

**LOCAL ENERGY COMMUNITIES LOCATION ASSESSMENT FOR THE MUNICIPALITY OF XXXXX**

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# Introduction

The generation of electrical energy through photovoltaic installations has attracted increasing interest at the municipal level due to several factors, such as the reduction of components costs, the increase in electricity prices and the development of more favourable legislation. These circumstances have led to a decrease in the payback periods of these facilities, making them increasingly attractive.

In this context of promoting renewable energies, the creation of an energy community in the municipality of XXXXX represents a significant opportunity to promote the use of clean and sustainable energies. This report aims to provide a detailed analysis of the municipality's solar potential, in order to facilitate the implementation of an energy community based on the generation of photovoltaic solar energy.

This preliminary study focuses on determining the solar potential and photovoltaic generation capacity of the different urban areas of XXXXX, covering residential, industrial, public services and commercial sectors, in order to develop an energy community in the municipality. To this end, the roofs of buildings within the municipal area have been analysed using advanced tools based on Geographic Information Systems (GIS). These tools allow the evaluation of the main morphological and typological characteristics of the roofs, providing a solid basis to identify the best locations for photovoltaic installations and thus facilitate the creation of a robust and efficient energy community.

The analysis of the different models developed will provide an estimate of the best locations for the installation of photovoltaic production facilities and an approximation of the energy produced by them. This report includes the evaluation of ${NUM\_BUILDINGS} buildings for different uses (all the buildings in the municipality), taking the cadastral parcel as the unit of analysis and which occupies an area of ​​${SURFACE} km2. The necessary information has been obtained from standard geographic databases available from different official organizations. The study is based on the survey of a digital surface model that allows obtaining the three-dimensional morphology and typology of the buildings, with a resolution of 1 meter, which is generated from LIDAR (Light Detection and Ranging) point cloud maps.

# Data Sources

To determine the solar irradiation on the roofs of the municipality of XXXXX, it is necessary to identify the information that will be necessary to carry out this process. In this case, different existing maps from free access geographic and cartographic databases have been used. More specifically, for Spain the data sources used are the following:

* LIDAR point cloud: The point cloud files are essential to carry out the analysis since the digital surface model of the municipality is created from them. In this case, for Spain, the point clouds used correspond to the LIDAR flight of the National Aerial Orthophotography Plan (PNOA) and are provided by the National Geographic Institute (IGN). The files are made up of 2x2 km sheets with an average density of 0.5 points/m2.
* Aerial photographs: To have an aerial view of the municipality analysed we have consulted images from different services such as the PNOA orthophotos available in the IGN. Orthophotos are used as a guide to delineate the study area and conduct a review of buildings during data preparation.
* Distribution of buildings: It is necessary to include in the model a delimitation of the buildings and their location. The General Directorate of Cadastre offers a consultation service with cartographic data in vector format of the rural and urban cadastre. Data such as cadastral references, the delimitation of buildings and the different construction elements present in each parcel are available, as well as public information associated with the cadastral parcels such as the uses of the buildings.

Imagen de parcelas catastrales?

Figura 3. Mapa de parcelas catastrales de XXXXX.

* Administrative limits: The delimitation of the municipality, identification and distribution of urban centres can be consulted in the IGN download centre.

# Analysis of municipality PV potential

## Roof analysis

The different buildings in the municipality have been classified according to their use, there are six types of use that have been grouped into four groups, these are:

* Residential, represents ${PCT\_1} % of the roof surface available in the municipality.
* Industrial, composed of industrial and agricultural use (${PCT\_2} % industrial, ${PCT\_3} % agricultural), represents ${PCT\_4} % of the surface.
* Commercial, composed of shops and offices, represents ${PCT\_5} % of the surface.
* Public services, represents ${PCT\_6} % of the surface.
* Gráfico, Gráfico circular

  Descripción generada automáticamente
* Figura 2. Distribución de las áreas de tejado por tipo de uso de los edificios.

## Surface availability

Once the geographical analysis has been carried out, data related to the ${NTOTAL\_PARCELAS} cadastral parcels belonging to the municipality of XXXXX have been obtained. Of the total cadastral buildings, ${N\_PARCELAS\_NO\_ADECUADAS} buildings are not suitable for the creation of energy communities through the installation of photovoltaic panels on their roofs due to poor orientation, inclination, size or location (shadows), and ${N\_PARCELAS\_ADECUADAS} locations do have an adequate level of solar radiation to establish these local energy communities. Of the total roofs of the municipality, ${PCT\_7} % of the total roof area has morphological and solar potential for the location of community photovoltaic modules. So, these spaces on the roofs of the municipality obtain adequate solar radiation, their inclination adapts to the limitations of photovoltaic technology (roofs with less than 45º slope) and they are not affected by large shadows.

As a summary, we can observe two graphs that describe the overall PV potential of the municipality, these are:

1. The roof areas that are appropriate for installing PV as a function of the use of the building.

Figura 4. Área de tejado apropiada para producción fotovoltaica en función del tipo de uso del edificio.

1. Percentage of appropriate roofs depending on the size of the building area.

Figura 5. Tejados disponibles en función de su superficie y por tipo de uso.

## Solar radiation potential

Within this roof surface available for photovoltaic production, the solar radiation potential of the municipality has been studied. In this study, it has been estimated that the average solar radiation of the suitable areas of the municipality's roofs is **${RADIACION\_SOLAR} kWh/m2**. The distribution of solar radiation between the different buildings can be observed in Figure 6, where most buildings obtain an average solar radiation of their total surface of between ${MIN\_MEDIA\_RS} kWh y ${MAX\_MEDIA\_RS} kWh.

Gráfico, Histograma

Descripción generada automáticamente

Figura 6. Distribución de edificios en función de la radiación solar media por parcela.

The buildings in the municipality have been classified according to the type of use in order to determine the solar potential of the different urban fabrics. More specifically, the average solar radiation according to the use of the buildings studied can be observed in Figure 7.

Figura 7. Radiación solar media según el uso de las parcelas.

## Electrical energy production potential

Considering the solar radiation of all the buildings and their available surface area, the solar radiation potential has been calculated. More specifically, the municipality of XXXXX has an annual photovoltaic production potential of **${POTENCIAL\_PRODUCCION} MWh/year**. However, it can be assumed that only a percentage of the total estimated potential will be installed.

Of the photovoltaic production, it is estimated that 40-60% of the energy will be consumed synchronously (self-consumption), although it is expected that with the progress of the energy transition and the energy empowerment of consumers in the coming years, they will be able to increase their levels of self-consumption by adapting their electricity consumption habits.

Figure 8 shows in detail and by sector the photovoltaic generation potential and the capacity that would have to be installed to achieve said energy production.

Gráfico

Descripción generada automáticamenteFigura 8. Potencial solar de los tejados de XXXXX por tipo de uso.

Analyzing Figure 8, the potential photovoltaic capacity in the entire municipality is **${CAPACIDAD} MWp**. The total number of panels needed to achieve this power would be close to **${TOTAL\_PANELES} units**, assuming photovoltaic modules with a unitary potential of 450 W and an area of ​​2.1 m2 for each module, in accordance with the modules currently installed in residential installations.

# Optimal buildings for the development of an energy community PV installation

This section outlines the optimal buildings identified for the development of a photovoltaic (PV) installation within an energy community. The selection of these buildings was based on several key parameters, including suitable roof area, mean solar radiation, energy production potential, population density or average income in the area selected. These parameters ensure that the chosen buildings are well-suited to maximize the efficiency and benefits of the PV installation for energy communities.

**Criteria for Selection**

1. **Energy Production Potential**: The potential energy output of each building was estimated based on:
   * **Suitable Roof Area**: Buildings with large, unobstructed roof areas maximize the space available for solar panels and the generated energy.
   * **Mean Solar Radiation**: Buildings with high average levels of solar radiation in their roofs can ensure consistent energy production.
   * **PV panels efficiency**: Characteristics of standard PV panels were used to achieve a more precise estimation of the potential.

with higher potential buildings ranked more favourably.

1. **Population Density**: Buildings in areas with higher population density were prioritized to ensure the energy generated meets the needs of a larger community, enhancing the social impact of the installation.
2. **Average Income of the Area**: Buildings located in areas with lower average income were given preference, aiming to provide affordable energy to communities that might benefit most from reduced energy costs.

**Candidate Buildings**

Below is a table presenting the top 10 candidate buildings for the energy community PV installation. Each building's potential has been evaluated based on the criteria mentioned above, providing a comprehensive overview to inform the final selection process.

El listado de las primeras ${N\_TABLA\_PARCELAS} parcelas candidatas a ser comunidades por el criterio de búsqueda y filtrado de la plataforma es el siguiente:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CADASTRAL ID | Current Use | SUITABLE AREA (m2) | Mean Solar Radiation (kWh/m²/year) | Energy Production Potential (MWh/year) | Population density (?) | Average Income (€) |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

The sorting criteria selected for this study through the LEC platform are the following:

1. ${PARAMETRO\_1}
2. ${PARAMETRO\_2}
3. ${PARAMETRO\_3}

The table highlights the significant potential for energy generation across the selected buildings, with additional consideration given to social and economic factors. Buildings located in areas with higher population density and lower average income are prioritized to ensure that the energy produced benefits communities with greater needs. This approach aligns with the goal of creating a sustainable and socially impactful energy community, where the benefits of renewable energy are accessible to all.

The selection of these buildings was conducted using Geographic Information System (GIS) analysis, which allowed for a precise assessment of the physical and demographic characteristics of each candidate location. However, further technical and legal assessments will be required to ensure the final suitability of these buildings for PV installation. These additional evaluations will address factors such as detailed structural analyses, compliance with local regulations, and the potential for integration with existing infrastructure.

A picture containing graphics, font, logo, symbol

Description automatically generatedA picture containing graphics, graphic design, logo, design

Description automatically generated**OUR TEAM**

A red text on a black background

Description automatically generated with medium confidenceA picture containing font, graphics, logo, text

Description automatically generatedA picture containing text, font, graphics, poster

Description automatically generated

A blue and white sign with white text

Description automatically generated with low confidenceA picture containing text, font, logo, graphics

Description automatically generated

A picture containing font, line, graphics, logo

Description automatically generated

A red text on a black background

Description automatically generated with medium confidenceA close-up of a logo

Description automatically generated with low confidenceA picture containing font, text, screenshot, graphics

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A picture containing text, font, graphics, graphic design

Description automatically generatedA picture containing text, screenshot, font, graphics

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Description automatically generated with medium confidenceA picture containing font, text, logo, graphics

Description automatically generated

A close-up of a logo

Description automatically generated with low confidence

A black background with blue text

Description automatically generated with low confidence

**A qr code on a white background

Description automatically generatedSee you online!**

**A blue circle with black letters

Description automatically generated with medium confidenceA blue circle with a black bird in it

Description automatically generated with low confidence**

A picture containing text, screenshot, operating system, design

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