains to know the income to be received from the community. As already mentioned in the model, this income is composed of:

- Self-consumed energy at SPOT market price.
- Excess self-consumed energy injected into the grid at the SPOT price.

For this purpose, the code included in the appendix is used again to find the following values of income per single-family dwelling and community:

Self-consumed energy (kWh)	1896,51
Value of self-consumed energy (€)	199,92
Overpayments (€)	67,06
Annual income per dwelling (€)	266,98
Annual income per community (€)	8009,46

Taking into account that the life expectancy of this type of project can be 25 years (the plates can last longer but lose effectiveness), the internal rate of return (IRR, which would make the present value of the project 0) with an initial investment of 65800 € and inflows of 8010 € for 25 years:

$$0 = \frac{\sum_{t=1}^{25} 8010}{(1 + IRR)^{25}} - 65800; IRR = 11\%$$

Knowing that the wacc (the minimum expected return) in renewable projects is very low, and that in photovoltaic projects it does not exceed 7% [21], it can be concluded that the project is profitable.

If we wanted to know the present value of the project, without calculating the wacc and assuming the standard 7%, the present value of the project would be, applying the net present value formula for the 25 years of the project:

$$NPV = -65800 + \sum_{t=1}^{25} \frac{8010}{(1 + 0{,}07)^t} = 25743{,}18 \text{ €}$$

Although not expecting the €8010 in revenues over the life of the project, as specified in the business model, we can still state that the investment and therefore the model is profitable.

Capítulo 7. ALIGNMENT WITH THE ODS

The Sustainable Development Goals (SDGs) are a set of global targets designed to eradicate poverty, protect the planet and ensure global prosperity.

Each of the Sustainable Development Goals has specific targets to be achieved by 2030. It is important for governments, businesses and citizens alike to be aware of these goals in order to help achieve them.

Energy communities are an initiative that aligns with many of these objectives for many of the values it brings. The objective with which it is most in line would be the following:

7.1 AFFORDABLE AND CLEAN ENERGY

One of the most important consequences and fundamental objective of the energy communities is the reduction of energy poverty.

Currently in Spain 15% of households suffer inadequate temperatures or are late in paying their bills, if not both. This means that about 7 million people suffer or may suffer energy poverty. Access to energy is fundamental in today's society and making it affordable is one of the main objectives of energy communities.

In addition, the issue of climate change and the efforts of governments and private companies to reduce their carbon footprint are more than evident. Energy communities could go a long way in this regard by involving not only companies and authorities but also citizens.

7.2 CLIMATE ACTION

In this respect it is also very much in line with the climate action goal. Climate change causes serious problems such as drought and food shortages. It is vital that both governments and citizens take action to combat climate change, as well as the private sector.

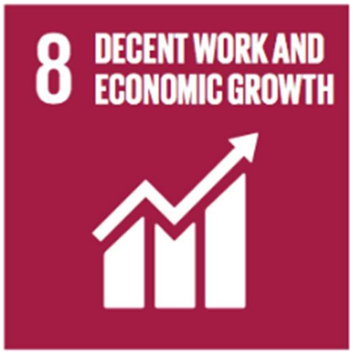
7.3 SUSTAINABLE CITIES AND COMMUNITIES

It is also very much in line with the goal of making cities and towns inclusive, safe, resilient and sustainable. More and more of the population lives in urban areas. So proper planning and energy management of such areas is essential.

7.4 RESPONSIBLE CONSUMPTION AND PRODUCTION

The use of fossil fuels as a source of energy goes against the objective of responsible (sustainable) production and consumption. In a couple of decades, the equivalent of three planets will be needed to maintain the current lifestyle, so it is essential to promote sustainable production and consumption, such as renewable energy.

7.5 DECENT WORK AND ECONOMIC GROWTH



The creation of energy communities also promotes economic growth. Not only does it aim to reduce energy poverty, but it also creates numerous decent jobs linked to the commissioning, maintenance and operation of the plants.

7.6 PARTNERSHIPS FOR THE GOALS

Finally, as we have already seen, in order to maximize the potential of energy communities, collaboration between all types of legal entities, governments, public entities and citizens is necessary.

Energy communities are projects that can become fundamental for the energy transition and to end energy poverty. That is why of the 17 sustainable development goals set by the UN, communities are aligned with up to 6 of them. The enormous benefits they can bring are economic as well as social and environmental.

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