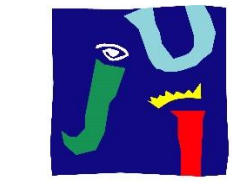

UNIVERSITAT JAUME·I

HOW RENEWABLE ENERGY CAN BOOST RURAL ECONOMY

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1. INTRODUCTION

1.1. Presentation of the research

Some of the current concerns of society are climate change and depopulation in rural areas. Finding a viable solution to all these problems is extremely urgent, as they directly impact the future of the country, which depends on rural areas.

Climate change is a threat to health, ecosystems, and Earth in general. Rural areas are the most affected by this phenomenon, as it contributes both to aridity and depopulation. These concurrent issues not only affect the rural communities, but they also have far-reaching effects on rural ecosystems' resilience and sustainable development. In fact, up to 17.5% of rural areas in Spain are affected by depopulation and aridity at the same time.

Renewable energy would be able to solve all these problems at once. Firstly, renewable energy would reduce and eventually get rid of the dependence on fossil fuels, subsequently reducing CO2 emissions and climate change. Furthermore, renewable energy is economically beneficial, not only because reduce energy imports, but also because it develops rural areas and increases employment in the area.

However, the implementation is not easy, as these sources of energy depend on the weather conditions, so they are not predictable. Renewable energy installations also need to be in strategical sites, where the sun shines or where the wind blows. Therefore, it is important to consider the location of renewable energy projects, as they can disrupt the natural beauty of landscapes and have an impact on vegetation and wildlife.

Implementation of renewable energy cannot be done at any cost. It is essential to find a balance between the social and economic goals and the environmental reality. That balance is sustainability, which can be found by analysing the corporate social responsibility of the companies carrying out the projects.

Despite these challenges, the advantages of renewable energy are substantial. Not only does it offer a sustainable solution to environmental concerns, but it also presents a cost-effective alternative to fossil fuels. With low-maintenance requirements and abundant, free sources of energy such as sunlight and wind, renewable energy has the potential to lower electricity prices and contribute to a more sustainable and prosperous future.

CSR is key for companies undertaking projects like renewable energy generation installations, which will be studied in this research. By prioritizing CSR, negative impacts can be minimised and positive outcomes maximized for rural areas.

To put these risks into perspective, two real cases have been studied. These cases are Clúster Maestrazgo wind power project promoted by Forestalia and MAGDA solar parks promoted by Akuo and Premier groups. In these cases, both the promoters and the projects are going to be analysed, as well as their advantages and disadvantages, impact on their stakeholders and a comparative between them.

1.2. Justification

The project aims to address the pressing concerns of climate change and depopulation in rural areas. These issues have significant implications for the future of the country, particularly since rural areas play a crucial role in the overall well-being and sustainability of the nation.

1.3. Objectives

The objectives of this project are to determine whether any renewable energy generation project can contribute to sustainable development and, if not, to identify the necessary conditions for it to do so through CSR, in order to further align with these goals. Sustainable development includes combating climate change and rural depopulation, which are the environmental and social aspects involved.

To evaluate this, the two cases are going to be analysed and compared using CSR criteria. These projects are of different magnitude and source of energy, giving a wider perspective on the impact on the stakeholders, i.e., the potential benefits and drawbacks and if, eventually, these projects will (or not) be the needed sustainable solution to the issues mentioned above.

1.4. Methodology

The methodology used in this research is the *case method*. This method tries to enhance learning through the analysis of real-life or hypothetical situations applying critical thinking and problem-solving skills to comprehend complex issues.

First, we will proceed to carry out a theoretical analysis of the concepts involved in the work, including CSR (Corporate Social Responsibility), depopulation in rural areas, renewable energies, climate change, and unemployment.

2. CONCEPTUAL REVIEW

In this section, the concepts used in the research are going to be defined in order to give a context about the problems that are aimed to be solved and the possible solutions proposed.

2.1. CSR meaning

Corporate Social Responsibility or CSR is a concept that has been continually evolving through history, therefore, a variety of definitions that reflect the concerns of each era can be found.

The concept of Corporate Social Responsibility (CSR) has a long history that dates back to the late 1800s. During this time, corporations were primarily focused on maximizing profits and maximizing shareholder value. However, as the size and influence of corporations grew, their impact on society also increased. This led to a growing concern about the responsibility of corporations to address social and environmental issues. As the 19th century progressed, this ethical view of business continued to gain traction, with social reformers and labour leaders calling for greater responsibility on the part of corporations[1].

In the early 20th century, the concept of CSR was further developed by several influential thinkers, such as Howard Bowen, who introduced this concept for the first time in the economic literature in his book *Social Responsibilities of the Businessman* (1953). Bowen defined CSR as the obligations of businessmen to pursue policies that are desirable from the perspective of society's objectives and values[2].

In the 1960s, Frederick extended this definition to include the responsibilities of businesses to use their resources for social good.

In the 1970s and 1980s, the concept of CSR shifted to include considerations of corporate ethics and compliance with legal and social norms.

In the 1990s, Wood argued that business and society are interdependent, and the responsibility of businesses to society extends beyond legal compliance.

In the early 2000s, McWilliams and Siegel added that CSR involves going beyond compliance and engaging in actions that further social good.

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[1] (THOMASnet, 2019)

[2] (Kraus & Brtitzelmaier, 2012)

More recently, the concept of CSR has broadened to encompass environmental sustainability, human rights, and corporate governance, among other issues. The global community's growing awareness of the impact of business practices on society has led to increased expectations for businesses to act responsibly and sustainably. This is included in one of the most recent definitions.

According to Hopkins (2007, p 15)[3]:

CSR is concerned with treating the stakeholders of the firm ethically or in a responsible manner. 'Ethically or responsible' means treating stakeholders in a manner deemed acceptable in civilized societies. Social includes economic and environmental responsibility. Stakeholders exist both within a firm and outside. The wider aim of social responsibility is to create higher and higher standards of living, while preserving the profitability of the corporation, for people both within and outside the corporation.

In order to summarise all the previous definitions and relate them to sustainable development, the following definition is going to be used.

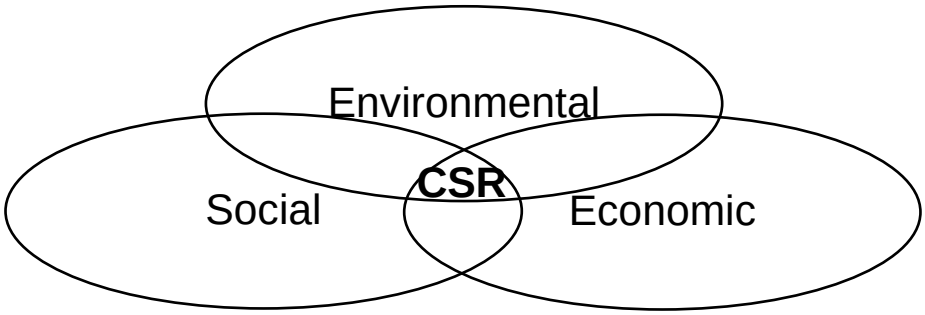
According to Forum of Experts in Social Responsibility of the Spanish Ministry of Labour and Social Affairs (2007):

Corporate Social Responsibility is, besides the strict compliance with the legal duties in force, the voluntary inclusion in its governance and management, in its strategy, policies and procedures, of the social, work-related, and environmental concerns, as well as those concerning the respect to human rights that arise in the transparent relationship and dialogue with its stakeholders, in this way taken on the responsibility for the consequences and impacts of its actions.

By analysing this definition, we can deduce that CSR encompasses a triple bottom line (social, environmental, and economic), making it closely related to sustainable development. It is crucial to identify and manage the relationship with stakeholders and to determine and manage the impacts of the organization's activities.

[3] (Hopkins, 2012)

Figure 1. Pillars of sustainability and lines of action of CSR



Source: own elaboration

2.1.1. Sustainable development

The Brundtland Report, also known as "Our Common Future," was published in 1987 for the UN[4]. This report recognized the disproportionate consumption of natural resources by the industrialized world compared to the developing world and provided a widely accepted definition of sustainable development as well as its objectives. According to the Brundtland Report, sustainable development is defined as[5]:

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

This definition emphasizes the concept of balancing economic, social, and environmental considerations to ensure long-term well-being. It recognizes that development should not only focus on immediate economic growth but should also consider social equity and environmental protection to ensure a better quality of life for both current and future generations.

The Brundtland Report highlights the interdependence of economic, social, and environmental aspects, emphasizing that sustainable development requires addressing these dimensions together rather than pursuing them in isolation. It encourages an integrated approach to policymaking and decision-making that considers the long-term implications and strives for a harmonious and equitable relationship between people and the planet.

[4] (Wikipedia, 2023)

[5] (World Commission on Environment and Development, 1987)

United Nations Sustainable Development Goals (SDGs) are in alignment with the Brundtland Report's objectives and definition of sustainable development. United Nations SDGs are a set of 17 interconnected goals and 169 targets adopted by the United Nations Member States in 2015. The SDGs provide a comprehensive framework and global agenda for addressing the world's most pressing social, economic, and environmental challenges. These goals aim to guide efforts towards sustainable development and create a more equitable, prosperous, and sustainable future for all.

These major goals are shown in **Figure *2***: to finish with poverty (1) and hunger (2), health and well-being (3), quality education (4), gender equality (5), clean water and sanitation (6), **affordable and clean energy** (7), decent work and economic growth (8), industry, innovation and infrastructure (9), reduced inequalities (10), **sustainable cities and communities** (11), responsible consumption and production (12), **climate action** (13), life below water (14), life on land (15), peace, justice, and strong institutions (16) and, lastly, **partnerships for the goals** (17).

Figure 2. United Nations' Sustainable Development Goals (SDGs).

Source: (United Nations, n.d.-a)

CSR and sustainable development are closely-related concepts, since one would be *meaningless* without the other. Therefore, CSR is the voluntary actions taken by companies to improve society and the environment while operating ethically and sustainably. Nowadays, these actions include initiatives related to climate change, environmental conservation, and the preservation of historical and cultural heritage, among others. The primary goal of CSR is to balance the economic, social, and environmental impacts of a company's operations, thereby contributing to sustainable

development. By integrating these principles, companies aim to create long-term value for stakeholders while ensuring the well-being of present and future generations.

2.1.2. Stakeholders and impact

In a corporation, a stakeholder is a member of "groups without whose support the organization would cease to exist"[6]. In other words, stakeholders are individuals or groups that have an own interest or concern in a particular company, project, or initiative. They are affected by and can affect the activities, decisions, and outcomes of the entity they are associated with.

Stakeholders can be categorized into two main groups: internal stakeholders and external stakeholders. Internal stakeholders typically include employees, managers, and shareholders who have a direct relationship with the organization. External stakeholders encompass individuals or entities outside the organization who are impacted by its actions or have an interest in its operations, such as customers, suppliers, environment, local communities and the government.

Stakeholders often have diverse interests, needs, and expectations. They may seek financial returns, employment opportunities, high-quality products or services, environmental sustainability, social responsibility, ethical practices, transparency, or community engagement.

Stakeholders can influence the organization through various means, such as through their purchasing power, regulatory actions, public opinion, or investment decisions[7]. Their support or opposition can significantly impact the reputation, success, and sustainability of the organization. Therefore, it is crucial for businesses and projects to engage and build positive relationships with stakeholders, considering their interests and concerns, and incorporating their feedback and perspectives into decision-making processes. This collaboration facilitates tasks like identifying relevant issues, proposing appropriate indicators, assessing their value, validating results, and suggesting improvement activities.

Corporate Social Responsibility (CSR) is closely related to the impact on stakeholders. The concept of CSR recognizes that businesses have a responsibility beyond generating profits and should consider the interests and well-being of various stakeholders. When organizations implement CSR initiatives, they aim to have a

[6] (R. Freeman & Reed, 1983)

[7] (R. E. Freeman, n.d.)

positive impact on stakeholders by addressing their concerns, needs, and expectations. This includes engaging with stakeholders, understanding their perspectives, and incorporating their feedback into decision-making processes. By doing so, organizations can minimize negative impacts and maximize positive impacts on stakeholders.

CSR initiatives can have a significant impact on employees. Through fair labour practices, providing a safe and inclusive work environment, and offering opportunities for growth and development, organizations can positively influence employee well-being and job satisfaction. This, in turn, can lead to increased productivity, employee loyalty, and reduced turnover rates. In fact, CSR is profitable in the medium and long term[8].

Measuring the social impact of a business offers several benefits, including compliance with government requirements, access to financing, increased transparency, improved stakeholder relations, enhanced reputation, employee attraction and retention, social license to operate, better risk management, improved decision-making, and new business opportunities[9].

Although social impact measurement is a relatively new practice for the private business sector, the concept of measuring impacts is not unfamiliar to them. Companies have long been familiar with measuring their economic impact through financial reports. In response to stakeholder demands, environmental considerations were later included. Eventually, companies began publishing sustainability reports that encompass financial, environmental, and social aspects. These reports recognize the multidimensional nature of sustainability and its effects on both internal and external stakeholders.

One methodology used to measure the contribution of companies to the common good is *The Balance of the Common Good*, promoted by Christian Felber. The methodology assesses companies based on **Table *1*. Matrix of the Common Good.** The methodology assesses companies based on a Common Good Matrix, which includes 17 criteria evaluating their activities in relation to values such as human dignity, solidarity, ecological sustainability, social justice, transparency, and democratic participation. The methodology can be applied to any type of company and involves considering the perspectives of stakeholders. It generates metrics that go beyond legal compliance,

[8] (Vaca Acosta et al., 2007)

[9] (Ayuso, 2018)

focusing on the company's actions and their impact on the common good. The Balance of the Common Good provides a holistic framework for companies to evaluate and improve their social impact and contributions beyond financial profitability.

Figure 3. The 5 steps to measure social impact.

Source: (AEF, 2015)

Table 1. Matrix of the Common Good.

Valor ▸ / Grupo de contacto ▾	Dignidad humana	Solidaridad	Sostenibilidad ecológica	Justicia social	Participación democrática y transparencia
A) Proveedores	A1: Gestión ética de la oferta/suministros 90				
B) Financiadores	B1: Gestión ética de finanzas 30				
C) Empleados inclusive propietarios	C1: Calidad del puesto de trabajo e igualdad 90	C2: Reparto justo del volumen de trabajo 50	C3: Promoción del comporta-miento ecológico de las personas empleadas 30	C4: Reparto justo de la renta 60	C5: Democracia interna y transparencia 90
D) Clientes / productos / servicios / otras empresas	D1: Relaciones éticas con los clientes 50	D2: Solidaridad con otras empresas 70	D3: Concepción ecológica de productos y servicios 90	D4: Concepción social de productos y servicios 30	D5: Aumento de los estándares sociales y ecológicos sectoriales 30
E) Ámbito social: región, soberanía, generaciones futuras, personas y naturaleza mundial	E1: Efecto social/ Significado del producto/ servicio 90	E2: Aportación a la comuni-dad 40	E3: Reducción de efectos ecológicos 70	E4: Orientación de los beneficios al bien común 60	E5: Transparencia social y par-ticipación en la toma de decisiones 30
Criterios – Negativos	Quebrantamiento de las Normas de trabajo OIT -200	Compra hostil -200	Gran impacto medioambiental a ecosistemas -200	Evasión de impuestos -200	No revelación de todas las participaciones -100

Source: (Economía del Bien Común, 2017)

Impact of companies on common good are different depending on the stakeholder. By producing high-quality products or services, ensuring transparency in business practices, and considering the environmental and social impacts of their offerings, organizations can build trust and loyalty among customers. CSR can also involve addressing customer concerns such as product safety, ethical sourcing, and fair pricing.

Local communities, another group of stakeholders, can benefit from CSR initiatives that focus on community development and engagement. This can include investing in local infrastructure, supporting educational programs, promoting environmental sustainability, and collaborating with community organizations to address local challenges. Such initiatives can enhance the organization's reputation, foster positive relationships with the community, and contribute to sustainable development.

Furthermore, CSR can have an impact on shareholders and investors. By integrating environmental, social, and governance (ESG) factors into their decision-making processes, organizations can demonstrate long-term value creation and risk management, attracting socially responsible investors. This, in turn, can lead to increased access to capital and potentially better financial performance.

In summary, CSR initiatives are aimed at creating a positive impact on stakeholders. By considering the diverse interests and concerns of stakeholders, organizations can contribute to their well-being while addressing social, environmental, and economic challenges. Overall, stakeholders play a vital role in shaping the social, environmental, and economic impact of organizations. Recognizing their significance and actively engaging with them can contribute to better decision-making and the creation of shared value for both the organization and its stakeholders.

2.2. Rural depopulation

Depopulation refers to a decline in population size, either in a specific geographical region or globally. It can occur due to various factors such as low birth rates, high death rates, migration, and natural disasters. Depopulation can have significant economic, social, and environmental impacts.

Rural depopulation is a phenomenon in which the population of a rural area, typically a small town or village, decreases over time. It occurs when people leave rural areas to live in urban areas, or to move to other rural areas with more economic opportunities or amenities.

The two components of population change are natural change and net migration. Natural change is the number of births minus the number of deaths in a place over a period of time. Net migration is the number of people moving to a place minus the number of people moving out. Rural population loss is a result of both natural change and net migration[10].

There are several reasons for rural depopulation, including limited job opportunities, the closure of local businesses and services, and the availability of more diverse and attractive lifestyles in urban areas. Additionally, younger generations are often drawn to the convenience and excitement of urban life, leaving older generations behind in rural areas.

Rural depopulation can have significant impacts on rural communities, including a decline in the availability of services and resources, a decrease in economic activity, and a potential loss of cultural and social capital.

AsPinilla & Sáez (2021) point out:

Between 1950 and 2007, the European rural population lost around twenty million inhabitants, from 45% to just 36% of total population. In the continent as a whole, the rural population decreased between 1950 and 1970 at an average annual rate of 0.3% and between 1970 and 2000 at 0.2%.

More specifically, in the Region of Valencia, 157 of the 542 municipalities are at risk of depopulation since the population in those municipalities has shrunk by 14.5% between 1996 and 2016[11]. Regarding the reasons of the depopulation, the study conducted by

[10] (Marre, 2020)

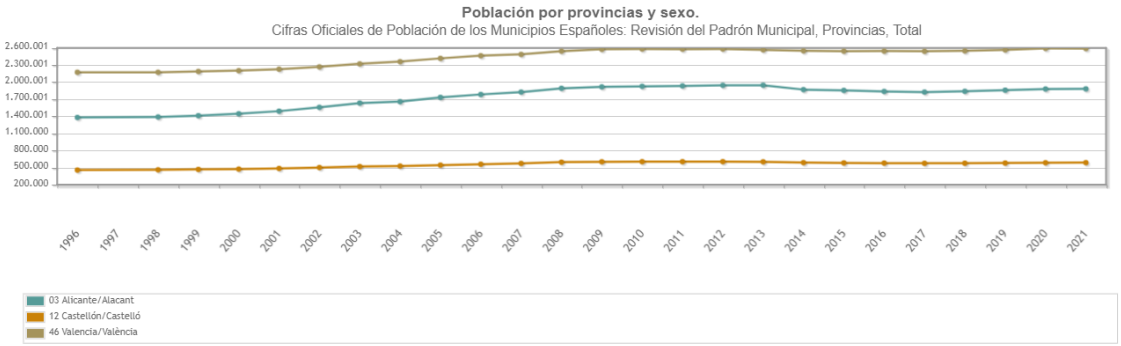
[11] (Alamá-Sabater et al., 2019; GVA, 2017)

GVA (2017) mentions that “depopulation is related to accessibility, economic dynamics and public services”.

However, population in the Region of Valencia grew slightly in the same period[12]. Also, as shown in **Figure *4***, population grew individually in each of the provinces of this Region: Castellón, Valencia and Alicante.

In **Figure *5***, we can see the municipalities that are at high risk of depopulation. These municipalities are in the interior of the province of Castellón, and to a lesser extent, in the interior of Valencia and Alicante. In **Figure *7***, we can see how population density was more consistent in 1900 and over the years it became concentrated in cities, while rural areas became increasingly depopulated.

Figure 4. Demographic growth in the provinces of the Region of Valencia

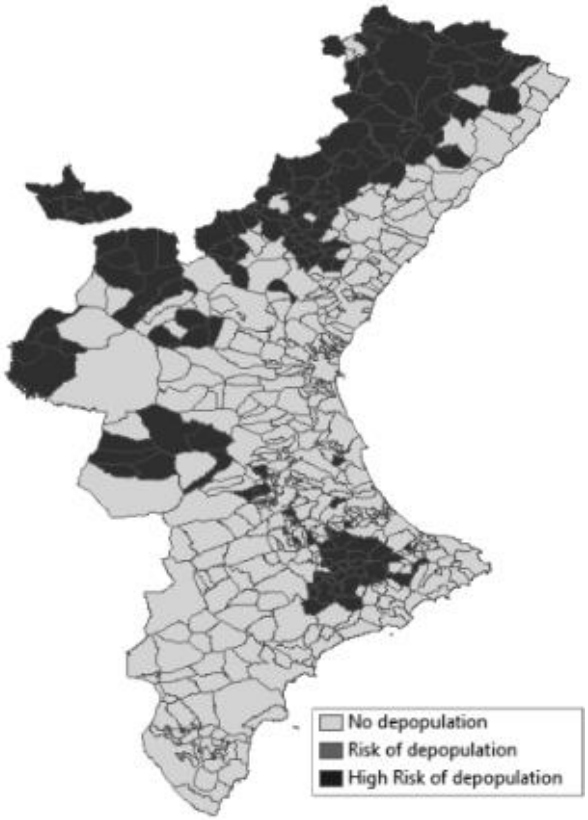


Source: INE 2023

The combination of all the depopulation factors has led to the depopulation in rural areas in the Region of Valencia. On the other side, urban areas have kind of *benefited* from this phenomenon, as they have seen their population and economy grow as well as their influence over the Region. Even so, some urban areas are still struggling from some problems such as low birth rates and ageing population.

[12] (INE, 2023)

Figure 5. Depopulation map of the Region of Valencia

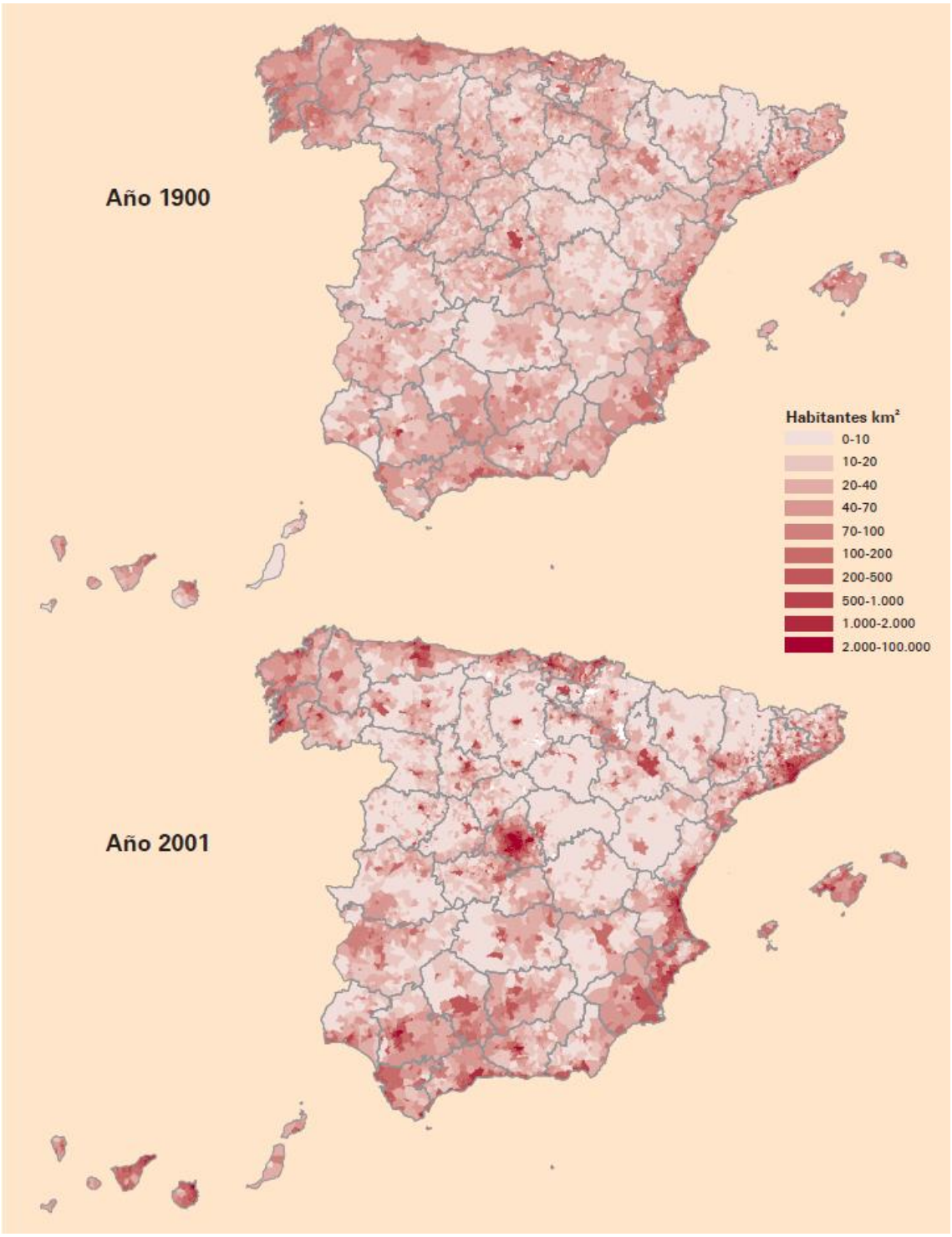


Source: Alamá-Sabater et al., 2019

Figure 6. Net migration balance of rural areas by country of birth

Source: (Camarero & Sampedro, 2020)

Figure 7. Municipal population densities in Spain. Years 1900 and 2001



Source: Raúl Mínguez Fuentes, 2018

2.2.1. Driving factors

According to different authors that have studied about rural depopulation in the Southwestern Europe, there are several factors why rural areas may be experiencing depopulation[13]. These include demographic, economic, environmental, social and cultural factors.

Demographic factors, such as low birth rates and an aging population, play a significant role in rural depopulation. Low birth rates and an aging population refer to situations where there are relatively few births and the population is getting older over time. As a result, there are fewer young people living in these areas. In addition, fewer young people tend to stay in rural areas and move away to urban centres in search of better job opportunities and social amenities. It is also important to note that immigration has had a role in slowing down the depopulation rate in these areas[14], as **Figure *6*** shows. However, it has not been enough to recover the lost population during the last few decades, as deaths still exceed births.

Economic factors also contribute to depopulation, such as limited access to services and markets, which can lead to low income levels and few job opportunities. During the second half of the twentieth century occurred the decline of the agriculture in favour of the service sector, which led to the out-migration and depopulation of the areas where this economic activity predominated, the rural areas[15]. Therefore, many young people have moved to urban areas in search of better job prospects and higher wages.

Additionally, rural areas often lack the amenities and services that young people desire, such as entertainment and cultural activities. As people move away from rural areas, businesses and industries suffer, leading to a decrease in job opportunities and economic growth[16]. This, in turn, leads to a decrease in the quality of life for those who remain in rural areas. The lack of investment in rural areas may also contribute to depopulation, as businesses and industries may not see rural areas as profitable or viable places to invest[17]. These conditions make it difficult for rural communities to thrive and grow.

[13] (Vicente Pinilla et al., 2008), (Garcia Valdivia, 2018) and (Pinilla & Antonio Sáez, 2017)

[14] (Camarero & Sampedro, 2020)

[15] (Collantes, 2007)

[16] (Garcia Valdivia, 2018)

[17] (Marre, 2020)

Social and cultural factors are also important drivers of rural depopulation. Changes in values and lifestyle of the new generations can lead to a lack of interest in staying in rural areas. Some of the reasons why young people may prefer to live in an urban environment could be that it is less common to be judged and, in general, the environment is more open-minded. In addition, the absence of cultural and leisure services in rural areas may make a rural environment less attractive to younger generations. This can result in a loss of rural traditions and values. At the same time, people remaining in rural areas may feel increasingly isolated and with less social support.

Lastly, environmental factors provoked by the climate change can impact agricultural production and contribute to economic instability, which can further contribute to rural depopulation. Spain's rural areas are experiencing depopulation due to various environmental factors. Some of these factors include climate change, aridity, water scarcity, soil degradation and land abandonment[18]. About 17.5% of rural areas in Spain are exposed to both high rates of depopulation and aridity[19]. Rural depopulation in Spain has been a long-term trend since the rural exodus in 1975[20]. The depopulation of rural areas in Spain has significant social and environmental implications, including the loss of ecosystem services and the reduction of biodiversity.

In conclusion, all these factors contribute to the depopulation in rural areas. These factors have been summarised in **Table *2***. Also, **Figure *9*** illustrates the links between mitigating and driving factors that have been most frequently discussed in papers.

Next, we will see the studies that have been conducted to address this issue.

[18] (Bruno et al., 2021)

[19] (Villamayor-Tomas et al., 2022)

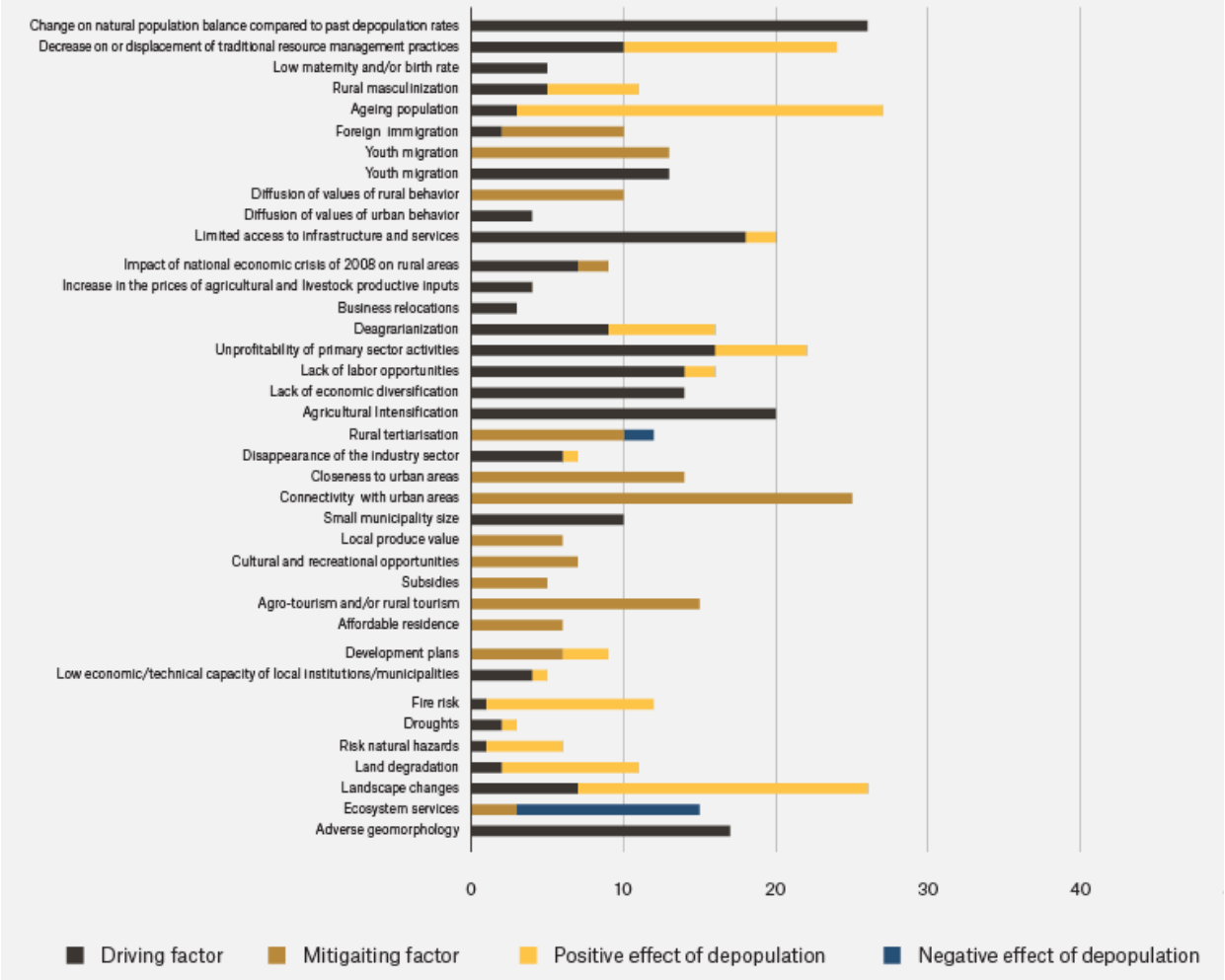
[20] (Villamayor & Redín, 2020)

Table 2. Summary of the main depopulation factors in rural areas

	Economic reasons: Rural areas may not have the same economic opportunities as urban areas, which can lead to people moving to cities in search of work or better job opportunities.
	Demographic reasons: Rural areas may have an ageing population, with fewer young people and families, leading to a decline in population. Also, low birth rates indicate that the population cannot be sustained in terms of its size. Incoming immigration helps, but is not enough.
	Migration: People may be moving from rural areas to cities or other countries in search of better living standards, education, and job opportunities, especially young generations.
	Social and cultural factors: Younger generations are changing societal attitudes, causing social values to shift, and seeking new ways to enjoy life. Therefore, they may choose to live in urban areas due to the availability of more amenities and entertainment options.
	Natural disasters and environmental degradation: Natural disasters and environmental degradation can harm local economies, causing people to leave the area in search of safer places.

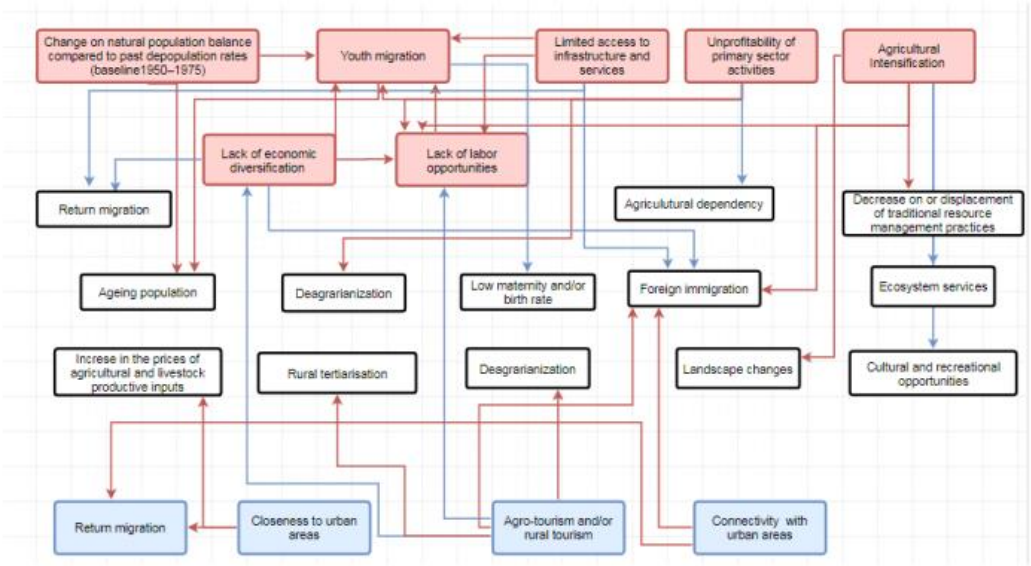
Source: own elaboration

Figure 8. Depopulation impacts and factors.

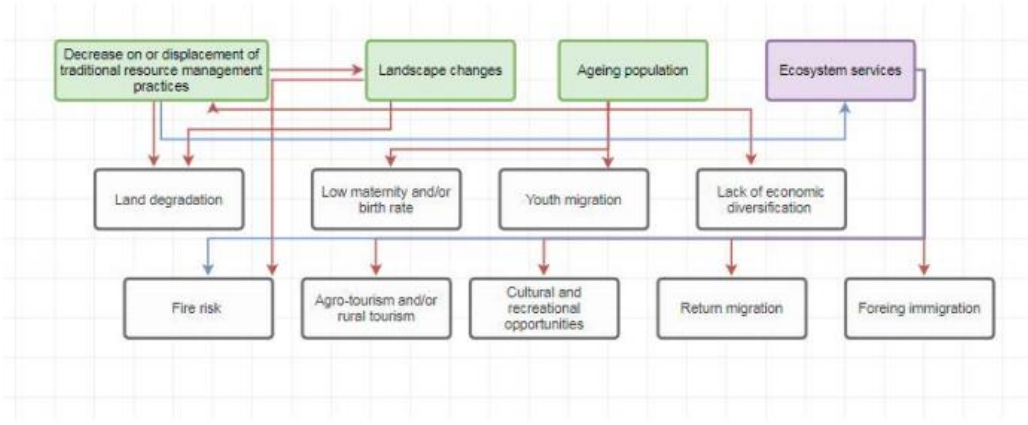


Source: (The Social Observatory - "la Caixa" Foundation, 2022)

Figure 9. Interactions between variables: driving and mitigating factors



Interactions between variables which were accounted by twelve or more than twelve papers as driving factors of depopulation (box in red), mitigating factors (box in blue). Red arrows symbolize positive relationship and blue ones negative relationship



Interactions between variables which were accounted by twelve or more than twelve papers as positive cause of depopulation (box in green) or negative cause of depopulation (box in purple). Red arrows symbolize positive relationship and blue ones negative relationship

Source: (Villamayor & Redín, 2020)

2.2.2. Mitigating factors

Studies on depopulation have identified various factors that can help address the issue, commonly referred to as mitigation factors. These include (from the most relevant to the least)[21]: connectivity to urban areas, agro-tourism and/or rural tourism, closeness to urban areas, rural tertiarization, diffusion of values of rural behaviour, foreign immigration, cultural and recreational opportunities, local produce value, affordable residence, development plans, subsidies, ecosystem services and impact of national economic crisis of 2008 on rural areas. The relevance of the effect of these mitigating factors are shown in **Figure *8***.

Rural areas that are close to urban areas are often dynamic local economies while more remote, sparsely populated areas generally experience weaker economic growth and a higher risk of poverty for the population[22]. However, closeness is not accessibility. The increase of accessibility is one of the most important strategies to achieve territorial cohesion and slow down depopulation processes in rural areas[23].

Rural tourism is one of the activities that can help prevent depopulation. It can regenerate the rural economy and bring skilled urban people back into the countryside as lifestyle entrepreneurs[24]. Rural tourism can also help prevent depopulation by creating new jobs, improving livelihoods and fighting depopulation[25].

The other important factor reducing rural depopulation is immigration from other countries. **Figure *6*** shows how some rural areas are increasing its population thanks to immigrants born abroad[26]. According to *Camarero & Sampedro*'s research of 2020, the arrival of foreign citizens has slowed down the depopulation of rural Spain, a phenomenon that has been affecting the country for decades. Even though there are still more deaths than births, since 2018, there has been a certain demographic recovery of the rural population in municipalities with less than 10,000 inhabitants. Rural areas now look very different because of population flows. About 10% of the people living in these municipalities in 2019 were foreign-born, with the number rising

[21] (The Social Observatory - "la Caixa" Foundation, 2022)

[22] (Augère-Granier & McEldowney, n.d.)

[23] (Martínez Sánchez-Mateos & Ruiz Pulpón, 2021)

[24] (López-Sanz et al., 2021)

[25] (UNWTO, n.d.)

[26] (Camarero & Sampedro, 2020)

to 16% for people aged 20 to 39. Immigrants revitalize and rejuvenate rural Spain and make a big generational renewal contribution.

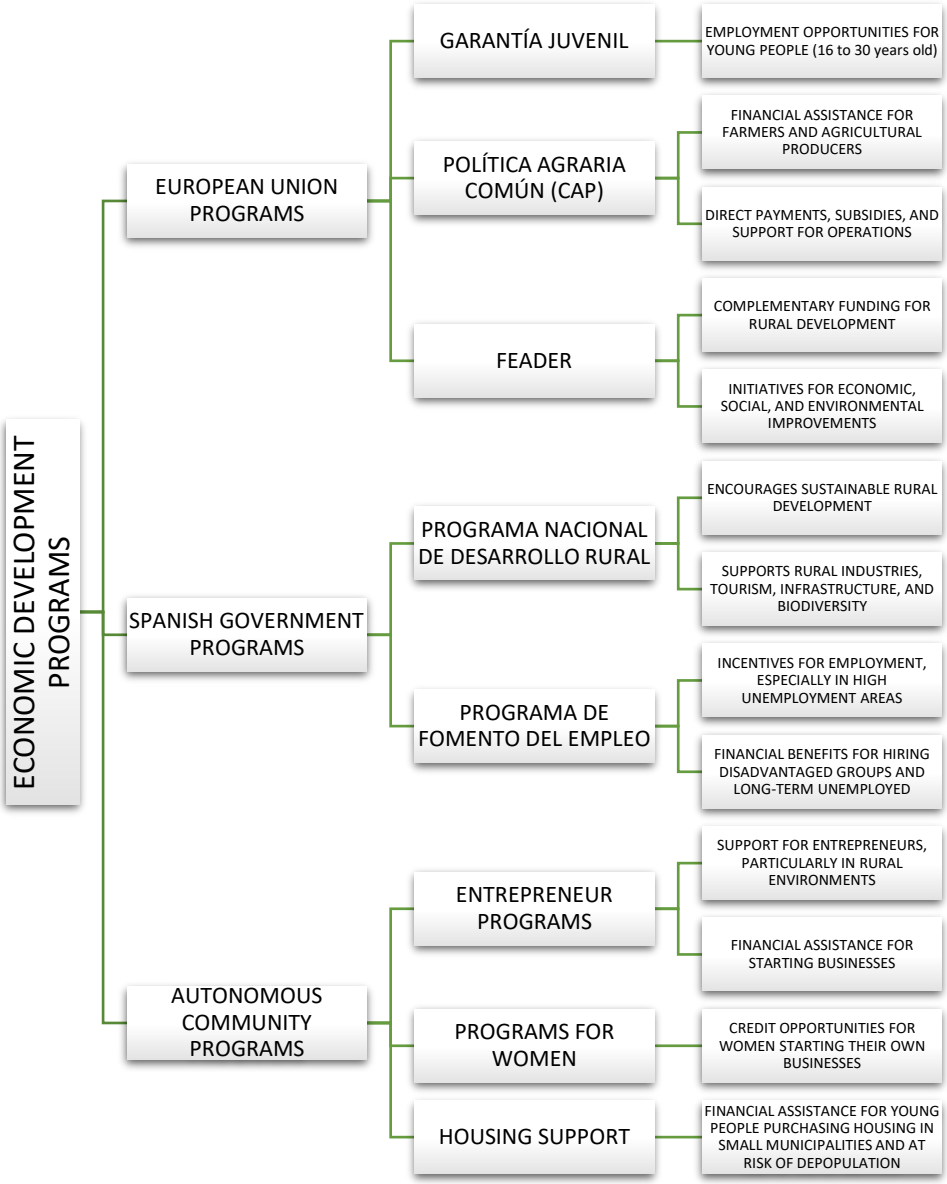
It is interesting to note in **Figure 8** how little is the effect of subsidies despite all the effort put by the government. Still, Government has played a crucial role in maintaining the population in rural areas during the last few decades through its support of essential services, economic development programs, infrastructure projects, and cultural and recreational activities[27]. There are several subsidies aimed at combating unemployment, with an emphasis on rural and depopulated areas and the vulnerable people in society like women or young people. These subsidies are summarized in **Figure *10***.

However, it is crucial to acknowledge that these factors, while they can mitigate depopulation, also come with their own set of challenges and complexities[28]. For instance, industrialization, mechanization, and the concentration of farms and agricultural services in the hands of major companies have been suggested as a solution to the lack of generational replacement in farming. While these developments can address the decline in the number of farmers, they can also contribute to the problem by limiting access to production resources for young farmers and immigrants. Furthermore, concentrating agricultural activities in areas with better land can worsen the abandonment of less productive farms, leading to soil degradation and further fuelling depopulation.

[27] (The Social Observatory - “la Caixa” Foundation, 2022)

[28] (The Social Observatory - “la Caixa” Foundation, 2022)

Figure 10. Government economic development programs with a focus on rural areas.



Source: own elaboration with data taken from different official websites[29].

[29] (Ministerio de Hacienda y Función Pública, n.d.), (SEPE, n.d.), (Ministerio de Agricultura Pesca y Alimentación, n.d.-a), (Ministerio de Hacienda y Función Pública, n.d.), (Ministerio de Agricultura Pesca y Alimentación, n.d.-b), (Ministerio de Trabajo y Economía Social, n.d.), (San Martín, 2023) and (Instituto de las mujeres, n.d.)

2.2.3. Renewable energy as a way to enhance and diversify the rural economy

Given the driving and mitigating factors, potential solutions need to be implemented to address the phenomenon of rural depopulation, which endangers the rural way of life.

The aim is to enhance demographic, economic, and environmental factors, as well as improve social and leisure services. Current factors that are reducing the depopulation rate in rural areas include government initiatives and increased immigration.

Therefore, if depopulation remains a problem, it is likely because mitigating factors are inadequate or insufficiently applied. Consequently, it may be necessary to explore alternative solutions.

It is important to consider strategies that focus on increasing birth rates and/or attracting new residents in order to grow the young population of a region. Economic and social factors can significantly impact the effectiveness of these strategies.

One potential solution is to promote economic growth and improve the social environment of the region. This might be done through investment, with the growth of renewable energy sources in rural regions being a feasible approach.

The implementation of renewable energy sources might incentivize to the creation an atmosphere that is favourable for the start-up of new businesses, since these new companies would benefit from the access to affordable energy. Additionally, the government could facilitate the development of these areas by offering tax incentives.

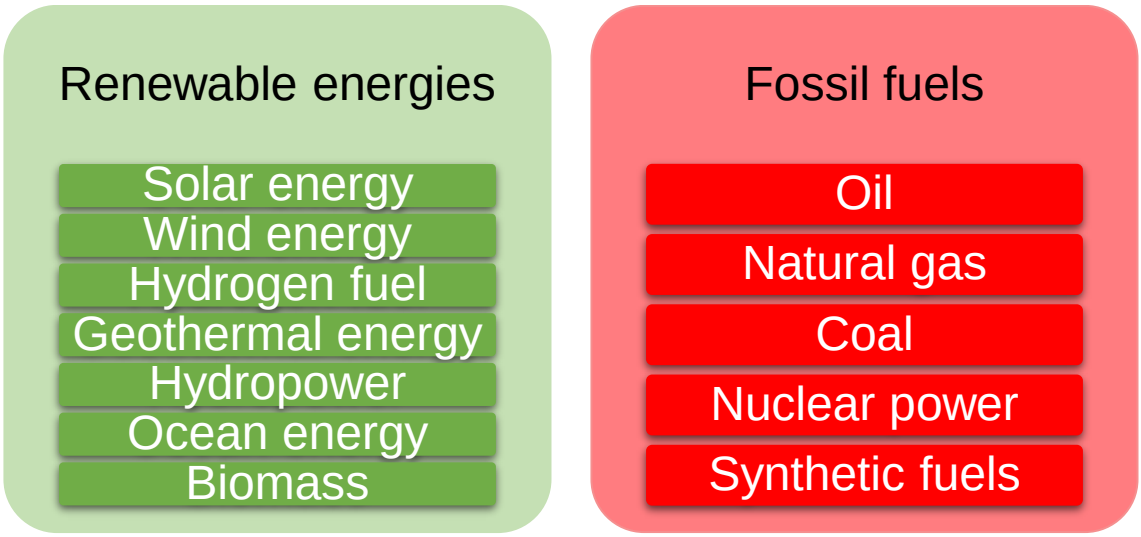
2.3. Renewable energies

Renewable energies refer to energy sources that are replenished naturally and are available in unlimited quantities, unlike non-renewable energy sources such as fossil fuels. According to United Nations (n.d.), “renewable energy is energy derived from natural sources that are replenished at a higher rate than they are consumed”.

The most common forms of renewable energy include solar, wind, geothermal and hydropower. These sources of energy are considered renewable because they can be replenished before being consumed, so they do not deplete finite resources. Additionally, they are considered clean energy sources as they do not emit harmful pollutants or greenhouse gases into the atmosphere.

There is a debate in whether nuclear power is a renewable energy or not, since nuclear plants do not emit greenhouse gases during the electricity generation process. However, nuclear plants use fossil fuels in electricity production (which are not replenished before being consumed) and nuclear waste has a negative impact on environmental and human health. Therefore, nuclear energy cannot be fully considered as a renewable energy source.

Figure 11. Quick view of the different types of renewable energies and fossil fuels



Source: own elaboration

Returning to renewable energies, these have common advantages and disadvantages. The increased use of renewable energies can help reduce dependence on non-renewable energy sources and contribute to a cleaner, more sustainable energy mix[30]. Another advantage is that renewable energy infrastructure requires low maintenance, so they can be more cost-effective in the long run. Lastly, renewable energy can stimulate economic growth and an increasing employment, especially in underdeveloped rural areas, where the electrical grid is underdeveloped or it does not exist at all.

However, renewable energies have some disadvantages that need to be solved. These are higher capital costs and lower electricity production compared to traditional sources, unreliable energy production due to weather patterns, low efficiency levels and the requirement of a large upfront investment in infrastructure. On top of that, electricity networks can only handle a certain amount of electricity without risking overload and instability. Wind companies face particular difficulties in this regard due to their high installed capacity, which must be limited to ensure safe and stable operation of the entire electricity sector.

Table 3. Advantages and disadvantages of using renewable energy sources.

Advantages	Disadvantages
Environmental protection (reduced greenhouse gas emissions)	Weather conditions dependence
Reduced fossil fuel consumption	Non-continuity and unpredictability
Reduced energy imports dependence	Acceptance of renewable electricity in the power system
Stimulating the development of innovation and the economy	Low ability to produce electricity
Increasing employment	Low energy efficiency
Rural development	Low maximum capacity utilization/low capacity factor
Reduction of energy scarcity (expansion of rural electrification capacities)	Relatively high cost of electricity production

Source: (Maradin, 2020)

[30] (Maradin, 2020)

Table 4. Advantages and disadvantages of different renewable energy resources and some negative environmental impacts of different renewable energy resources.

Advantages and disadvantages of different renewable energy resources.

Energy source	Advantages	Disadvantages
Biomass energy	• Abundant and renewable • Can be used to burn waste products	• Burning biomass can result in air pollution • May not be cost effective
Geothermal energy	• Provides an unlimited supply of energy • Produces no air or water pollution	• Start-up/development costs can be expensive • Maintenance costs, due to corrosion, can be a problem
Hydropower	• Abundant, clean, and safe • Easily stored in reservoirs • Relatively inexpensive way to produce electricity • Offers recreational benefits like boating, fishing, etc.	• Can cause the flooding of surrounding communities and landscapes. • Dams have major ecological impacts on local hydrology. Can have a significant environmental impact • Can be used only where there is a water supply • Best sites for dams have already been developed
Marine energy	• Ideal for an island country • Captures energy that would otherwise not be collected	• Construction can be costly • Opposed by some environmental groups as having a negative impact on wildlife • Takes up lots of space and difficult for shipping to move around
Solar energy	• Potentially infinite energy supply • Causes no air or water pollution	• May not be cost effective • Storage and backup are necessary • Reliability depends on availability of sunlight
Wind energy	• Is a free source of energy • Produces no water or air pollution • Wind farms are relatively inexpensive to build • Land around wind farms can have other uses	• Requires constant and significant amounts of wind • Wind farms require significant amounts of land • Can have a significant visual impact on landscapes • Need better ways to store energy

Some negative environmental impacts of different renewable energy resources.

Energy source	Potential negative impacts on the environment
Biomass	May not be CO_2 natural, may release global warming gases like methane during the production of biofuels, landscape change, deterioration of soil productivity, hazardous waste
Geothermal	subsidence, landscape change, polluting waterways, air emissions
Hydropower	Change in local eco-systems, change in weather conditions, social and cultural impacts
Marine energy	Landscape change, reduction in water motion or circulation, killing of fish by blades, changes in sea eco-system
Solar	Soil erosion, landscape change, hazardous waste
Wind	Noises in the area, landscape change, soil erosion, killing of birds by blades

Source: (Ellabban et al., 2014)

2.3.1. Energy storage

The solution to the intermittent renewable energies is to store the energy. So, when the renewable energies are at the peak of production (spring and summer), part of that electricity would be stored, so it is not wasted and it does not collapse the electrical grid. Then, when the sun is not shining or the wind is not blowing (fall and winter), the previous excess of energy can be consumed.

Energy storage is crucial for the renewable energies to thrive. Storing energy would solve most of the renewable energies' problems. There are different technologies that allow to store energy, these are shown in ***Table 5***. The problem with most of these systems is that they are not able to store the energy for too long and currently it is very costly to build those infrastructures.

Table 5. Energy storage systems.

1. Pumped hydro storage (PHS)	2. Thermal energy storage (TES)	3. Compressed air energy storage (CAES)
4. Small-scale compressed air energy storage (SSCAES)	5. Energy storage coupled with natural gas storage (NGS)	6. Energy storage using flow batteries (FBES)
7. Fuel cells—Hydrogen energy storage (FC–HES)	8. Chemical storage	9. Flywheel energy storage (FES)
10. Superconducting magnetic energy storage (SMES)	11. Energy storage in supercapacitor	

Source: (Ibrahim et al., 2008)

Table 6. Comparison of technical characteristics of energy storage systems.

	Efficiency (%)	Capacity (MW)	Energy density (Wh/kg)	Capital ($/kW)	Capital ($/kWh)	Response time	Lifetime (years)	Maturity	Environmental impact
TES	30–60	0–300	80–250	200–300	3–50	–	5–40	Developed	Small
PHS	75–85	100–5000	0.5–1.5	600–2000	5–100	Fast (ms)	40–60	Mature	Negative
CAES	50–89	3–400	30–60	400–2000	2–100	Fast	20–60	Developed	Negative
Flywheel	93–95	0.25	10–30	350	5000	Very fast (< ms)	~15	Demonstration	Almost
Pb–acid battery	70–90	0–40	30–50	300	400	Fast	5–15	Mature	Negative
Ni–Cd battery	60–65	0–40	50–75	500–1500	800–1500	Fast	10–20	Commercial	Negative
Na–S battery	80–90	0.05–8	150–240	1000–3000	300–500	Fast	10–15	Commercial	Negative
Li-ion battery	85–90	0.1	75–200	4000	2500	Fast	5–15	Demonstration	Negative
Fuel cells	20–50	0–50	800–10,000	500–1500	10–20	Good (< 1 s)	5–15	Developing	Small
Flow battery	75–85	0.3–15	10–50	600–1500	150–1000	Very fast	5–15	Developing	Negative
Capacitors	60–65	0.05	0.05–5	400	1000	Very fast	~5	Developed	Small
Supercapacitors	90–95	0.3	2.5–15	300	2000	Very fast	20+	Developed	Small
SMES	95–98	0.1–10	0.5–5	300	10,000	Very fast	20+	Demonstration	Benign

Source: (Kousksou et al., 2014)

According to Kousksou et al., 2014, “from the developed technologies, compressed air or CAES has the lowest cost per kWh compared to all the other technologies” and it has some advantages to PHS, which is a well-developed and highly reliable technology, but the main problem with this type of storage is finding suitable sites.

According to Bussar et al. (2016), “only the hydrogen energy storage as only long-term storage option is able to noticeably impact the total electricity cost”, which makes it an interesting type of energy storage system. The primary obstacles to their inclusion, even with the potential of hydrogen-based technologies and long-term storage applications, are related to the uncertainty of their economic feasibility (because of high system costs and low energy efficiency) and the dependency on high hydrogen market prices[31].

By last, superconducting magnetic energy storage systems are highly efficient in directly storing power, although they are quite costly. Only very large scales appear to have the potential for SMES to become economically appealing. As the other storage energy solutions, cost reduction is one of the main areas of development.

In Spain, pumping hydro storage or PHS is currently the main system used to store energy[32]. Pumping stations are capable of consuming electricity from the grid to pump water from a lower water reservoir to a higher one in order to later release the water back to the lower reservoir and generate electricity with a turbine. All of this is done with an efficiency close to 70%." **Figure *12*** and **Figure *13*** show the monthly consumption of the pumping stations and their profile. It is noticeable that the amount of energy stored has increased over the years. However, this technology has to be installed in very specific places which are difficult to find. This makes this technology difficult to escalate.

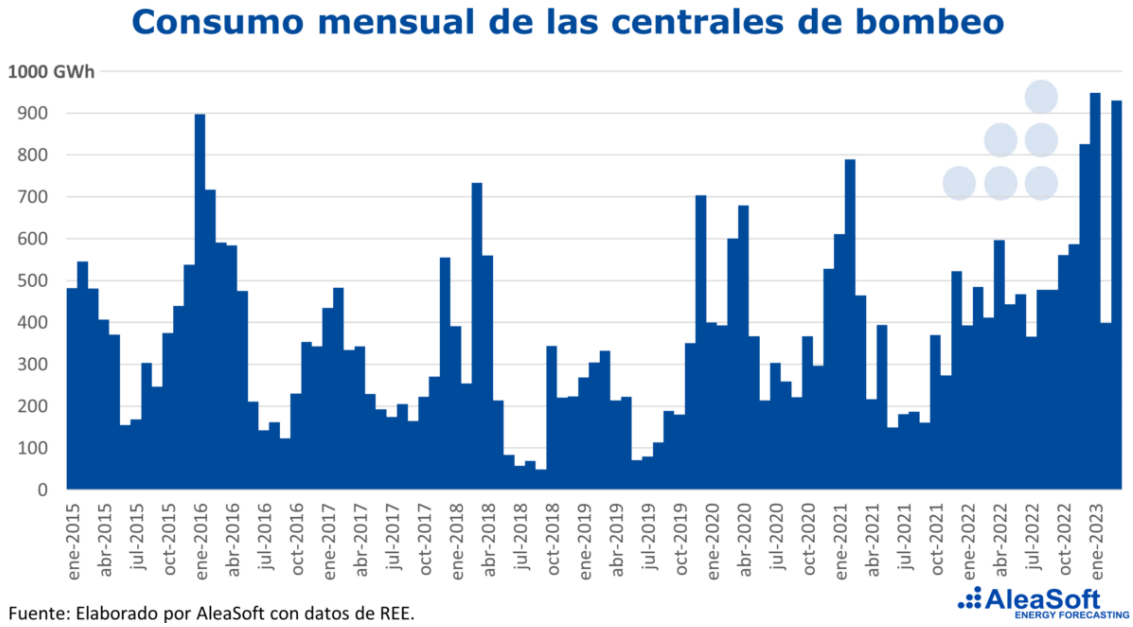
According to Brey (2021), by 2030 Spain could replace 16 GW of conventional energy sources with 65 GW of new renewable energy facilities, creating a 16.17 TWh energy surplus in the spring and summer that could be used in the autumn and winter. Utilizing a hydrogen storage system, the extra electrical energy could be converted into hydrogen by electrolysis and stored in the current natural gas network on a yearly basis. By using this strategy, 7.27 TWh of excess renewable energy can be reused while avoiding 2.54 million tons of CO2eq of annual emissions. However, an investment of V2,500 M euros would be required to construct the necessary 5 GW of polymeric electrolysers, and a change in the legislative framework would be needed to allow transportation of 100% hydrogen over the current natural gas network. Additionally, the use of hydrogen as a seasonal energy storage method would complement the intraday control of electrical energy using batteries and eliminate the

[31] (Kousksou et al., 2014)

[32] (Aleasoft Energy Forecasting, 2023)

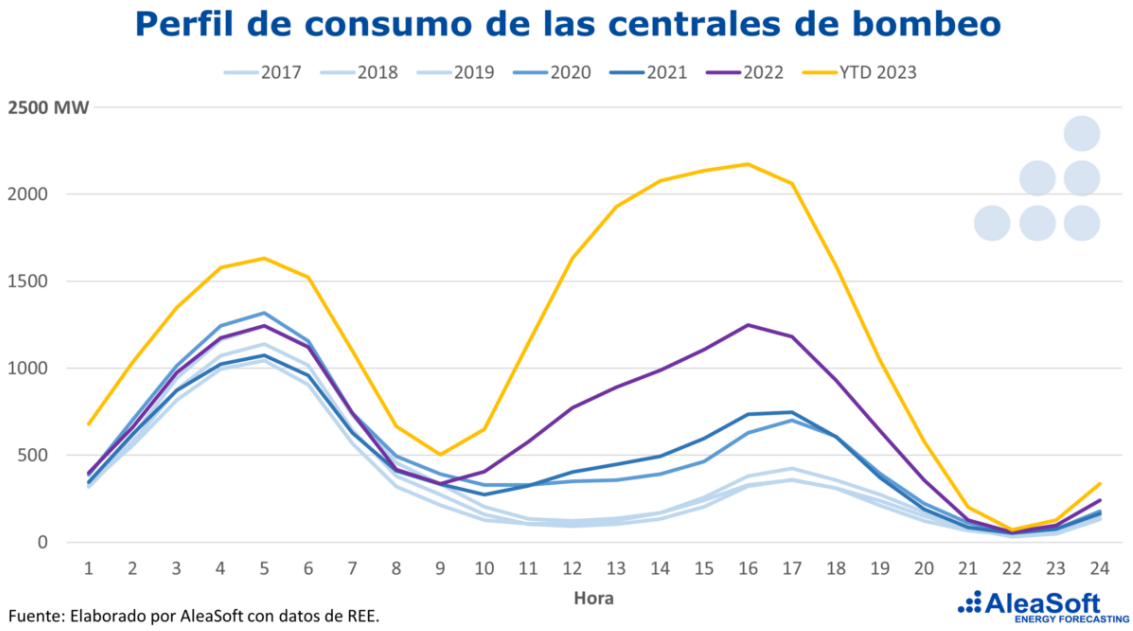
need to import natural gas in the fall and winter. Spain aims to generate all its electricity from renewable sources by 2050, which would necessitate upgrading its existing natural gas infrastructure to one that can handle 100% hydrogen only.

Figure 12. The monthly consumption of the pumping stations.



Source: (Aleasoft Energy Forecasting, 2023)

Figure 13. The consumption profile of the pumping stations.



Source: (Aleasoft Energy Forecasting, 2023)

2.3.2. Solar and wind energy in the Region of Valencia

From the different types of renewable energies, depopulated rural areas in the Region of Valencia have a competitive advantage in solar and wind energy because of many reasons.

Firstly, the Region of Valencia has a particularly favourable climate for solar energy production, with high levels of sunshine throughout the year. Also, villages in the interior of the Region of Valencia are at a high elevation, where the wind hits the strongest. These factors are optimal for running wind turbines and photovoltaic panels.

Secondly, rural areas have some empty land that is no longer used for agriculture. Solar panel and wind turbine companies could buy or lease these lands at a relatively low price. This way, these lands would be productive again.

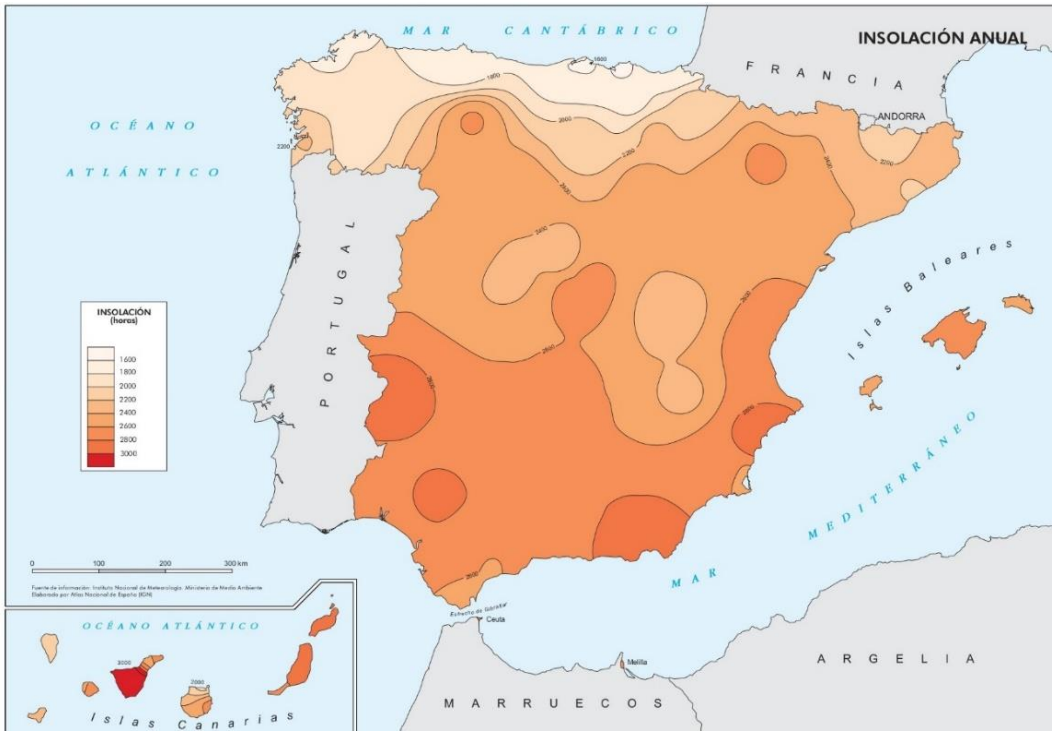
Thirdly and lastly, the Region of Valencia has a higher unemployment rate than the national average. Specifically, unemployment in the Region of Valencia in December 2022 was 13.53%[33]. The Spanish average for the same date was 13.1%[34]. This means that companies can contribute to society by creating job opportunities.

The more hours of sunshine, the more energy (measured in kW/h) the solar panels will be able to produce. Similarly, the stronger the wind blows consistently in an area, the more energy the wind turbines will be able to generate.

[33] (INE, n.d.)

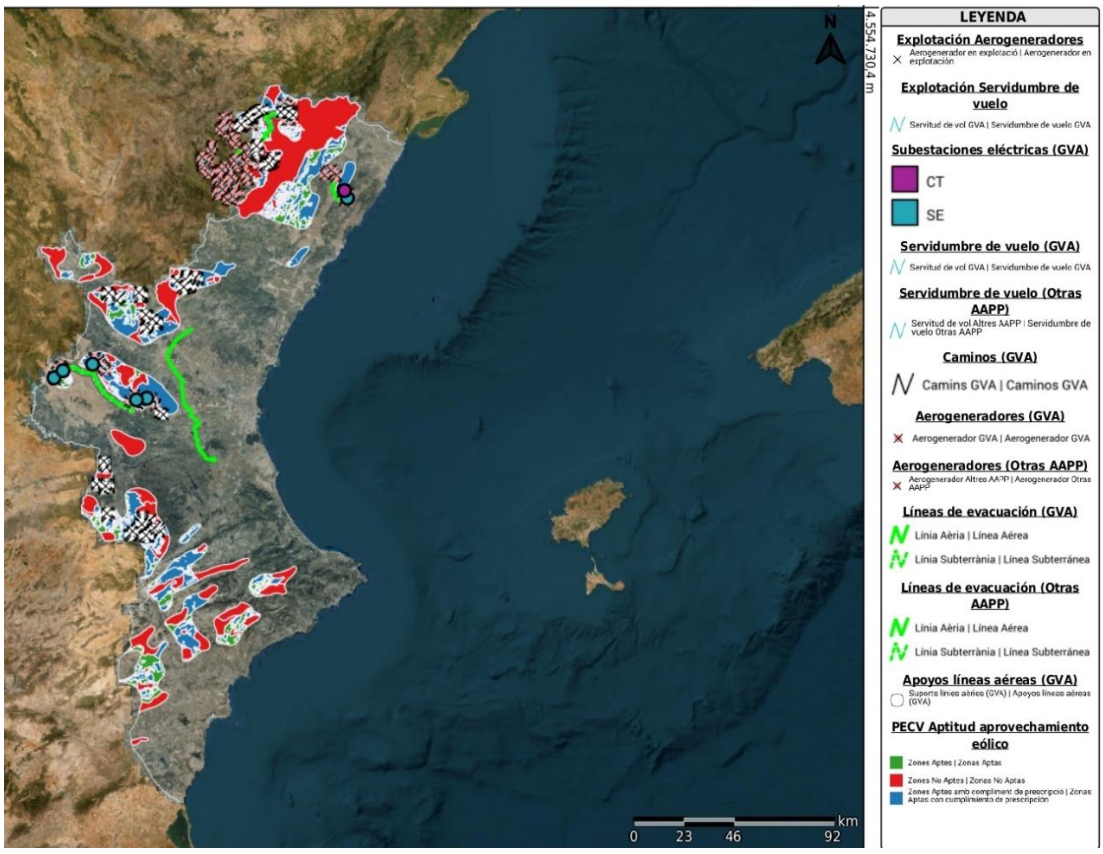
[34] (Datosmacro.com, n.d.-a)

Figure 14. Hours of sunshine in Spain



Source: Instituto Geográfico Nacional, n.d.

Figure 15. Wind energy in the Region of Valencia



Source: Institut Cartogràfic Valencià, n.d.

As shown in **Figure *14***, hours of sunshine increase at a fairly regular rate to the south, from 1600 yearly hours of sunshine in Galicia, Asturias, Cantabria and the Basque Country to over 2800 hours in some parts of the southern Peninsula and most of the islands. It is estimated that Spain receives about 2500 hours of sunshine per year[35]. Focusing on the Region of Valencia, it receives more than 2600 hours of sunshine per year, and, in Alicante, it can reach more than 2800 hours. Therefore, the Region of Valencia is over the national average.

Figure *15* shows the areas included in the Region of Valencia's wind energy plan. As the map legend shows, the areas where wind turbines are already in operation have a white background and a cross. Areas that are shown with a light red background and a cross are wind farms in process for which an implementation authorization has been requested (note that this map also shows the parts of these wind farms that are in the neighbouring province Teruel). Then there are the electrical substations (marked in blue and purple) and the evacuation lines (light green). White areas show Airline support. Finally, in the areas where there are no wind turbines so far, there are the suitable areas (green), non -suitable areas (red) and areas suitable with prescription compliance (blue). To sum up, wind farms still have a lot of area (green and blue) where they could expand in the Region of Valencia.

The Region of Valencia currently produces 70% of the energy it consumes[36]. Of that energy, 14,554 GWh were non-renewable and 3,364 GWh were renewable. According to current estimates, in 2026 the renewable facilities that are currently in operation and those being processed would produce 16,257 GWh. Therefore, renewable energy is the path to energy independence and sustainability.

2.3.3. Renewable energies and employment

Renewable energies create employment differently during each of the phases of their life cycle. These phases are development, installation/uninstallation and operation and maintenance.

As shown in **Table 7**, the phase of technological development in the renewable energy industry involves a medium volume of employment, meaning that it is not the largest phase in terms of employment creation. During this phase, employment locations tend to shift from international to local, indicating that the renewable energy sector still depends on foreign expertise while gradually developing local talent. Due to the

[35] (Vallejo Gutiérrez, 2022)

[36] (Andrés Durà, 2022)

consistent amount of work in this phase, employees can expect long-term job security. The creation of new technologies in this stage requires a very high level of specialization, as it calls for personnel with highly developed technical and engineering skills.

The phase of installation and uninstallation of the equipment involves a high volume of employment. The employment locations tend to switch from local to foreign. The duration of employment is temporary, with high levels of specialization required due to the technical nature of the work.

Last stage is operation and maintenance, that is, when the project is up and running. It typically involves a low volume of employment, mainly consisting of local workers who are responsible for the ongoing maintenance of the project. The employment is stable, meaning that workers can expect long-term job security. The level of specialisation required for these jobs is typically medium, as workers need to have a good understanding of the technical aspects of the project and be able to perform routine maintenance and repairs as needed.

Table 7. Phases of the life cycle of the exploitation of renewable energy sources and influence on employment.

Phase	Volume of employment	Location of employment	Duration of employment	Level of specialisation
Technological development	Medium	From foreign to local	Stable	Very high
Installation/uninstallation	High	From local to foreign	Temporary	High
Operation and maintenance	Low	Local	Stable	Medium

Source: (Llera-Sastresa et al., 2010)

Renewable energy also creates indirect employment, which are jobs created as a result of the economic activity of this sector. ***Table 8*** and **Table *9*** show the breakdown of indirect employment generated in the construction and operation/management stages in the life cycle of the exploitation of different types of renewable energies. Indirect employment created by renewable energy can also result from the reduction in energy prices in an area, which will be explained next. Low energy prices can attract businesses to an area, creating jobs and thus attracting workers and their families to live in that area.

Regarding employment in rural areas, renewable energies projects installed in those areas would create employment mainly in installation/uninstallation and operations and management phases. As shown in **Table 7** explained above, these phases would create temporary and long-term employment, respectively. Therefore, the phase that benefits rural areas the most is the operations and management one since it would create jobs for local people without requiring too much specialization. It is also important to note that the employment created in the installation phase could attract temporarily some people to the area, since it requires a high volume of employment. That could benefit the rural area economically and demographically for a certain period.

Renewable energies create more employment, are more inexpensive in the long term and pollute much less than fossil fuels[37]. According to Zafar (2022), the number of jobs created by renewable energy projects are the following:

Based on World Bank data, wind, solar and biomass energy create 4.6, 5.4, and 7.4 direct jobs respectively for every one million dollar of spending. They also create 4.9, 4.4, and 5.0 indirect jobs as well as 8.4, 9.3, and 12.4 induced jobs for every million invested. Coal pales in comparison as it only creates 0.8 direct jobs, 2.9 indirect jobs, and 2.3 induced jobs for every one million dollars spent.

Table 8. Breakdown of life cycle employment factors.

Breakdown of life cycle employment factors (person-years per GWh) for the nine different renewable power generation technologies.

	Construction stage			Operation & Maintenance stage			Total
	Direct	Indirect	Subtotal	Direct	Indirect	Subtotal	
Residential PV	0.67 (24.6%)	1.43 (52.4%)	2.10 (77.0%)	0.33 (12.0%)	0.30 (11.0%)	0.63 (23.0%)	2.73 (100.0%)
Large-scale PV	0.59 (20.8%)	1.12 (39.5%)	1.71 (60.3%)	0.89 (31.5%)	0.23 (8.2%)	1.13 (39.7%)	2.84 (100.0%)
Wind	0.24 (12.7%)	0.70 (36.9%)	0.94 (49.7%)	0.50 (26.5%)	0.45 (23.8%)	0.95 (50.3%)	1.89 (100.0%)
Large-scale Geothermal	0.27 (28.1%)	0.40 (36.0%)	0.67 (64.1%)	0.15 (23.2%)	0.20 (12.7%)	0.35 (35.9%)	1.01 (100.0%)
Small-scale Hydro	0.56 (30.0%)	0.71 (38.6%)	1.27 (68.6%)	0.46 (25.0%)	0.12 (6.4%)	0.58 (31.4%)	1.85 (100.0%)
Wood biomass	0.22 (5.7%)	0.17 (4.4%)	0.39 (10.1%)	0.65 (16.6%)	2.85 (73.3%)	3.50 (89.9%)	3.89 (100.0%)
Sewage sludge biogas	0.41 (13.7%)	0.88 (29.3%)	1.30 (43.0%)	0.91 (30.3%)	0.80 (26.7%)	1.72 (57.0%)	3.01 (100.0%)
Animal waste biogas	1.01 (20.7%)	0.95 (19.4%)	1.96 (40.1%)	1.14 (23.4%)	1.78 (36.4%)	2.92 (59.9%)	4.88 (100.0%)
Food waste biogas	0.63 (12.5%)	0.98 (19.4%)	1.61 (31.9%)	0.95 (18.9%)	2.48 (49.2%)	3.43 (68.1%)	5.04 (100.0%)

Source: (Hondo & Moriizumi, 2017)

[37] (Zafar, 2022)

Table 9. Contribution of the renewable energies to the indirect employment in the construction and O&M stages.

Table A
The top five industrial sectors that have relatively high indirect employment opportunities at the construction stage for the nine renewable power generation technologies.

		Contribution
Residential PV		
	PV modules	6.9%
	Semiconductor devices	6.3%
	Wholesale trade	5.0%
	Miscellaneous electronic components	3.0%
	Research and development (intra-enterprise)	2.3%
Large-scale PV		
	Wholesale trade	4.3%
	PV module	3.7%
	Semiconductor devices	3.3%
	Road freight transport (except self-transport)	2.4%
	Miscellaneous electronic components	1.6%
Wind		
	Nacelle of wind turbine	6.1%
	Blade of wind turbine	3.7%
	Tower of wind turbine	2.9%
	Wholesale trade	2.5%
	Civil engineering and construction services	1.5%
Large-scale geothermal		
	Production well drilling	4.6%
	Wholesale trade	4.1%
	Road freight transport (except self-transport)	3.2%
	Injection well drilling	1.8%
	Miscellaneous business services	1.6%
Small-scale hydro		
	Civil engineering and construction services	5.3%
	Wholesale trade	4.7%
	Plastic products	2.9%
	Road freight transport (except self-transport)	2.0%
	Worker dispatching services	1.7%
Wood biomass		
	Wholesale trade	0.7%
	Boiler	0.5%
	Miscellaneous business services	0.3%
	Civil engineering and construction services	0.3%
	Worker dispatching services	0.3%
Sewage sludge biogas		
	Wholesale trade	3.5%
	Relay switches and switchboards	2.4%
	Rotating electrical equipment	2.1%
	Civil engineering and construction services	1.6%
	Worker dispatching services	1.2%
Animal waste biogas		
	Wholesale trade	2.8%
	Road freight transport (except self-transport)	1.5%
	Metal products for construction	1.5%
	Chemical machinery	1.3%
	Rotating electrical equipment	1.2%
Food waste biogas		
	Wholesale trade	2.8%
	Chemical machinery	2.4%
	Rotating electrical equipment	1.2%
	Road freight transport (except self-transport)	0.9%
	Miscellaneous business services	0.9%

(Note) Manufacturing and construction industrial sectors are underlined.

Table B
The top five industrial sectors that have relatively high indirect employment opportunities at the O&M stage for the nine renewable power generation technologies.

		Contribution
Residential PV		
	Miscellaneous electrical devices and parts	2.4%
	Wholesale trade	1.6%
	Worker dispatching services	0.6%
	Research and development (intra-enterprise)	0.5%
	Electric measuring instruments	0.5%
Large-scale PV		
	Non-life insurance	2.2%
	Judicial, financial and accounting services	1.2%
	Wholesale trade	0.5%
	Worker dispatching services	0.3%
	Relay switches and switchboards	0.3%
Wind		
	Judicial, financial and accounting services	3.8%
	Non-life insurance	3.0%
	Wholesale trade	1.9%
	Retail trade	1.3%
	Miscellaneous general-purpose machinery	1.0%
Large-scale geothermal		
	Production well drilling	3.8%
	Non-life insurance	2.0%
	Injection well drilling	1.6%
	Wholesale trade	1.2%
	Judicial, financial and accounting services	1.1%
Small-scale hydro		
	Non-life insurance	2.7%
	Judicial, financial and accounting services	0.8%
	Wholesale trade	0.2%
	Miscellaneous business services	0.2%
	Worker dispatching services	0.2%
Wood biomass		
	Silviculture	14.8%
	Wooden chips	12.3%
	Logs	8.8%
	Road freight transport (except self-transport)	5.9%
	Wholesale trade	5.2%
Sewage sludge biogas		
	Miscellaneous business services	4.6%
	Sewage disposal	3.3%
	Wholesale trade	2.8%
	Judicial, financial and accounting services	2.6%
	Repair of construction	1.7%
Animal waste biogas		
	Animal waste disposal	14.4%
	Judicial, financial and accounting services	3.3%
	Wholesale trade	2.6%
	Retail trade	1.3%
	Rotating electrical equipment	1.3%
Food waste biogas		
	Food waste disposal	22.6%
	Judicial, financial and accounting services	3.2%
	Wholesale trade	2.4%
	Motor vehicle maintenance services	1.8%
	Miscellaneous business services	1.7%

Source: (Hondo & Moriizumi, 2017)

2.3.4. Renewable energy and electricity prices

In Spain, the electricity market operates through a pool where power generators submit their offers, and the market operator matches them with the demand bids. This market is divided into different zones based on the network capacity and transmission costs.

The "*subasta eléctrica*" or auction takes place within this pool, where generators bid to sell their energy for each hour, and the price is set according to the cost of production of the highest accepted offer[38]. This price is called the wholesaler's price. It is applied across most zones, except for the island territories and Ceuta and Melilla, where prices are regulated by the government.

Currently, if the highest accepted offer is, for example, gas, producers will get paid the cost of producing energy from that. This can result in higher costs for the consumer than if the highest accepted offer was from a cheaper source, such as wind energy. In other words, if the highest accepted offer comes from non-renewable energy source, it could cause a significant increase in the price, as the price of raw materials can vary significantly.

It is widely recognized that the production of renewable energy sources is often less expensive than the production of non-renewable energy sources[39]. This cost advantage is attributed to various factors, including the lower operational and maintenance costs associated with renewable energy technologies, as well as the declining costs of renewable energy technologies such as solar and wind power. As a result, increasing the proportion of renewable energy in the energy mix can help reduce the overall cost of electricity production and improve the economic sustainability of the energy sector.

Increasing renewable energy production can significantly reduce electricity prices. Prove of this is that “a marginal increase of 1 GWh of electricity production using renewable energy sources is associated with a reduction of around 1.9 € in electricity prices (around 4% of the average daily price between 2005 and 2009)”[40].

Lower electricity prices can ultimately benefit consumers by reducing their electricity bills and increasing their disposable income. This could lead to increased spending on other goods and services, which may boost the economy. Moreover, lower electricity

[38] (Civieta, 2021)

[39] (Bogdanov et al., 2021)

[40] (Gelabert et al., 2011)

prices may encourage energy-intensive industries to increase their production, leading to job creation and economic growth.

2.4. Climate change

Climate change is one of the biggest threats facing our planet today. It refers to "long-term shifts in temperatures and weather patterns"[41]. These changes are primarily driven by human activities, particularly the burning of fossil fuels such as coal, oil and gas, which releases greenhouse gases such as carbon dioxide into the atmosphere. These gases trap heat from the sun, warming the planet and causing the climate to change.

Current effects of the climate change are rising sea levels, global warming, more frequent extreme weather events such as hurricanes, droughts, and heatwaves, melting glaciers and ice caps, ocean acidification, and biodiversity loss[42]. Climate change is a global problem with far-reaching impacts on ecosystems, human health, and the world economy.

Rural areas are especially vulnerable to the impacts of climate change, as they often rely on natural resources for their livelihoods and face greater challenges in adapting to changes in the environment. Climate change is, in fact, one of the depopulation factors[43]. **Figure *16*** shows how climate change affects up to 23% to rural depopulation through aridity. According to the same source, about 29% of rural Spain is exposed to high rates of depopulation, 45% by aridity issues (caused by climate change), and 17.5% by simultaneous occurrences of both phenomena. This 17.5% decreases to 11.5% in accessible rural regions (those with a low population density and mostly agricultural land uses, but which are nonetheless connected to urban centers) and rises to 23.3% in isolated rural areas (those without a low population density and agricultural land uses, but which are also isolated from urban centers).

According to **Figure *17***, the Region of Valencia is mostly affected by international trade. This is the development of agro-industrial and renewable energy sectors as potential depopulation mitigation factors. For example, if Spain were to export agricultural products to other countries, this could contribute to economic growth and job creation in rural areas, potentially slowing down depopulation. However, this may be counter-productive to face climate change.

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[41] (United Nations, n.d.-b)

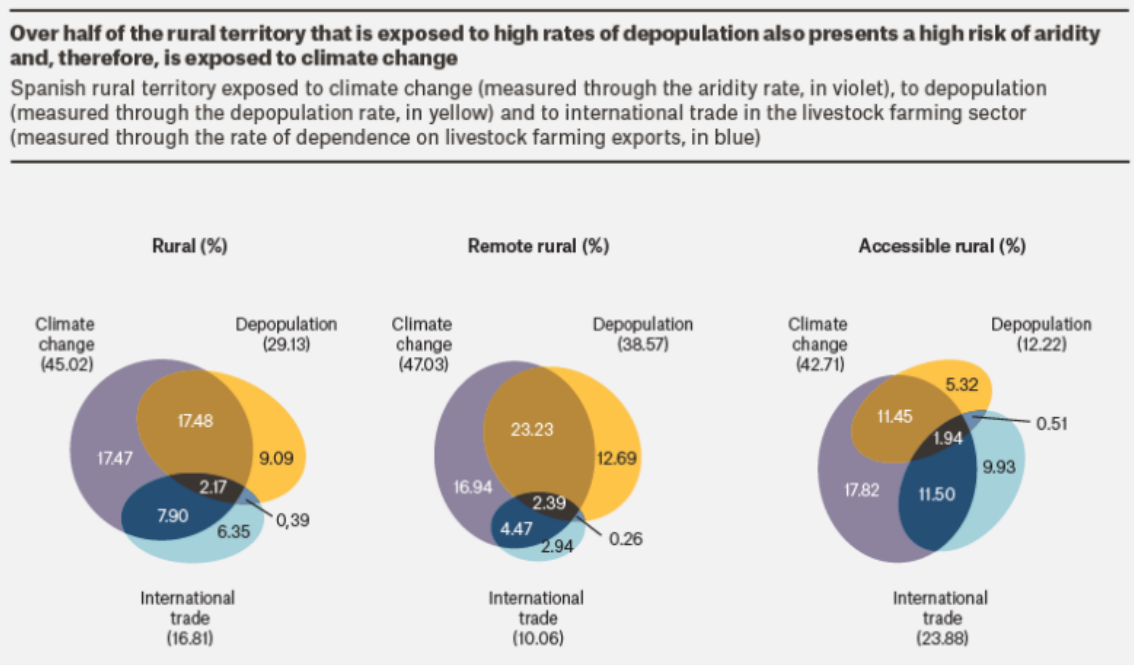
[42] (NASA, n.d.)

[43] (The Social Observatory - "la Caixa" Foundation, 2022)

At the same time, rural areas can also play a critical role in mitigating climate change by adopting renewable energy solutions. Renewable energy technologies, such as solar and wind offer a way to reduce greenhouse gas emissions and mitigate the impacts of climate change. These technologies can be particularly well-suited to rural areas, where there is often an abundance of natural resources, such as wind and sunlight, that can be harnessed to produce clean energy.

Also, the water scarcity problem in third-world countries could be solved with renewable energy and the introduction of desalination, which would provide up to 3 billion m3 of clean water per day[44]. However, most of the development across the regions is yet to take shape.

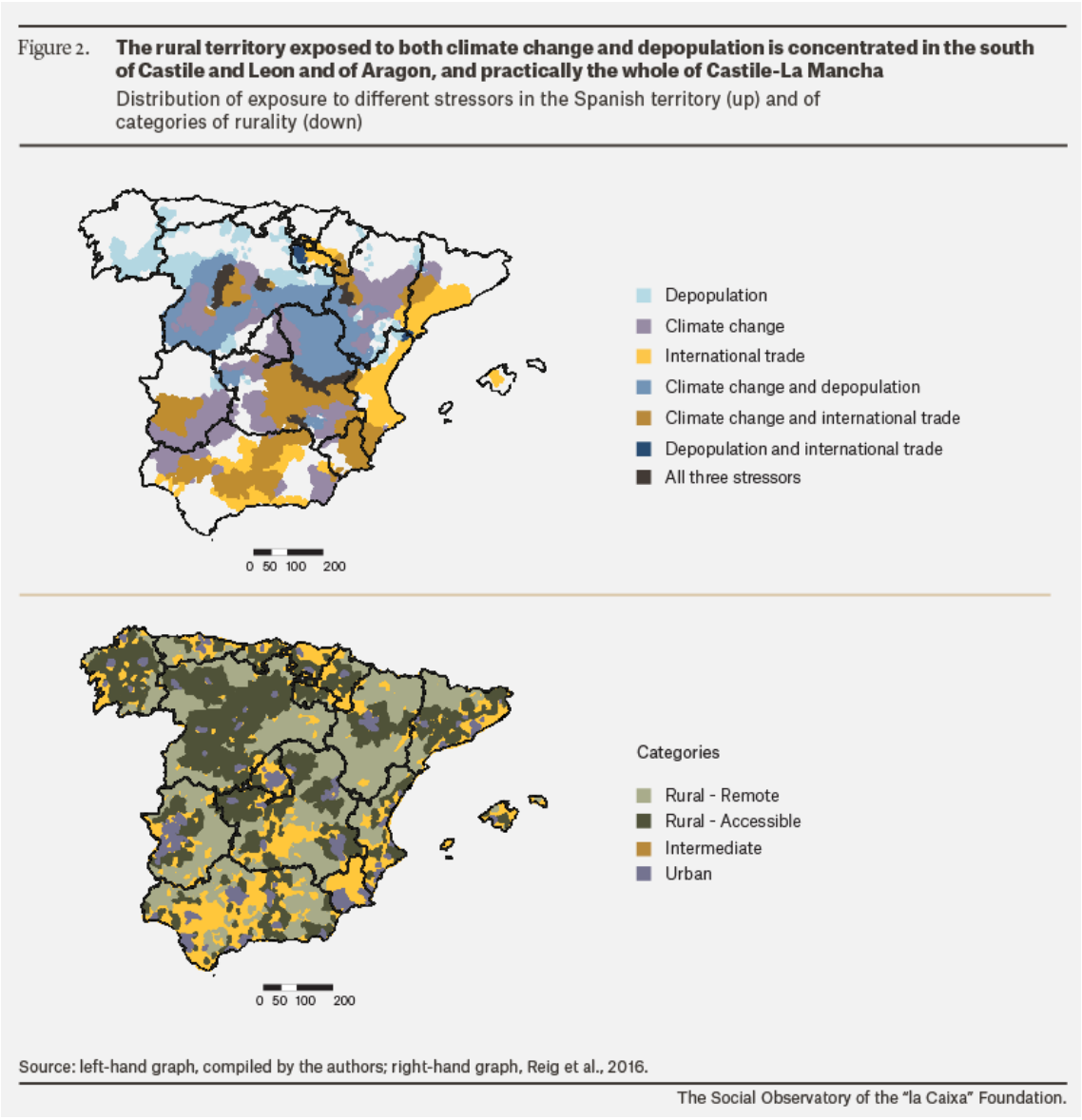
Figure 16. Relation among the different types of rural depopulation with climate change and international trade.



Source: (The Social Observatory - “la Caixa” Foundation, 2022)

[44] (Bogdanov et al., 2021)

Figure 17. A: Exposure to depopulation, climate change and international trade. B: Categories of rural areas.



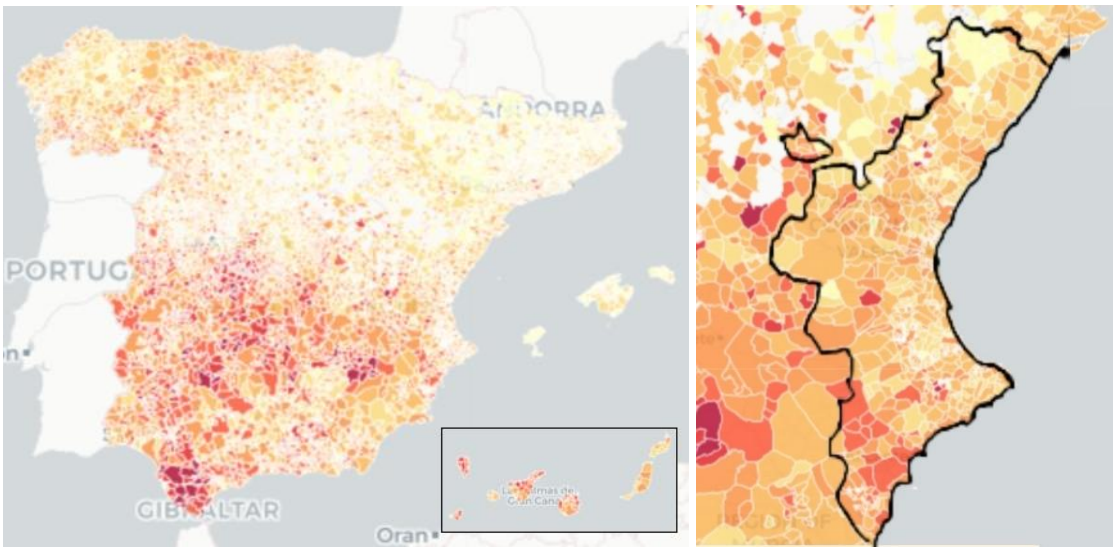
Source: (The Social Observatory - "la Caixa" Foundation, 2022)

2.5. Unemployment

High rates of unemployment have always been a problem in Spain. Spain's unemployment rate in December 2022 was 13.1%, more than the 6.1% average for the Eurozone, according to figures from Eurostat[45]. The unemployment rate has, however, been progressively decreasing since 2013, when it peaked at a record high of 27%. In the Region of Valencia, unemployment rate in December 2022 was 13.53%[46], even higher than the national average.

The financial crisis of 2008 had a severe negative impact on the nation and increased unemployment significantly. More recently, the Spanish economy and job market were significantly impacted by the COVID-19 epidemic, which temporarily increased unemployment in 2020.

Figure 18. Unemployment per municipalities



Source: screenshot of Datosmacro.com, n.d. At the left, Spain. At the right, a silhouette of the Valencia region drawn on top.

Rural areas specifically suffer this problem the most. This is because unemployment in a rural area eventually means depopulation. In order to face this problem and turn it into a solution, rural areas need *a reboot.*

Renewable energies, such as wind and solar power, can increase the population in rural areas by providing economic opportunities and better living conditions. The

[45] (Eurostat, n.d.)

[46] (INE, n.d.)

installation of renewable energy projects in rural areas can create jobs in the construction, operation, and maintenance of the facilities, and these jobs can attract people to the area. The income generated from these jobs can also support local businesses and services, further enhancing the local economy.

Renewable energies can also bring low-cost electricity to rural areas, which can make it more attractive for people to live there. This can lead to increased demand for housing, services, and businesses, which can stimulate further economic growth.

In addition, by offering a cleaner and more sustainable source of energy, renewable energies can raise the standard of living in rural regions. This can lessen pollutants and lead to better health results, attracting more potential residents to the area.

Ultimately, the use of renewable energies can help to revitalize rural areas by bringing new residents and businesses to the area while also creating economic opportunities and better living conditions.

3. CASE OF FORESTALIA

3.1. About Forestalia

According to what Forestalia publishes on its website, Forestalia is a Spanish company dedicated to promoting renewable energies such as wind, photovoltaic, and biomass. Forestalia's mission is to promote and develop sustainable renewable energy projects that contribute to a healthy and environmentally friendly environment while maximizing resource efficiency and generating opportunities for rural areas[47]. Their vision is to be a leading player in the renewable energy market and work towards a carbon-free economy that generates sustainable socio-economic development.

Forestalia was born in 2011 in Zaragoza as a pioneering company in the new green economy. Since then, it has promoted more than 2 GW of renewable facilities that are already in operation and has a portfolio of projects under development that exceeds 8 GW[48]. They have achieved that without any premiums or subsidies, and replacing them with hard work, vision, perseverance, trust, innovation, and courage. This is because they think that the technological maturity of the sector enables profitable and efficient renewable energies without the need for investment subsidies[49].

Forestalia has an integrated and diversified business model by technologies, covering the entire life cycle of the projects, from their promotion, business structure, construction supervision, environmental monitoring, and asset management. It also supervises all project phases with sustainability and ESG (environmental, social, and governance) criteria.

In terms of Environmental criteria, Forestalia is committed to promoting a sustainable economy that is free or neutral in carbon. It strives for decarbonization and a just and responsible energy transition to comply with international, European, and national obligations[50].

In terms of Social criteria, Forestalia aims to generate employment and development opportunities in the territories where it operates, particularly in rural areas with difficulties due to depopulation. The company also supports healthy habits, sports, and culture, and sponsors clubs and initiatives in the areas where it develops projects.

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[47] (FORESTALIA, n.d.-g)

[48] (FORESTALIA, n.d.-e)

[49] (Vidal, 2017)

[50] (FORESTALIA, n.d.-a)

In terms of Governance criteria, Forestalia is committed to complying with international quality standards and certificates. The company is also aware of the importance of social responsibility and promotes sustainable development in a carbon-neutral economy in order to fight climate change through innovative business approaches. Additionally, it seeks to generate positive returns and support socio-economic development in the territories where it operates.

Forestalia's CSR policy is structured around economic, social, environmental, and labour pillars[51]. The company's principles of action include complying with international commitments related to CSR, maintaining practices based on ethics and transparency, communicating and dialoguing with stakeholders, following national and international laws and regulations, conserving and promoting the environment, respecting human rights, and committing to transparency.

In fact, the company is committed to promoting gender equality and non-discrimination in the workplace. They have implemented strict protocols against harassment, discrimination, and violence. At the same time, Forestalia prioritizes work-life balance and supports employee training.

Forestalia aims to satisfy its clients and stakeholders by continuously monitoring their satisfaction, innovating its products and services, and providing transparent information.

The company also has a model of management and relations with suppliers, which seeks to ensure ethical and socially responsible processes with all parties involved in the value chain. The company's priority is to preserve the health and well-being of its employees and maintain a "zero accidents and injuries" vision.

The company has a Commission of Safety and Health and a Sustainability Commission that oversees regular and periodic actions related to risk prevention and sustainability. Forestalia also has a Code of Ethics and Conduct, and purchasing guidelines and policies that align with its principles and values.

Among its most notable projects are the Goya Project, which consists of a set of wind farms in Aragon with a total capacity of 200 MW; the Phoenix Project, which expands the former with another 342 MW of wind power; the El Aliagar Park, which is a 49 MW

[51] (FORESTALIA, n.d.-f)

photovoltaic plant in Zaragoza; and Cubillos del Sil, which is a 50 MW forest biomass-based power generation plant in León[52].

3.2. Cluster Maestrazgo wind power project

Clúster Maestrazgo is a wind power project that initially included 22 wind farms in the municipalities of Mosqueruela, Fortanete, Cantavieja, La Iglesuela del Cid, Villarluengo, Tronchón and Mirambel in the province of Teruel, and the evacuation lines also pass through the towns of Portell de Morella, Cinctorres, and Morella, in the province of Castellón. ***Table 10*** and **Figure 19** show a breakdown of wind turbines by zone, wind park, power, medium voltage point, and access route and the initially proposed project by the promoter for the 22 wind parks and their evacuation infrastructure up to the SET-Morella 400 kV, respectively.

This project, presented by Forestalia, was approved in December 2022 by the Ministry for Ecological Transition and Demographic Challenge (MITECO), which issued a resolution authorizing 20 wind farms with 125 wind turbines, out of the initial 161, with a total power of 762.5 megawatts (MW)[53]. The initial project included 161 wind turbines and a power of almost 883 MW, but 36 have been removed and others relocated, mainly due to impacts on birds and proximity to urban areas.

The two wind farms that are completely excluded are Cabecero I, in Fortanete, due to its very high risk of collision with birds, and Cid V, in Villarluengo, because it coincides with areas of high presence of bearded vultures *(gyps fulvus).* Forestalia had modified the wind turbine model with respect to the initial proposal, increasing its power from 5.5 MW to 6.1 MW, while maintaining the dimensions of the device, with a maximum hub height of 120.9 meters, a blade diameter of 158 meters, and a total height of 200 meters. The exclusion of the 36 devices by MITECO represents a reduction of 120 MW in the total power.

The project includes the installation of medium voltage infrastructure, transformer substations, and evacuation lines to carry the energy generated by the wind farms to the Iglesuela collector substation, where the power will be raised to 400 kV. From there, the energy will be jointly evacuated to the REE Morella 400 kV substation for delivery to the transport network.

[52] (FORESTALIA, n.d.-c), (FORESTALIA, n.d.-b) and (FORESTALIA, n.d.-d)

[53] (Aguilar, 2022) and (BOE, 2022)

According to the report issued by MITECO, the cluster has no direct impact on any of the Special Protection Areas for Birds (SPA), although twelve wind farms are located on a Special Conservation Area, integrated into the Natura 2000 Network of Maestrazgo and Sierra de Gúdar, and two others in the Rambla de las Truchas Special Conservation Area. In addition, the Muelas and Estrechos del Río Guadalope protection area is affected by access to three wind farms. The impact of evacuation infrastructure on the landscape has been evaluated as moderate.

Regarding landscape impacts, the wind turbines are visible from 24 of the 36 population centres included in the 10-kilometer envelope, with Mosqueruela and La Iglesuela del Cid, located less than two kilometres from the nearest wind turbine, being the most affected. The impact of wind farms in which any of the wind turbines would be visible within two kilometres of population centres has been evaluated as severe, while for the rest of the wind farms, the impact has been assessed as compatible or moderate.

In order to compensate the society for the environmental impact, visual aesthetics, and potential inconveniences during the construction of the project, Forestalia offered “free electricity” to the residents of the villages involved in the project[54]. So far, approximately 40 municipalities in the Aragon region have accepted the proposal and signed agreements with Forestalia. These agreements allow households with registered residents in the participating municipalities to receive a daily electricity bonus equivalent to a maximum of 15 kilowatt-hours (kWh) per day. The company has committed to providing this free electricity throughout the entire lifespan of the renewable energy plants, estimated to be around 30 years. In addition to the free consumption benefit, Forestalia has committed to provide additional municipal funds for socio-economic development, job creation, and population retention efforts in the respective areas.

However, there are municipalities, including Morella, Portell de Morella, and Cinctorres, that have rejected the proposal, since they have emphasized the need for further clarification and detailed information before considering any agreements or partnerships. These municipalities will probably renegotiate the agreement, since Forestalia received the favourable environmental report in November 2022 and expects to receive the construction permit by mid-2023.

[54] (Libertad Digital, 2023), (Plaza, 2023d) and (el Periódico de Aragón, 2023)

The project has been environmentally friendly and has had a positive impact on the community as well. The project's success will not only boost the local economy but also provide job opportunities for the community members. Additionally, the project has raised awareness about sustainable energy and has inspired other businesses to follow suit. Overall, the project has been a great example of how economic development and environmental protection can go hand in hand.

In addition to the environmental impact, it's important to consider the economic impact of this project. The development of the Clúster Maestrazgo is expected to bring significant economic benefits to the region. The construction of the wind farms and associated infrastructure will create hundreds of jobs, both during the construction phase and the operational phase, which will last for decades. Additionally, the wind farms will generate revenue for local landowners who lease their land for the wind turbines.

Furthermore, the project will contribute to Spain's goal of achieving 74% renewable energy by 2030. The Clúster Maestrazgo will generate enough electricity to power over 420,000 households, reducing Spain's dependence on fossil fuels and helping to combat climate change.

However, it's also important to consider the concerns of local communities about the visual impact of the wind turbines. The Miteco report acknowledges that the turbines will be visible from many nearby towns and villages, and that the impact on the visual landscape and cultural heritage of the region must be considered. The report also addresses potential noise pollution, bird and bat collisions, and the impact on the local ecosystem. Overall, the report concludes that while there will be some negative impacts, the benefits of the wind farm outweigh the costs and it can be built in a way that minimizes harm to the environment and local communities. However, it's important to note that there are still ongoing debates and controversies surrounding the development of wind farms, particularly regarding their potential impact on wildlife and local communities.

3.3. Advantages and disadvantages

The Clúster Maestrazgo wind power project, consisting of 22 wind farms in the provinces of Teruel and Castellón, has both advantages and disadvantages. Approved by the Ministry for Ecological Transition and Demographic Challenge in December 2022, the project authorizes 20 wind farms with 125 wind turbines, providing a total power of 762.5 megawatts (MW). While the project contributes to Spain's renewable

energy goals and reduces reliance on fossil fuels, it also raises concerns about visual impact, noise pollution, bird and bat collisions, and potential harm to the local ecosystem.

On the positive side, the Clúster Maestrazgo wind power project plays a crucial role in Spain's commitment to renewable energy. With a total capacity of 762.5 MW, it generates a significant amount of electricity, capable of powering over 420,000 households. This contributes to a reduction in carbon emissions and helps combat climate change. Additionally, the project stimulates the local economy by creating employment opportunities during both the construction and operational phases, benefiting the community members. Furthermore, its success in promoting sustainable energy raises awareness and inspires other businesses to adopt similar practices, thereby fostering positive environmental change.

Moreover, Forestalia's proposal of providing "free electricity" to residents affected by the wind farm project offers multiple benefits. It compensates for the environmental impact, visually enhances the aesthetics, and addresses potential inconveniences during construction. Over 40 municipalities in Aragon have accepted the proposal, allowing households to receive up to 15 kilowatt-hours of electricity per day throughout the renewable energy plants' 30-year lifespan. Forestalia also commits additional funds for socio-economic development, job creation, and population retention efforts, highlighting their commitment to environmental sustainability and community support. However, some municipalities like Morella, Portell de Morella, and Cinctorres have rejected the proposal due to a lack of clarity and detailed information.

However, certain drawbacks need to be considered. The visual impact of the wind turbines on the landscape and cultural heritage of the region is a significant concern. The MITECO report acknowledges that the turbines will be visible from many nearby towns and villages, potentially affecting the visual aesthetics. Furthermore, the project raises concerns about noise pollution, bird and bat collisions with the wind turbines, and its impact on the local ecosystem. These factors require careful consideration and mitigation measures to minimize harm to the environment and local communities.

Despite these disadvantages, the benefits of the Clúster Maestrazgo wind power project outweigh the costs. It contributes significantly to Spain's renewable energy targets and offers economic opportunities for the region. The concerns surrounding visual impact, noise pollution, wildlife protection, and ecosystem preservation can be addressed through proper planning, mitigation measures, and ongoing dialogue with the local communities. It is important to continue evaluating the project's impacts and

implementing measures to ensure that its benefits are maximized while minimizing any potential harm.

In conclusion, the Clúster Maestrazgo wind power project represents a significant step towards clean and sustainable energy generation. While it presents challenges in terms of visual impact, noise pollution, and environmental concerns, the project's advantages in terms of renewable energy generation, economic development, and environmental awareness are substantial. By carefully addressing the project's disadvantages and implementing mitigation strategies, the Clúster Maestrazgo wind power project can pave the way for a greener and more sustainable future.

Table 10. Breakdown of wind turbines by zone, wind park, power, medium voltage point, and access route.

Bloque (longitud)	Parque	Potencia (MW)	N.º Aerog.	Punto de salida de las conducciones de media tensión	Ruta de acceso [1]
IE-Norte (29,7 km)	Cid II.	44	7	Centro de Seccionamiento, hasta la SET CID III.	Ruta norte [2].
	Cid III.	44	8	SET CID III.	Ruta norte.
	Cid IV.	44	8	SET CID IV.	Ruta norte.
	Cid V.	30,35	6	Centro de Seccionamiento, hasta la SET CID III.	Ruta norte.
IE-Este (19,8 km en el eje principal y dos ramales de 5,7 y 2,0 km)	Estrella I.	44	8	SET Estrella I.	Ruta sur y oeste [3].
	Estrella II.	44	8	SET Estrella II.	Ruta sur y oeste.
	Estrella III.	38,5	7	SET Estrella II.	Ruta sur y oeste.
	Estrella IV.	38,5	7	Centro de seccionamiento, hasta la SET Estrella I.	Ruta sur y oeste.
	Vacada II.	38,5	7	Centro de seccionamiento, hasta la SET Estrella I.	Ruta sur y oeste.
	Concejo II.	44	8	Centro de seccionamiento, hasta la SET Iglesuela.	Ruta norte.
	Concejo III.	44	8	Centro de seccionamiento, hasta la SET Iglesuela.	Ruta norte.
IE-Oeste (28,6 km en el eje principal y un ramal 7,7 km)	Cabecero I.	38,5	7	SET Cabecero I.	Ruta norte.
	Cabecero II.	38,5	7	Centro de seccionamiento, hasta la SET Cabecero I.	Ruta sur y oeste.
	Cabecero III.	38,5	7	SET Cabecero III.	Ruta sur y oeste.
	Cabecero IV.	38,5	7	SET Cabecero III.	Ruta sur y oeste.
	Vacada I.	38,5	7	SET Cabecero I.	Ruta sur y oeste.
	Vacada III.	38,5	7	SET Vacada III.	Ruta sur y oeste.
	Vacada IV.	38,5	7	SET Vacada III.	Ruta sur y oeste.
	Vacada V.	38,5	7	SET Cabecero III.	Ruta sur y oeste.
	Vacada VI.	38,5	7	SET Cabecero II.	Ruta sur y oeste.
-	Concejo I.	44	8	SET Iglesuela.	Ruta norte.
IE-total Morella	Cid I.	44	8	SET Iglesuela.	Ruta norte.

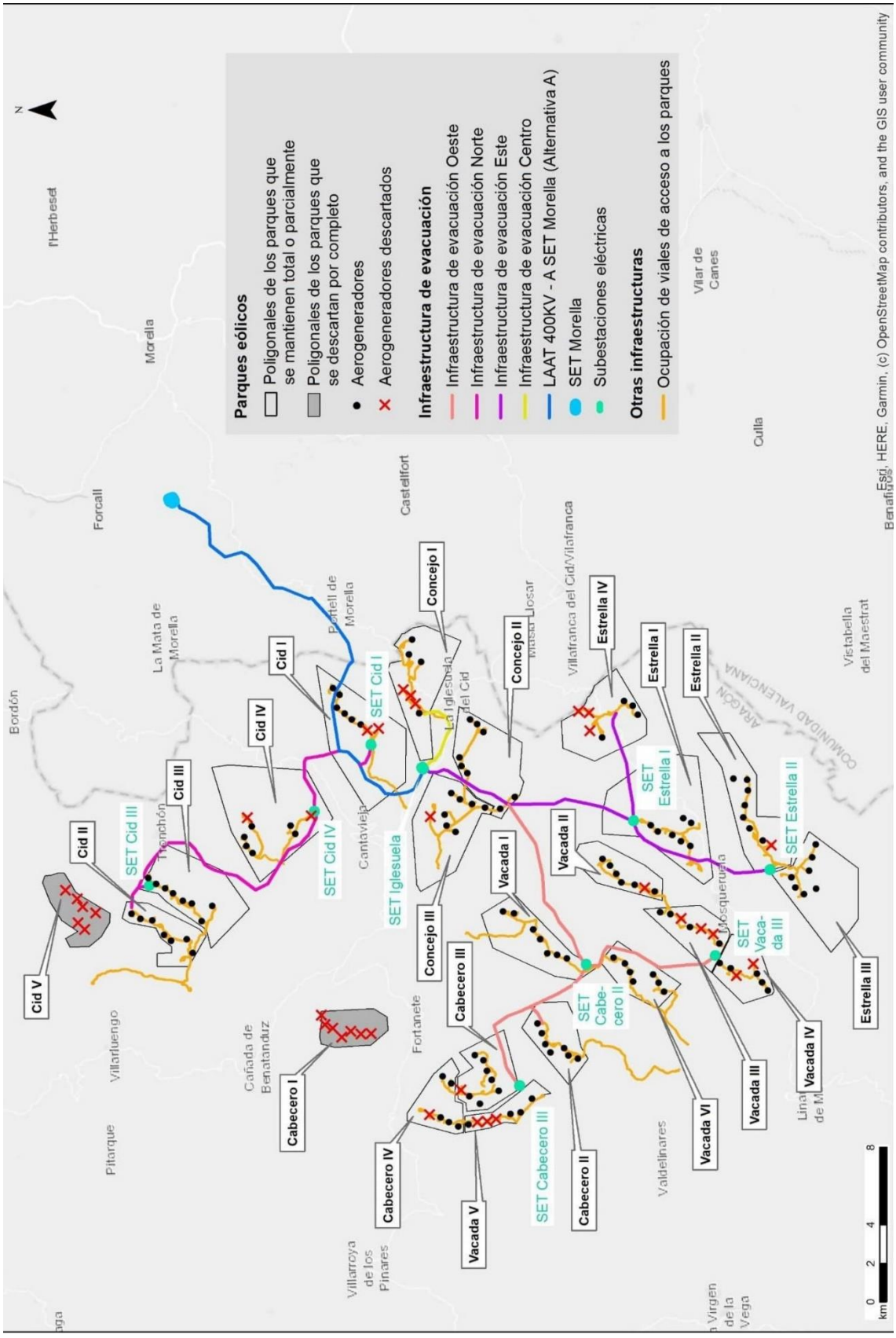
[1] Para definir las rutas de acceso se toma como referencia el límite provincial entre Castellón y Teruel, en el que la CV-15 pasa a denominarse A-227, a la cual se accede desde el eje Castellón-Alcañiz (N-232) en Morella (provincia de Castellón).

[2] Las carreteras asociadas a la ruta norte, de La Iglesuela-Cantavieja-Fortanete son: A-227, A-226, A-1702, A-2706, VF-TE-16 y VF-TE-17 (hacia Cantavieja y Mirambel).

[3] Las carreteras asociadas a la ruta sur y oeste, de Mosqueruela son: A-226 (hacia Fortanete), A-1701, VF-TE-17 (hacia Mosqueruela) y SC-44106-01.

Source:(BOE, 2022)

Figure 19. Definitive implementation map of the project with the initially proposed 22 wind parks and their evacuation infrastructure up to the SET-Morella 400 kV.



Source: (BOE, 2022)

3.4. Stakeholders and impact

It is crucial to continuously evaluate the stakeholders and the impact of the project on them incorporating the concept of Corporate Social (CSR), to make sure the negative effects are minimised at the same time benefits outweigh potential drawbacks. Analysing these effects is vital for the success of the Clúster Maestrazgo wind power project.

Stakeholders can be classified into two categories: internal and external. Internal stakeholders are those who are directly involved in the implementation or execution of the project, have a relationship with the organization and have an interest on the success of the project. These are the developers and operators, construction and engineering firms involved in the project and investors or financing companies. External stakeholders are those who are not directly involved in the project, but still are affected by its outcomes, such as the local residents, landowners and farmers, local businesses and industries, government, utility companies and grid operators and, most importantly, environment. It is important to ensure that all stakeholders' actions align with CSR principles, such as promoting sustainable development.

Despite not being involved in the project, external stakeholders will experience most of the project's effects, such as changes in their surroundings, economic impacts, or environmental consequences. Therefore, social, environmental and economic impact on all the stakeholders has to be analysed.

The first internal stakeholder is **the developer and operator of the project, Forestalia**. As the developer of the wind power project, Forestalia has an interest in its successful implementation. The company is committed to sustainable development, meeting international quality standards, and promoting a carbon-neutral economy. The Clúster Maestrazgo wind power project also presents significant opportunities for the company. It benefits from the project's construction, operation, and maintenance phases, which generate revenue and contribute to their business growth. The success of the project enhances their reputation in the renewable energy sector and strengthens their position as industry leaders.

The project provides **construction and engineering firms** with substantial business opportunities. They are involved in the design, development, and installation of wind turbines, infrastructure, and associated facilities. This creates jobs and stimulates economic growth for these firms, contributing to their financial success.

Investors and financing companies play a crucial role in supporting the project financially. Their investment allows the project to move forward and provides them with potential long-term returns. The Clúster Maestrazgo wind power project offers attractive investment prospects in the renewable energy sector, aligning with the growing demand for sustainable and profitable ventures.

Regarding external stakeholders, **local communities** would be the most affected in terms of proximity and immediate impact. They would experience the project's effects more directly, including changes in the local landscape, potential noise pollution, and visual impact from the wind turbines. Therefore, it is essential to consider their concerns and engage in effective communication and community engagement to address any potential issues and ensure their support for the project. In addition to the potential effects mentioned above, the project may also bring about employment opportunities for the local communities, contributing to economic growth and development in the region. Furthermore, local residents would benefit from the agreement between Forestalia and their local governments, as they would receive “free electricity” while the project is in operation, provided their local government agreed.

Concerns of local communities include visual impact, noise pollution, and ecosystem preservation. All these issues are part of **the environment**. According to the report in which the project was approved[55], the *Ministry for Ecological Transition and Demographic Challenge* (MITECO) was the responsible of evaluating the environmental impact assessment of the project.

The project has both positive and negative environmental impacts. On the positive side, it offers clean and renewable energy generation. However, there are concerns regarding the visual impact on the landscape, noise pollution, bird and bat collisions, and potential disruption to the local ecosystem. To address these issues, the project should prioritize measures such as careful turbine placement, adherence to noise regulations, ongoing monitoring, and implementation of mitigation strategies to minimize harm to wildlife and the surrounding environment. Also, all temporarily altered areas will be restored to their natural state, and in case of earthquakes, the affected areas will be restored both in terms of land and vegetation. These measures are essential to ensure the project's sustainability and minimize any adverse effects.

Bird collisions have also been assessed. In conclusion, the Clúster Maestrazgo wind power project by Forestalia demonstrates a strong CSR impact on various

[55] (BOE, 2022)

stakeholders. By prioritizing environmental sustainability, engaging in effective communication with local communities, supporting economic growth and development, and adhering to regulatory standards, the project aligns with responsible and sustainable practices. The project's commitment to CSR principles enhances its positive contributions to society, the environment, and the local economy, making it a significant step towards clean and sustainable energy generation in Spain.

Table *11* shows the minimum distances among wind turbines to be considered for each of the protected species. **Table *12*** shows the estimated number of collisions per year of non-endangered species.

The environmental impact assessment conducted by MITECO concludes that, while there will be some negative impacts, the overall benefits of the wind farm outweigh the costs. However, ongoing monitoring and adaptive management should be implemented to address any unforeseen environmental consequences and optimize the project's sustainability.

Concerning local **governments**, most municipalities have accepted Forestalia's proposal of "free electricity," while others have rejected it due to the need for more information. Regardless of this, MITECO approved the project and issued the necessary permits. Government authorities have a responsibility to ensure that the project meets environmental standards and contributes to Spain's renewable energy targets.

As **landowners** in the project area, **farmers** may face both benefits and challenges. On the positive side, farmers have the opportunity to lease their land for wind turbine installation, providing an additional source of income and contributing to the local economy. This can contribute to their financial stability and diversification of agricultural activities. However, there may also be concerns for farmers, especially impacts on forest fire surveillance posts due to reduced visibility, as well as impacts on helicopter water-loading points.

The project may affect the visibility of fire surveillance posts and helicopter water-loading points, potentially impacting forest fire prevention efforts. However, the project developer has conducted visibility analyses and deemed the decrease in visibility from the wind turbines as insignificant. To address concerns about firefighting capabilities, the project adheres to criteria set in Forest Fire Defense Plans, ensuring that every forested area has a water point within a 4 km distance. Additional water points will be installed for reservoirs situated within 1,500 m of the project's infrastructure. These

measures aim to mitigate potential environmental and operational challenges while preserving cultural heritage and supporting effective fire prevention and firefighting in the region.

Despite these measures, the different departments involved in agriculture are divided regarding the support to the project, as the **Table *13*** and **Table *14*** show.

About **utility companies and grid operators**, the project construction and operation will impact the existing energy infrastructure and require coordination to integrate the generated wind power into the grid effectively. The installation of wind turbines and associated infrastructure may require upgrades or modifications to the electrical grid. The evacuation of the electricity generated is projected to go through a 400KV line until the SET Morella. Coordinating with utility companies and grid operators is essential to optimize the transmission and distribution of the renewable energy generated by the project.

The last but not least stakeholder to be considered are the **local businesses and industries.** They are likely to experience both direct and indirect effects from the wind power project. Directly, there may be opportunities for local businesses to participate in the construction phase, supplying materials, equipment, and services. Additionally, the ongoing operation and maintenance of the wind farm could create job opportunities for nearby communities. Indirectly, the presence of the wind power project may stimulate economic activity in the area, such as increased tourism and business investment. However, it is important to consider potential challenges that local businesses may face, such as changes in the local landscape and potential disruptions during the construction phase. Close collaboration between project developers and local businesses is crucial to mitigate any negative impacts and maximize the potential benefits for the local economy.

Concerning the impacts of the project, there are environmental, economic and social impacts. Environmentally, the project aims to contribute to Spain's renewable energy goals, reducing dependence on fossil fuels and combating climate change. However, there are concerns about the impact on birds and bats, noise pollution, and potential harm to the local ecosystem. The MITECO report acknowledges the need to address these concerns and mitigate any negative environmental impacts.

As for economic impacts, the project provides economic benefits to the region by creating employment opportunities during both the construction and operational phases. It also generates revenue for local landowners who lease their land for the

wind turbines. Furthermore, Forestalia's commitment to providing additional funds for socio-economic development and population retention efforts demonstrates a positive economic impact.

Socially, Forestalia's commitment to promoting employment opportunities and development in rural areas contributes to the social well-being of the communities where the project is located. The company's focus on gender equality, non-discrimination, and work-life balance further demonstrates its commitment to social responsibility.

In conclusion, the Clúster Maestrazgo wind power project by Forestalia demonstrates a strong CSR impact on various stakeholders. By prioritizing environmental sustainability, engaging in effective communication with local communities, supporting economic growth and development, and adhering to regulatory standards, the project aligns with responsible and sustainable practices. The project's commitment to CSR principles enhances its positive contributions to society, the environment, and the local economy, making it a significant step towards clean and sustainable energy generation in Spain.

Table 11. Minimum distances to consider in population studies of LESRPE species.

Grupos	Radio (km)
Aves necrófagas.	25
Quirópteros.	10
Grandes águilas, aves acuáticas y otras planeadoras.	5
Resto aves.	1

Source: (BOE, 2022)

Table 12. Estimated number of collisions per year of specimens of non-endangered species from the LESPRE that trigger the consideration of a wind turbine as dangerous.

Grupo taxonómico	N.º colisiones / año
Rapaces diurnas (accipitriformes y falconiformes) y nocturnas (strigiformes).	3
Aves marinas (gaviiformes, procellariformes y pelecaniformes), acuáticas (anseriformes, podiciformes, ciconiformes y phoenicopteriformes), larolimícolas (charadriiformes), gruiformes, pterocliformes y caprimulgiformes.	5
Galliformes, columbiformes, cuculiformes, apodiformes, coraciiformes, piciformes y paseriformes.	10
Quirópteros.	10

Source: (BOE, 2022)

Table 13. Consultations with affected public administrations and stakeholders, and their responses. Clúster Maestrazgo, 1.

Consultados*	Contestación
Administración Estatal	
Dirección General de Carreteras. Ministerio de Transportes, Movilidad y Agenda Urbana.	Sí[1]
Dirección General de Calidad y Evaluación Ambiental y Medio Natural. Ministerio para la Transición Ecológica y el Reto Demográfico.	Sí[2]
Dirección General de Aviación Civil. Ministerio de Transportes, Movilidad y Agenda Urbana.	Sí[3]
Agencia Estatal de Seguridad Aérea (AESA). Ministerio de Transportes, Movilidad y Agenda Urbana.	Sí
Confederación Hidrográfica del Júcar. Ministerio para la Transición Ecológica y el Reto Demográfico.	Sí[4]
Confederación Hidrográfica del Ebro. Ministerio para la Transición Ecológica y el Reto Demográfico.	Sí
Subdirección General de Residuos. Ministerio para la Transición Ecológica y el Reto Demográfico.	No
Oficina Española de Cambio Climático. Ministerio para la Transición Ecológica y el Reto Demográfico.	Sí
Administración Autonómica	
Consejo de Ordenación del Territorio en Aragón. Departamento de Vertebración del Territorio, Movilidad y Vivienda. Gobierno de Aragón.	Sí
Dirección General de Ordenación del Territorio. Departamento de Vertebración del Territorio, Movilidad y Vivienda. Gobierno de Aragón.	Sí
Dirección General de Energía y Minas. Departamento de Industria, Competitividad y Desarrollo Empresarial. Gobierno de Aragón.	No
Dirección General de Transportes. Departamento de Vertebración del Territorio, Movilidad y Vivienda. Gobierno de Aragón.	No
Dirección General de Carreteras. Departamento de Vertebración del Territorio, Movilidad y Vivienda. Gobierno de Aragón.	Sí[5]
Dirección General de Patrimonio Cultural. Departamento de Educación, Cultura y Deporte. Gobierno de Aragón.	Sí
Dirección General de Urbanismo. Departamento de Vertebración del Territorio, Movilidad y Vivienda. Gobierno de Aragón.	No
Dirección General de Medio Natural y Gestión Forestal. Departamento de Agricultura, Ganadería y Medioambiente. Gobierno de Aragón.	Sí
Dirección General de Turismo. Departamento de Industria, Competitividad y Desarrollo Empresarial del Gobierno de Aragón.	No
Dirección General de Interior y Protección Civil. Departamento de Presidencia y Relaciones Institucionales. Gobierno de Aragón.	Sí[6]
Servicio de Biodiversidad. Departamento de Agricultura, Ganadería y Medio Ambiente. Gobierno de Aragón.	No
Dirección General de Desarrollo Rural. Departamento de Agricultura, Ganadería y Medio Ambiente. Gobierno de Aragón.	No
Instituto Aragonés de Gestión Ambiental (INAGA). Departamento de Agricultura, Ganadería y Medio Ambiente. Gobierno de Aragón.	Sí
Instituto Aragonés del Agua. Departamento de Agricultura, Ganadería y Medio Ambiente. Gobierno de Aragón.	No
Dirección General de Cambio Climático y Educación Ambiental. Departamento de Agricultura, Ganadería y Medio Ambiente. Gobierno de Aragón.	Sí
Dirección General de Salud Pública. Departamento de Sanidad. Gobierno de Aragón.	Sí
Consejo Provincial de Urbanismo (Teruel). Subdirección General de Urbanismo. Dirección General de Urbanismo. Departamento de Vertebración del Territorio, Movilidad y Vivienda. Gobierno de Aragón.	Sí
Servicio Provincial de Agricultura, Ganadería y Medio Ambiente en Teruel. Departamento de Agricultura, Ganadería y Medioambiente. Gobierno de Aragón.	Sí
Servicio Provincial de Teruel de Educación, Cultura y Deporte. Gobierno de Aragón.	No
Servicio Provincial de Industria, Competitividad y Desarrollo Empresarial de Teruel. Sección Energía. Gobierno de Aragón.	No
Servicio Provincial de Industria, Competitividad y Desarrollo Empresarial de Teruel. Sección Minas Gobierno de Aragón.	Sí
Dirección General de Cultural y Patrimonio. Conselleria de Educación, Cultura y Deporte. Generalitat Valenciana.	No
Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica. Generalitat Valenciana.	No

Source: (BOE, 2022)

Table 14. Consultations with affected public administrations and stakeholders, and their responses. Clúster Maestrazgo, 2.

Consultados*	Contestación
Área de Movilidad. Conselleria de Política Territorial, Obras Públicas y Movilidad.	No
Dirección General de Industria, Energía y Minas. Conselleria de Economía Sostenible, Sectores Productivos, Comercio y Trabajo. Generalitat Valenciana.	No
Dirección General de Gestión del Medio Natural y Evaluación Ambiental. Consejería de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica. Generalitat Valenciana.	Sí
Agencia Valenciana de Seguridad y Respuesta a las Emergencias. Conselleria de Justicia, Interior y Administración Pública. Generalitat Valenciana.	Sí
Dirección General de Salud Pública. Conselleria de Sanidad Universal y Salud Pública. Generalitat Valenciana.	Sí
Dirección General de Política Territorial y Paisaje. Conselleria de Política Territorial, Obras Públicas y Movilidad. Generalitat Valenciana.	Sí[7]
Servicio Territorial de Urbanismo de Castellón. Conselleria de Política Territorial, Obras Públicas y Movilidad. Generalitat Valenciana.	Sí
Servicio Territorial de Obras Públicas de Castellón. Dirección General de Obras Públicas, Transportes y Movilidad Sostenible. Conselleria de Política Territorial, Obras Públicas y Movilidad. Generalitat Valenciana.	Sí
Subdirección General de Evaluación Ambiental. Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica Generalitat Valenciana.	No
Dirección General de Prevención de Incendios Forestales. Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica Generalitat Valenciana.	No
Dirección General de Cambio Climático y Calidad Ambiental. Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica. Generalitat Valenciana.	No
Dirección General del Agua. Conselleria de Agricultura, Desarrollo Rural, Emergencia Climática y Transición Ecológica. Generalitat Valenciana.	Sí
Dirección Territorial de Cultura de Castellón. Conselleria de Educación, Cultura y Deporte. Generalitat Valenciana.	No
Administración Local	
Vías y Obras. Diputación Provincial de Teruel.	Sí
Diputación Provincial de Castellón.	Sí
Ayuntamiento de Mosqueruela.	Sí
Ayuntamiento de Puertomingalvo.	Sí
Ayuntamiento de Cantavieja.	No
Ayuntamiento de Iglesuela del Cid.	Sí
Ayuntamiento de Mirambel.	Sí
Ayuntamiento de Villarluengo.	Sí
Ayuntamiento de Tronchón.	Sí
Ayuntamiento de Fortanete.	Sí
Ayuntamiento de Cañada de Benantaduz.	No
Ayuntamiento de Valdelinares.	No
Ayuntamiento de Linares de Mora.	Sí
Ayuntamiento de La Cuba.	Sí
Ayuntamiento de Portell de Morella.	Sí
Ayuntamiento de Castellfort.	No
Ayuntamiento de Cinctorres.	Sí
Ayuntamiento de Forcall.	Sí
Ayuntamiento de Morella.	Sí

Source: (BOE, 2022)

Table 15. Consultations with affected public administrations and stakeholders, and their responses. Clúster Maestrazgo, 3.

Consultados*	Contestación
Ayuntamiento de Todolella.	Sí
Ayuntamiento de La Mata de Morella.	Sí
Ayuntamiento de Vilafranca del Cid.	No
Entidades Públicas.	
Parque Cultural del Maestrazgo.	No
Asociación Viento Alto.	Sí
Comarca de Gúdar-Javalambre.	Sí
Comarca del Maestrazgo.	No
Comarca de Els Ports.	Sí
Red Eléctrica de España.	Sí
Endesa Distribución.	Sí
Telefónica de España, S.A.U.	Sí
Retevisión I, S.A.	Sí
Sociedad Española de Ornitología (SEO/BirdLife).	Sí
Asociación Española para la Conservación y el Estudio de los Murciélagos (SECEMU).	Sí
Ecologistas en Acción – Teruel.	No
Grupo para el Estudio y Conservación de los Espacios Naturales (GECEN).	No
Energías Renovables del Mediterráneo, S.A.	Sí
Fundación Ecología y Desarrollo.	No
Asociación Naturalista de Aragón (ANSAR).	No
WWF-ADENA.	No
Sociedad Conservación Vertebrados (SCV).	No
Ecologistas en Acción del País Valencià.	No
Fundación para la Conservación del Quebrantahuesos.	Sí
Societat Valenciana d'Ornitología.	No
Greenpeace – España.	No

* La denominación actual de los consultados puede no ser la misma a la original debido a los cambios realizados por ellos mismos.

1. Responde la Unidad de Carreteras de Teruel de la Demarcación de Carreteras del Estado en Aragón de la Dirección General de Carreteras del Ministerio de Transportes, Movilidad y Agenda Urbana.
2. Responde la Subdirección General de Biodiversidad Terrestre y Marina tras serle remitido el informe por la Dirección General de Calidad y Evaluación Ambiental y Medio Natural del MITERD.
3. Responde la Subdirección General de Aeropuertos y Navegación Aérea de la Dirección General de Aviación Civil del Ministerio de Transportes, Movilidad y Agenda Urbana.
4. Responde el Área de Gestión del Dominio Público Hidráulico de la Confederación Hidrográfica del Júcar del MITERD.
5. Responde el Servicio Provincial de Vertebración del Territorio, Movilidad y Vivienda de la Subdirección Provincial de Carreteras de la Dirección General de Carreteras del Departamento de Vertebración del Territorio, Movilidad y Vivienda del Gobierno de Aragón.
6. Responde el Servicio de Seguridad y Protección Civil de la Dirección General de Interior y Protección Civil del Departamento de Presidencia y Relaciones Institucionales del Gobierno de Aragón.
7. Responde el Servicio de Infraestructura Verde y Paisaje y el Servicio de Gestión Territorial de la Dirección General de Política Territorial y Paisaje de la Consejería de Política Territorial, Obras Públicas y Movilidad de la Generalitat Valenciana.

Source: (BOE, 2022)

4. CASE OF MAGDA

4.1. About AKUO

According to what AKUO publishes on its website, AKUO is a leading renewable energy company that develops, finances, builds, and operates renewable energy projects around the world[56]. AKUO's approach to renewable energy development is based on a holistic and integrated approach that encompasses every stage of the project lifecycle, from development to operation. This includes site selection, project design, engineering, construction, operation, and maintenance[57].

AKUO was founded in 2007 and is headquartered in Paris, France. Since its founding, the company has grown rapidly and now is present in more than 20 countries across 5 continents. Some of them are France, United States, Dominican Republic, Greece, Poland, Bulgaria and Turkey. AKUO's portfolio of projects includes wind farms, solar power plants, hydroelectric power plants, biomass and storage facilities[58]. AKUO has currently 1.5 GW of energy in energy projects in operation and construction. Considering the future projects, they have more than 20 GW to be developed. **Figure *20*** shows the breakdown of these figures.

The organization's mission and priority are to implement innovative projects for energy and food independence, addressing climate change and promoting sustainable food for everyone, while adapting to unique contexts with positive environmental impact[59]. The organization values continuous improvement and learning, adapting to different regions, cultures, and countries.

Its vision is to promote progress through continuous improvement, acknowledging the importance of agility and adaptation. The organization aims to raise awareness and o take action, believing past models of progress may not be suitable for the current urgency faced by society, and ensuring notable and sustainable benefits to society from the overall results of its projects.

AKUO promotes the concept of agrivoltaics. Agrivoltaism is the practice of combining agricultural land use with solar energy production. This practice has benefits such as increased land productivity, reduced competition for land use, and more sustainable farming practices. An example of this is the Gaussan Abbey project, which is not only

[56] (Akuo, n.d.-e)

[57] (Akuo, n.d.-f)

[58] (Akuo, n.d.-b)

[59] (Akuo, n.d.-h)

focused on producing energy. It combines ancient seed preservation, regenerative agriculture, and innovative energy technologies to achieve energy independence. This agrivoltaic model fosters positive synergies between agriculture and solar panels, protecting and improving the land. The abbey also includes a training centre. AKUO operates over 30 projects like this one, with a capacity of nearly 200 MW[60].

Another project in AKUO's portfolio is Kita, the biggest photovoltaic park in West Africa. It has a power of 50 MW, which means it will be able to power around 91000 households and will avoid 51744 tonnes of CO2 per year[61]. But this project also has a social and agricultural dimension. Agroforestry, market gardening, cereal crops, and poultry farming have taken place on the land of the power plant. Hundreds of jobs have thus been created for women from neighbouring villages. This exemplary project demonstrates Akuo's ability to provide essential green energy to Mali while generating significant additional social benefits for local communities.

Other projects include the wind farm Escalade, in Texas, with a power of 336 MW, which is equivalent to supplying 115000 households[62]. One of the hydroelectric power plants AKUO operates is CBH, with a power of 53 MW[63]. It is located Bulgaria and it was acquired back in 2018. AKUO also installed the South Pacific's largest energy storage facility in Tonga[64]. The two battery storage facilities in Tonga, with the first 5 MWh / 10 MW battery aimed at improving the grid's stability and the second 23 MWh / 7 MW battery designed to help supply electricity at peak times. The batteries are important for Tonga's goal of increasing renewable energy to 70% of the energy mix by 2025.

AKUO is committed to Corporate Social Responsibility (CSR) and aims to reduce the world's dependence on fossil fuels supporting the transition of agricultural sectors, reducing greenhouse gas emissions, and co-developing projects with local populations[65]. They achieve this by constructing and operating green power plants that harness renewable resources such as wind and sun.

[60] (AKUO, n.d.-a)

[61] (Akuo, n.d.-g)

[62] (Akuo, n.d.-d)

[63] (Akuo, n.d.-c)

[64] (Akuo, n.d.-i)

[65] (Akuo, n.d.-a)

AKUO is committed to sustainability and works hard to ensure that its projects have a positive impact on the environment and the communities in which they operate. The company's approach to sustainability is based on three key pillars: environmental responsibility, social responsibility, and economic responsibility. This is minimizing the environmental impact of its projects by using renewable energy technologies and implementing energy-efficient practices while protecting the biodiversity and natural habitats. AKUO is also committed to working with local communities to ensure that its projects have a positive impact on the people who live and work in the areas where they operate. This includes the creation of jobs, the development of local infrastructure, and the support of local social and environmental initiatives.

In summary, AKUO is a leading renewable energy company that is committed to creating a world powered by clean and sustainable energy. The company operates in multiple countries and has a diverse portfolio of renewable energy projects. AKUO is committed to sustainability and works hard to ensure that its projects have a positive impact on the environment, the communities in which they operate, and its shareholders.

Figure 20. AKUO's key figures in 2022.

Source: (AKUO, n.d.-b)

4.2. MAGDA photovoltaic project

AKUO, together with the Chinese group Premier, has developed the MAGDA project, which aims to harness the region's solar potential and contribute to Spain's clean energy objectives with an estimated investment of €94.9 million[66]. Spanning over 472 hectares, the Magda solar park is set to become the largest authorized solar plant in the province.

The project includes 3 solar parks: North A and North B located in Les Coves de Vinromà and, the third, South, located in Benlloc[67]. A map showing the distribution of the solar parks can be found in **Figure *21***. In total, the solar park will consist of 258,622 bifacial photovoltaic modules, each with a capacity of 580 Wp, resulting in a total peak

[66] (Plaza, 2023a)

[67] (BOE, 2023)

power generation of 150 MW. By utilizing bifacial photovoltaic modules, the solar park maximizes energy capture by absorbing sunlight from both sides of the panels.

Then, the energy generated in the northern zones will be transmitted through underground 30 kV power lines to three collector substations: "SE MAGDA 1," "SE MAGDA 2," and "SE MAGDA 3." From these substations, the energy will be further distributed through underground 30 kV lines to the newly constructed "LES COVES 30/132 kV" substation in Les Coves de Vinromà. The energy produced in the "South" zone will be directly channelled to the newly built "SET EL CUARTICO 30/132 kV" substation.

To facilitate integration with the existing power grid, the energy will be evacuated from the "LES COVES 30/132 kV" and "EL CUARTICO 30/132 kV" substations to the "SET MAGDA 132/400 kV" substation. This will be achieved through two 132 kV overhead power lines, spanning 3,552 meters and 13,923 meters, respectively. Finally, the energy will be transmitted via a 400 kV overhead power line, extending 52,724 meters, to the connection point with the grid at the "SET LA PLANA 400 kV" substation.

The project underwent an environmental impact assessment conducted by the Directorate General of Quality and Environmental Evaluation under the Ministry for Ecological Transition and Demographic Challenge. The assessment evaluated the project's potential impacts on the environment, including factors such as vegetation, cultural heritage, and proximity to populated areas. It also took into account public participation and consultation results, shown in ***Table 16*** and ***Table 17***. It is important to note that occupational health, safety, and industrial aspects are regulated separately and not covered in the assessment.

During the assessment process, alternative locations for the solar park and evacuation lines were analysed. The selection of the chosen locations was based on economic, social, environmental, and technical considerations. Priority was given to minimizing the impact on vegetation, cultural heritage sites, and nearby communities. The evaluation of evacuation lines included assessing compatibility with other projects in the area, as well as their environmental and technical feasibility.

After a processing period of less than four months, the Ministry for Ecological Transition and Demographic Challenge issued a favourable environmental impact statement for the Magda solar park. The statement outlined 64 conditions that the project promoters must comply with to ensure adequate environmental protection. These conditions cover areas such as landscape preservation, protection of flora and

fauna, water resources, and cultural heritage. Industry experts suggest that these requirements will not pose significant obstacles to the investment and are easily manageable.

The photovoltaic plant project is expected to have limited impacts on water resources. The construction phase may temporarily affect water quality due to the transport of solid particles and accidental spills. However, the project's water consumption for cleaning purposes is estimated to be low compared to other uses in the area. Mitigation measures include erosion control, spill prevention protocols, and water quality monitoring.

The project area is home to diverse flora and fauna, and the construction phase may cause temporary impacts on habitats and wildlife populations. However, these impacts can be mitigated through measures such as habitat restoration, the creation of ecological corridors, and the development of new habitats on the structures. A monitoring plan will ensure the effectiveness of these measures.

Noise and vibration from construction and operation activities can affect the environment and nearby residential areas. The report proposes measures like noise barriers, work schedules, and low-noise equipment to mitigate these impacts. Continuous noise during the operation phase will be minimized through sound barriers, low-noise equipment, and regular maintenance.

The construction and operation of the photovoltaic plant may alter the visual perception of the landscape. To minimize visual impacts, the project will use low-profile structures, appropriate colours and materials, and implement landscaping and reforestation plans. Engaging with local stakeholders will ensure the effectiveness of these measures.

The project area contains cultural heritage sites, and measures will be taken to prevent or mitigate impacts on them. Archaeological surveys and monitoring will be conducted during construction, and any significant findings will be protected. The project will comply with heritage protection regulations.

The construction phase will create job opportunities and stimulate the local economy through labour, materials, and services. Measures will be implemented to minimize temporary inconveniences, such as traffic, noise, and dust, and regular communication with stakeholders will be maintained. The project's operation phase will contribute to the local economy through ongoing maintenance and operational activities, with opportunities for local businesses. Local employment and procurement will be prioritized.

The Environmental Impact Assessment (EsIA) conducted between October 2019 and May 2021 focused on studying birds in the project area. It confirmed the presence of certain protected bird species and identified potential risks, such as collisions and habitat loss. To address these risks, the promoter suggests measures like installing a fence that allows small animals to pass through and using insulators on electrical lines. During construction, efforts will be made to avoid harm to bird species and their nests. The promoter also proposes compensatory actions like creating habitats for insects, providing perches and nest boxes for birds, and offering shelters for reptiles and small mammals.

Regarding the landscape, the construction phase of the project may make the scenery look less attractive due to machinery, vegetation removal, and building work. However, the developer has taken steps to reduce this visual impact and believes it won't be significant. These steps include keeping existing trees and shrubs near watercourses, putting up a barrier of plants around the solar park, using modest colours for the buildings, hiding electrical connections underground, using natural paths instead of paved roads, restoring any disturbed areas, and gradually bringing back the natural vegetation as the work progresses.

In summary, the approval of the Magda solar park represents a significant step towards a clean and sustainable energy future for Castellón and Spain, as it will significantly contribute to national goals for renewable energy, lowering carbon emissions, and promoting a greener and more sustainable energy sector. It is expected to be the largest permitted solar facility in the province and consists of three solar parks. The project includes steps to reduce impacts on the ecosystem and guarantee sustainable development, with a focus on environmental preservation, cultural heritage conservation, and local economic stimulation.

4.3. Advantages and disadvantages

The MAGDA photovoltaic project, developed by AKUO and the Chinese group Premier, offers several advantages and disadvantages. With an estimated investment of €94.9 million, the project aims to harness solar energy and contribute to Spain's clean energy objectives. Spanning 472 hectares, it will become the largest authorized solar plant in the province. However, the project raises concerns about water resources, impact on flora and fauna, noise pollution, visual landscape, cultural heritage, and potential risks to bird species.

One of the significant advantages of the MAGDA project is its contribution to Spain's clean energy goals. With a capacity of 150 MW and 258,622 bifacial photovoltaic modules, the solar park maximizes energy capture by utilizing both sides of the panels. It helps reduce carbon emissions and dependence on fossil fuels, promoting a more sustainable energy sector. Additionally, the construction and operation of the project create job opportunities, stimulate the local economy, and prioritize local employment and procurement.

The project's environmental impact assessment takes into account various factors, such as vegetation, cultural heritage, and proximity to populated areas. The assessment process analysed alternative locations and prioritized minimizing impacts on vegetation, cultural heritage sites, and nearby communities. The positive outcome of the assessment, coupled with the favourable environmental impact statement, ensures adequate environmental protection through compliance with 64 conditions.

Regarding water resources, although the construction phase may temporarily affect water quality due to solid particle transport and accidental spills, the project's water consumption for cleaning purposes is estimated to be low compared to other uses in the area. Mitigation measures, including erosion control, spill prevention protocols, and water quality monitoring, help minimize impacts on water resources.

Flora and fauna in the project area may be temporarily affected during the construction phase. However, habitat restoration, the creation of ecological corridors, and the development of new habitats on structures help mitigate these impacts. A monitoring plan ensures the effectiveness of these measures, promoting the preservation of biodiversity.

Noise and vibration resulting from construction and operation activities can have environmental and residential impacts. The project proposes measures such as noise barriers, work schedules, and low-noise equipment to minimize these effects. Continuous noise during the operational phase will be reduced through sound barriers, low-noise equipment, and regular maintenance, ensuring a more harmonious coexistence with local communities.

The visual landscape is another aspect of concern, as the construction and operation of the photovoltaic plant may alter the perception of the surrounding scenery. To minimize visual impacts, the project incorporates low-profile structures, appropriate colours and materials, landscaping, reforestation plans, and engages with local stakeholders to ensure effectiveness.

Preservation of cultural heritage sites is a priority, and measures will be taken to prevent or mitigate impacts on these sites. Archaeological surveys and monitoring during construction, along with compliance with heritage protection regulations, help safeguard cultural heritage.

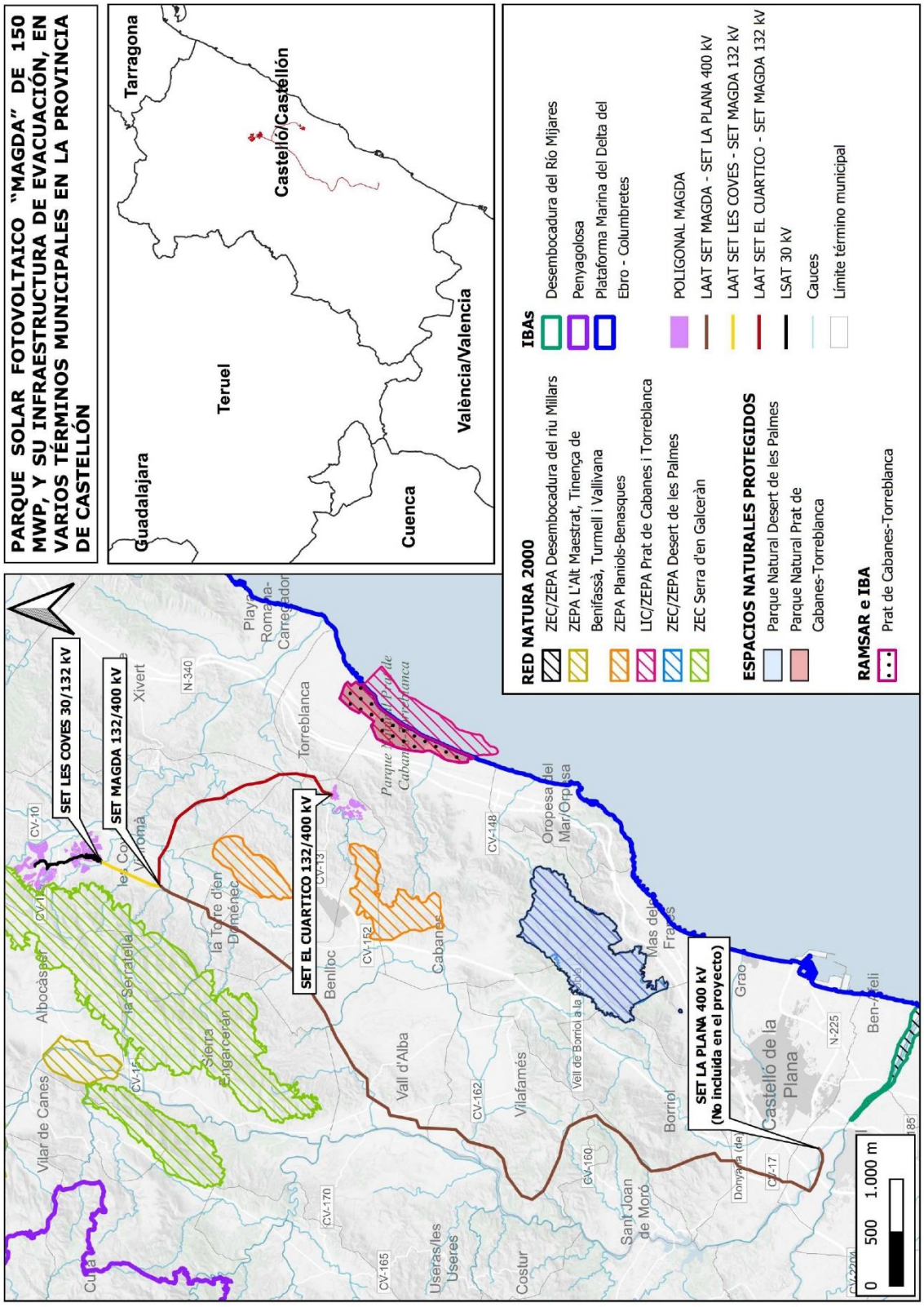
Bird species present in the project area require specific attention. Measures to address collision risks and habitat loss include the installation of fences allowing small animals to pass through and the use of insulators on electrical lines. The project also proposes compensatory actions, such as creating habitats for insects, providing perches and nest boxes for birds, and offering shelters for reptiles and small mammals. Careful monitoring and avoidance of harm to bird species and their nests during construction are essential.

While the MAGDA project brings numerous advantages in terms of renewable energy generation, job creation, and economic stimulation, it also raises concerns about potential environmental impacts. However, the project's comprehensive assessment, mitigation measures, and compliance with environmental regulations contribute to minimizing these drawbacks and promoting sustainable development.

Another aspect that could have been considered in the Magda project is the integration of agrivoltaics. Given AKUO's expertise in this technology, it would have been beneficial to incorporate it into the project. By integrating solar panels into agricultural areas, farmers can benefit from the shade provided by the panels, which can improve crop yields and reduce water evaporation. Additionally, agrivoltaics promotes sustainable land use by maximizing the utilization of available space and optimizing resource efficiency. Rather than focusing on energy production, the promoters of the project could have included other beneficial aspects for the community. Including agrivoltaics in the Magda project could have demonstrated AKUO's innovative approach to renewable energy development and demonstrated their commitment to environmentally conscious solutions.

In conclusion, the MAGDA photovoltaic project represents a significant stride towards Spain's clean energy goals. Most of the disadvantages occur during the construction phase, which will last less than a year. By effectively harnessing solar energy and prioritizing environmental protection, cultural heritage preservation, and local economic stimulation, the project will play a crucial role in the transition to a greener and more sustainable energy sector. Therefore, advantages outweigh disadvantages.

Figure 21. Photovoltaic solar park "MAGDA" of 150MWP, and its evacuation infrastructure, located in several municipalities in the province of Castellón.



Source: (BOE, 2023)

4.4. Stakeholders and impact

The Magda solar plant project, like the Clúster Maestrazgo wind power project, requires a comprehensive evaluation of stakeholders and the impact of the project on them, incorporating the concept of CSR to make sure the negative effects are minimised at the same time benefits outweigh potential drawbacks. Analysing these effects is vital for the success of the MAGDA photovoltaic project.

Stakeholders are the same as in the Clúster Maestrazgo wind power project. However, the impact on them is going to be different, as this project is photovoltaic. Internal stakeholders are the developers and operators, construction and engineering firms involved in the project and investors or financing companies. External stakeholders are the local residents, landowners and farmers, local businesses and industries, government, utility companies and grid operators and, most importantly, environment. It is important to ensure that all stakeholders' actions align with CSR principles, such as promoting sustainable development.

The project **developers and operators** are the French group AKUO and the Chinese group Premier. AKUO is the primary stakeholder and developer of the MAGDA project. The project aligns with AKUO's mission and priority of implementing innovative renewable energy projects with positive environmental impacts. The project contributes to AKUO's commitment to sustainability and reducing the world's dependence on fossil fuels. It also strengthens AKUO's position as a leading renewable energy company. The MAGDA project allows AKUO to expand its portfolio and further establish its presence in the renewable energy sector.

Similarly with Cluster Maestrazgo, **construction and engineering firms** and **investors and financing** companies are key for the project to move forward and have economic incentives to participate in the project.

Local communities may experience various effects as a result of the project. These can include changes in the local landscape due to the presence of the solar panels, potential noise pollution, and alterations to the visual aesthetics of the area. Additionally, the Magda solar plant project may bring economic benefits to the local communities. The construction and operational phases can create employment opportunities, contributing to local economic growth and development. Furthermore, the project's presence may stimulate economic activity in the region, such as increased tourism and business investment, indirectly benefiting the local communities.

Regarding the **environment**, the Magda solar plant project aims to contribute to the reduction of greenhouse gas emissions and combat climate change by generating clean and renewable energy. However, it is important to address potential environmental concerns like the impact on local ecosystems, biodiversity, and land use. Certainly, it does, since Magda received a favourable Environmental Impact Statement from MITECO.

The project is subject to 64 conditions aimed at protecting the environment, including landscape preservation, flora and fauna protection, water resource management, and cultural heritage preservation. Mitigation measures will be implemented to address potential impacts on water quality, habitats, wildlife, noise, and visual aesthetics. The project will prioritize erosion control, spill prevention, habitat restoration, and the use of low-noise equipment. Engagement with local stakeholders and compliance with heritage protection regulations are key aspects of the project. Through these measures, the Magda solar plant project aims to ensure minimal environmental impact and contribute to sustainable energy generation.

The environmental impact statement (DIA in Spanish) for Magda includes compensatory measures. These measures are intended to mitigate the environmental impact of the project and provide benefits to the local community. The remaining land will be used for the recovery of agricultural soil. The project will occupy 40% less land than initially projected and will only occupy lands signed with their **owners**, avoiding any land expropriation. The project will not destroy productive and ecological agricultural land, and measures are in place to maintain a productive ecological farming area[68]. The promoter of the project, Akuo, is working with Agriterra to support **farmers** in exploiting the land with new ecological and water-efficient crops[69].

The company, Akuo, aims to collaborate with local farmers to maximize the use of land and integrate agricultural activities alongside the solar project. This collaboration is aligned with the company's philosophy of conservation and promoting local activities. For every hectare occupied by the solar plant, the DIA stipulates the production of 1.5 hectares of agricultural land. The company expresses its commitment to ensuring the long-term agricultural development of the area by adding value to the territory and working closely with farmers.

[68] (Plaza, 2023c)

[69] (TheObjective, 2023)

A specific commitment mentioned is to have a certain amount of land dedicated to ecological cultivation for a minimum of 40 years. The goal is to support farmers by providing necessary resources such as access to land, machinery, and training, without seeking profit from agricultural activities.

Furthermore, the project also considers the possibility of reducing energy costs for interested municipalities. This could potentially benefit **local communities** by providing more affordable energy.

Government, specifically MITECO, is involved in overseeing and approving renewable energy projects like MAGDA. They assess the project's environmental impact, compliance with regulations, and adherence to licensing requirements. The favourable environmental impact statement obtained by AKUO indicates that the project has met the necessary regulatory criteria. However, autonomous government (chaired by the same political party) opposes to the project[70]. Most of the local governments affected by the project support it, according to **Figure 16** and **Figure 17**.

About **utility companies and grid operators**, the project construction and operation will impact the existing energy infrastructure and require coordination to integrate the generated wind power into the grid effectively. One of the main concerns of this project is the high-voltage line connecting Morella and La Plana grids, and Akuo is working with the **government** to find a solution. Valencian Government concerns about the environmental impact of the project's evacuation line, despite admitting it does not directly affect the Red Natura 2000. In order to solve these concerns, Akuo is proposing alternative solutions and offering to finance their implementation[71]. They suggest modifying the project's planning by adding a substation along the transmission line or reintroducing the Salzadella substation to minimize environmental effects. For now, the evacuation line is planned to be installed as in **Figure *21***.

The Magda solar plant project is expected to have both direct and indirect impacts on **local businesses and industries**. Directly, there will be opportunities for local businesses to participate in the construction phase by supplying materials, equipment, and services. This can stimulate economic activity and provide additional revenue sources. Indirectly, the presence of the solar plant can attract business investment and promote economic growth in the region. Increased tourism and job opportunities during the operation and maintenance phase can further benefit local businesses.

[70] (Plaza, 2023b)

[71] (Navarro, 2023)

Environmental, social and economic impacts in MAGDA’s project are similar to the ones in the Cluster Maestrazgo. Both projects aim to contribute to Spain's renewable energy goals and reduce dependence on fossil fuels. However, they face concerns regarding potential harm to wildlife, noise pollution, and the local ecosystem. In terms of economic impacts, both projects generate employment opportunities and revenue for local landowners. Forestalia and Akuo also demonstrate CSR through their commitment to promoting employment, supporting rural development, and adhering to principles of equality and non-discrimination. Addressing environmental concerns and ensuring positive economic and social outcomes are crucial for the success and sustainability of both projects.

Table 16. Consultations with affected public administrations and stakeholders, and their responses. MAGDA, 1.

Consultados	Contestación
Administración Estatal	
Dirección General de Carreteras.	Sí
Unidad de Carreteras del Estado en Castelló.	
Confederación Hidrográfica del Júcar.	Sí
Oficina Española de Cambio Climático.	Sí
Dirección General de Biodiversidad, Bosques y Desertificación. Subdirección General de Biodiversidad Terrestre y Marina.	Sí
Instituto Geológico y Minero de España.	Sí
Dirección General de Calidad y Evaluación Ambiental y Medio Natural.	No
Administración Autonómica	
Dirección General de Industria, Energía y Minas.	Sí
Servicio Territorial de Obras Públicas de Castelló - Dirección General de Obras Públicas, Transportes y Movilidad Sostenible.	Sí
Área movilidad – Carreteras – Dirección General de Obras Públicas, Transporte y Movilidad Sostenible.	Sí
Servicio Territorial de Urbanismo de Castelló - Dirección General de Urbanismo.	Sí
Servicio de Gestión Territorial – Dirección General de Política Territorial y Paisaje.	Sí
Servicio de Infraestructura Verde y Paisaje - Dirección General de Política Territorial y Paisaje.	Sí
Dirección General de Medio Natural y Evaluación Ambiental.	Sí
Dirección General de Cambio Climático.	Sí
Dirección General del Agua.	Sí
Dirección General de Prevención de Incendios Forestales.	Sí
Agencia Valenciana de Seguridad y Respuesta a las Emergencias.	Sí
Dirección General de Cultura y Patrimonio-Dirección Territorial de Cultura de Castelló.	Sí
Dirección General de Salud Pública y Adicciones.	Sí
Dirección General de Calidad y Educación Ambiental.	Sí
Administración Local	
Ayuntamiento de les Coves de Vinromà.	Sí
Ayuntamiento de Vilanova d'Alcolea.	Sí
Ayuntamiento de Torre d'En Domenech.	Sí
Ayuntamiento de Alcalá de Xivert.	Sí
Ayuntamiento de Torreblanca.	No
Ayuntamiento de Benlloc.	Sí
Ayuntamiento de Vall d'Alba.	Sí
Ayuntamiento de Cabanes.	Sí
Ayuntamiento de Vilafamés.	Sí
Ayuntamiento de Sant Joan de Moró.	Sí
Ayuntamiento de Borriol.	Sí

Source: (BOE, 2023)

Table 17. Consultations with affected public administrations and stakeholders, and their responses. MAGDA, 2.

Consultados	Contestación
Ayuntamiento de Castelló de la Plana.	No
Ayuntamiento de Almassora.	Sí
Diputación Provincial de Castelló.	No
Entidades públicas y privadas	
Aeropuerto de Castellón, SL.	No
Red Eléctrica de España, SAU.	Sí
I-DE Redes Eléctricas Inteligentes, SAU.	Sí
Enagás Transporte SAU.	Sí
GECEN-Grupo para el Estudio y Conservación de los Espacios Naturales.	No
Acció Ecologista AGRÓ.	Sí
Federación de Comunidades de Regantes de la Comunitat Valenciana.	No
Sociedad Valenciana de Ornitología.	No
Greenpeace España.	No
WWF-ADENA.	No
Fundación Ecología y Desarrollo.	No
Sociedad Española de Ornitología-SEO/Bird Life.	No
Sociedad Española de Biología de la Conservación de Plantas (SEBICOP).	No

Alegaciones recibidas en los trámites de información pública

Particulares

Asociación Naturalista de Ayora y La Valle (ANAV).
Plataforma Cívica Montesa Territori VIU.
Vinromá Servicios Globales SA.
Rural D'enrieres COOP.
SAT N 8579 Plana Alta.
Fincoves SL.
Cooper. Agroa. Sant Isidre les Coves Vinromà.
Benalbert SL.
Sat Riegos Covarchinenses.
Associació Comunitat Energetica Terres Sostenibles.
Comunidad Valenciana Activa (CV ACTIVA).
Club D´Esports De Muntanya Vilafamés.
Associació Cultural Vent.
Miel Apigolosa.
Club de Cazadores «La Ligera».
Asociacion Calma
Partido Politico Veïns de Borriol.
Associacio Cultural I Medi Ambiental Arrels.
Asociació Vitivinícola de Castelló.
Asociación Nostra Terra.
Adell Barbera TCEA.
Adell Barbera CB.
Associació Cultural La Botalaria.
Associacio Intermunicipal de Dinamitzacio i Promocio Economica de La Plana.
Colla Naturalista Espigol.

Source: (BOE, 2023)

5. COMPARISON OF THE CASES AND FINAL EVALUATION

In this section, the Cluster Maestrazgo and Magda projects are going to be compared using CSR criteria in **Table *19***. This framework allows us to evaluate the legality, ethics, transparency and the stakeholder and impact management on the economic, social, and environmental aspects surrounding each project. Plus, technology has been added to the comparison to understand its advantages on both projects. By comparing these aspects, we can gain a comprehensive understanding of the projects, their potential long-term impact and the projects' commitment to CSR. After comparing the projects, the CSR level of both projects will be evaluated using the **Matrix of the Common Good.**

Table 18. Summary of the projects.

	Clúster Maestrazgo	**MAGDA**
Promoter	Forestalia	Akuo and Premier
Type of energy	Wind	Photovoltaic
Location	Teruel and part of the evacuation line in Castellon	Castellon
Initial project and capacity	22 wind farms with 161 wind turbines, with a total capacity of 883 MW	Initially there were different alternatives
Final capacity	762.5 MW	150 MW
Final infrastructure	20 wind farms with 125 wind turbines	3 solar parks with 258,622 bifacial photovoltaic modules
Land occupation	294ha. and 241ha. temporary	445 ha.
Evacuation line	116 km long, including two 400 kV transformer substations, with 17 substations.	70 km long, including 7 substations.
Investment	Around €800M[72]	Around €95M

Source: own elaboration

[72] (Alonso, 2022)

Table 19. Comparative analysis of Clúster Maestrazgo and MAGDA projects using CSR criteria.

	Clúster Maestrazgo	MAGDA
Legality	The project received approval from the Ministry for Ecological Transition and Demographic Challenge (MITECO), indicating that it meets the necessary regulatory criteria. Most of the local governments affected by the project support it. Forestalia, the developer and operator of the project, aims to contribute to Spain's renewable energy targets, which aligns with the government's goals. Government authorities have a responsibility to ensure that the project meets environmental standards and contributes to Spain's renewable energy targets.	The project obtained a favourable Environmental Impact Statement from MITECO, indicating compliance with regulations and licensing requirements. The Valencian Government opposes the project due to concerns about the environmental impact of the evacuation line. Most of the local governments affected by the project support it, according to the information provided. AKUO, the primary stakeholder and developer of the project, is working with the government to find solutions to concerns raised, such as proposing alternative solutions and offering to finance their implementation.
Ethics	As renewable energy projects, both demonstrate a commitment to ethical business practices by prioritizing environmental sustainability and contributing to Spain's clean energy goals. They also contribute to society by engaging with local communities, creating job opportunities, and stimulating the local economy. Both projects aim to minimize their negative impacts on the environment and wildlife, showing a sense of responsibility towards the ecosystems they operate in. Forestalia is committed to ethical practices. Examples of these are	

	their Commission of Safety and Health and a Sustainability Commission that oversees regular and periodic actions related to risk prevention and sustainability. Forestalia also has a Code of Ethics and Conduct, and purchasing guidelines and policies that align with its principles and values. Similarly, Akuo has a CSR Committee, which focuses on implement CSR in all their projects. The background of this company in other projects demonstrate the commitment to ethics, society and environment and CSR in general. Akuo has developed all its projects considering local communities and their needs.	
Transparency	Transparency is crucial in gaining public trust and support for renewable energy projects. Despite Forestalia's commitment to transparency, the Clúster Maestrazgo project could benefit from providing more detailed information to municipalities that have rejected the proposal due to a lack of clarity, which demonstrates a lack of trust from some local governments. Clear and accurate information regarding the project's environmental impacts, mitigation measures, and benefits would help address concerns and facilitate informed decision-making.	MAGDA project demonstrates transparency by conducting an environmental impact assessment and complying with 64 conditions to ensure environmental protection. The project's assessment process and environmental impact statement contribute to providing stakeholders with a clear understanding of the project's potential impacts and the measures taken to mitigate them. MAGDA is also committed to the society, as it will be explained next.
Stakeholder and impact management (Economic)	The project is expected to have an investment of €800 million, which will contribute to the local economy through job creation and infrastructure development. Forestalia, plans to generate	The project involves an investment of €95 million, which will have a positive economic impact through job creation and local spending during the construction phase.

	762.5 MW of wind energy. This renewable energy production will help reduce dependence on fossil fuels and decrease energy costs. The project aims to boost the regional economy by attracting new businesses and investments associated with the renewable energy sector. It can also contribute to the development of related industries, such as manufacturing and maintenance of wind turbines. The availability of renewable energy can potentially attract industries that value sustainable practices, leading to economic growth and job opportunities in the region.	The solar plant aims to generate 150 MW of solar energy, which can contribute to reducing greenhouse gas emissions and promoting sustainability. AKUO has committed to local hiring and procurement practices, which can benefit the regional economy. The project has the potential to attract businesses and investments associated with the solar energy sector, such as solar panel manufacturing and installation companies, leading to economic diversification and growth.
Stakeholder and impact management (Social)	The wind power project has the potential to create jobs during the construction phase, as well as long-term employment opportunities for operations and maintenance of the wind turbines. This can have a positive impact on the local community by reducing unemployment and providing stable income sources. The project's focus on renewable energy can contribute to reducing carbon emissions and promoting environmental sustainability. This can benefit the society by mitigating climate change impacts	Like the wind power project, the Magda solar plant project can create employment opportunities during the construction phase and long-term jobs for the operation and maintenance of the solar plant. This can contribute to reducing unemployment and providing stable income sources for the local population. The project's generation of solar energy can have a positive social impact by reducing greenhouse gas emissions and promoting a cleaner

	and improving air quality, which is crucial for public health. The availability of renewable energy from the wind project can provide affordable and clean electricity to the surrounding communities. For example, Forestalia has signed an agreement with several municipalities which would allow households with registered residents in the participating municipalities to receive a daily electricity bonus equivalent to a maximum of 15 kilowatt-hours (kWh) per day. The company has committed to providing this free electricity throughout the entire lifespan of the renewable energy plants, estimated to be around 30 years. In addition, Forestalia has committed to provide additional municipal funds for socio-economic development, job creation, and population retention efforts in the respective areas.	environment. This can benefit the health and well-being of the local community by improving air quality and mitigating the effects of climate change. The project's commitment to local hiring can further benefit the social aspects by contributing to the local economy, supporting local businesses, and fostering community development. Moreover, Akuo aims to support farmers by providing necessary resources like land, machinery, and training, without seeking profit from agricultural activities. This aligns with their conservation philosophy and support for local activities. For every hectare occupied by the solar plant, Akuo ensures the availability of 1.5 hectares of agricultural land for a minimum of 40 years. Both project's emphasis on sustainable practices and clean energy can raise awareness about the importance of renewable energy sources, potentially inspiring individuals, and communities to adopt similar practices and reduce their carbon footprint.
Stakeholder	Both projects help mitigating	Solar power plants have a

and impact management (Environmental)	climate change by displacing the use of fossil fuels, which are major contributors to greenhouse gas emissions. By generating electricity from wind or solar energy, it helps reduce the reliance on non-renewable resources and the associated environmental impact of extracting and burning fossil fuels. The construction and operation of the wind power project may have some environmental impact. During the construction phase, there may be habitat disturbance, soil erosion, and noise pollution. However, with proper planning and mitigation measures, these impacts can be minimized. Additionally, the project implemented measures to protect wildlife, such as using radar systems to detect and shut down turbines during bird migration periods. Overall, the environmental impact is positive in both projects, as they help reduce carbon emissions and contribute to avoiding climate change.	relatively low environmental impact during operation. They do not produce air or water pollution and do not require significant water consumption for electricity generation. This is particularly beneficial in regions with water scarcity or where water resources need to be conserved. The production of solar panels involves the use of raw materials and energy, and their manufacturing processes can have some environmental impact. Like wind power projects, the site selection and environmental assessments play a crucial role in minimizing the impact on biodiversity. Both projects are planned to be located avoiding any natural reserve. Lastly, bi-facial panels included in the project contribute to the aesthetic appeal and environmental compatibility. The transparent parts of these panels allow light to pass through, reducing their visual impact.
Technological	The wind power project involves the installation and operation of wind turbines to generate	The integration of bi-facial solar panels in the Magda solar plant project enhances its overall

	electricity. These turbines utilize advanced technology such as aerodynamic designs, sophisticated control systems, and efficient rotor blades to harness wind energy and convert it into electrical power. Also, the project includes radar systems to detect and shut down turbines during bird migration periods. The project incorporates modern forecasting and monitoring systems to optimize the performance of the wind turbines. This can involve the use of advanced sensors, data analytics, and predictive models to anticipate changes in wind patterns and adjust the operation of the turbines accordingly, maximizing energy production. The transmission infrastructure of the wind power project is an essential technological aspect. It involves the use of power lines and substations to transmit the electricity generated by the wind turbines to the grid and distribute it to end consumers. This requires careful planning and engineering to ensure efficient and reliable transmission of power.	energy production capacity. By capturing sunlight from both the front and back sides of the panels, it can generate more electricity per unit of installed capacity. This innovative technology improves the plant's efficiency and makes it more resilient to variations in solar radiation and panel positioning. The bi-facial solar panels used in the Magda solar plant project are equipped with advanced monitoring systems that enable precise tracking of their performance and efficiency. This monitoring technology allows for real-time data collection on energy production, enabling prompt identification of any issues or maintenance needs. By ensuring optimal functioning of the panels, this technology enhances the plant's overall energy output and reliability.

Source: own elaboration

Summarizing, in terms of **legality**, the Clúster Maestrazgo wind power project has widespread local government support, while the Magda solar plant project faces opposition from the autonomous government due to environmental concerns. Despite that fact, both projects have been authorised by MITECO with a favourable Environmental Impact Statement. In order to evaluate the overall CSR commitment of both projects through the **Matrix of the Common Good.**, legality of both projects will be rated as **high**.

Both Forestalia and Akuo, as renewable energy projects, demonstrate a strong commitment to **ethics** and corporate social responsibility, which is shown in their organisational structure and in their previous projects. Therefore, this aspect will be rated as **high** in CSR.

When it comes to corporate **transparency**, both projects, particularly the Cluster Maestrazgo, could enhance their transparency by providing additional information about their activities and practices. This could include sharing more details about stakeholder engagement processes, social and environmental performance indicators, and community benefits. Making this information readily accessible to the public through reports or other communication channels would further strengthen transparency. Therefore, as there is room for improvement for both projects, this aspect will be rated as **medium** in CSR.

Furthermore, both projects involve significant investments that can have a positive impact on the local **economy**. The Clúster Maestrazgo project, in particular, has a larger scale and potential for job creation and infrastructure development. Therefore, Cluster Maestrazgo will be rated as **high** in this CSR aspect, while MAGDA will be rated as **medium**.

In terms of **social** aspects, both projects have positive outcomes such as job creation, promotion of sustainable practices, improved air quality, and community development. Additionally, these projects aim to make a positive impact on the area, either by offering free electricity to residents or by supporting employment and agriculture programs. Therefore, despite the size of the projects is not the same, the commitment to society in both projects is **very high**.

Both projects also have positive **environmental** aspects, as they contribute to the reduction of greenhouse gas emissions, conserve water resources, and promote the use of clean energy. Proper planning and mitigation measures are implemented to minimize negative impacts on biodiversity and ecosystems. Considering the final

environmental impact of the projects is much more beneficial than harmful, this aspect will be rated as **high** in CSR.

Advanced technology plays a crucial role in both projects, enabling efficient energy production and driving improvements in renewable energy efficiency and cost-effectiveness. Examples of such technology include radar systems used to detect and shut down turbines during bird migration periods, as well as high-efficiency wind turbines and bi-facial solar panels. As this aspect is not part of the CSR, it will not be evaluated.

After using the **Matrix of the Common Good.** and the available information to evaluate the CSR level, it can be concluded that the CSR level of both projects is overall high, which means both projects have a positive impact on their stakeholders.

6. CONCLUSIONS

In conclusion, renewable energies play a crucial role in addressing the socioeconomic problematic in rural areas while fighting against climate change. In addition, these sources of energy contribute to some of the United Nations' Sustainable Development Goals.

Implementation of renewable energy projects in rural areas stimulates job creation and community development. Building and maintaining infrastructure for renewable energy sources generates jobs, boosting regional economies and promoting skill development. Additionally, the presence of renewable energy facilities can attract investments, leading to the establishment of complementary businesses and services in rural communities.

Another crucial advantage of renewable energy sources is their ability to reduce electricity prices. Compared to fossil fuels, renewable energies are more cost-effective due to their low-maintenance requirements and reliance on abundant and free sources of energy, such as sunlight and wind. This affordability not only benefits rural areas but also promotes equitable access to clean energy, thereby addressing energy poverty and promoting social equality.

To address the weather-dependent nature of renewable energy sources, energy storage systems play a vital role. These systems enable the storage of excess energy generated during peak production periods, preventing wastage and allowing for its utilization during periods when renewable energy production is insufficient to meet demand. However, it is important to note that the efficiency of energy storage systems is still a challenge, which may temporarily increase electricity prices.

By adopting renewable energy practices, societies contribute to the reduction of greenhouse gas emissions, aligning with the global objective of achieving a 75% emission reduction from the energy sector. The transition to renewable energy sources helps combat climate change and supports sustainable development on a broader scale.

In this context, it is important to carefully consider the impact of *megaplants* and address the opposition they face from certain stakeholders. It is crucial to explore alternative approaches to installing renewable energy generation plants with lesser impact. For example, by reducing the size of installations and promoting distributed generation.

Increasing the level of Corporate Social Responsibility (CSR) in a project improves public acceptance and reduces harm to environment. When a project follows ethical practices and considers social and environmental benefits, people are more likely to support it. Additionally, a CSR-focused project tends to have a smaller negative impact on the environment. This is because, when people perceive that a project is genuinely focused on benefiting society and minimizing its negative impact on the environment, they are more inclined to support its implementation. In other words, the presence of a strong CSR framework can help build trust, credibility, and goodwill among the citizens, leading to reduced resistance and increased acceptance of the project.

It is equally important to identify whether the projects conduct a comprehensive study of the impacts and stakeholders' expectations. Some of the concerns include potential environmental degradation, destruction of agriculturally productive lands, and visual impacts. Also, during construction, there may be habitat disruption, soil erosion, and noise. However, with careful planning and mitigation measures, these impacts can be minimized, ensuring an environmentally sustainable project. Both projects have committed to the environment by adapting to it. Cluster Maestrazgo will include wildlife protection measures, like using radar to stop turbines during bird migration. On the other hand, MAGDA will prioritize the use of bi-facial solar panels, which allow light to pass through and reduce the visual impact on the surrounding environment.

Likewise, the promoters of these projects, Forestalia and Akuo, aim to contribute to the local economy, promote sustainability, and have positive social and environmental impacts. Examples of this are the promise of these promoters, respectively, to offer free energy to the residents of the affected municipalities and to provide non-profit assistance to local farmers. Both the wind power project and the solar plant project involve substantial investments, creating job opportunities and stimulating infrastructure development. By generating renewable energy, these projects reduce dependence on fossil fuels, decrease energy costs, and contribute to the reduction of greenhouse gas emissions. The focus on renewable energy can attract businesses and investments associated with the sector, fostering economic diversification and growth.

Additionally, the projects prioritize local hiring and procurement practices, benefiting the regional economy and supporting community development. Furthermore, the projects promote environmental sustainability, raise awareness about renewable energy, and contribute to improving air quality and mitigating the effects of climate change. Overall, these renewable energy initiatives offer a promising path towards a cleaner, more sustainable future with positive economic and social outcomes.

Despite all the challenges and risks involved, renewable energy projects that prioritize corporate social responsibility are ultimately beneficial for rural areas. They not only have a positive impact on the environment but also lead to reduced electricity prices, the creation of new job opportunities, and the attraction of businesses to the region. These benefits, in turn, contribute to countering depopulation trends and revitalizing rural areas. As renewable energies continue to advance and establish themselves as a long-term solution, it is imperative for rural areas to embrace these technologies and harness their benefits to thrive once again.

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