Analysis of key biodiversity protection and socio-economic aspects to ensure harmony between renewable energy projects and the territory

With the support of:

GOBIERNO DE ESPAÑA
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

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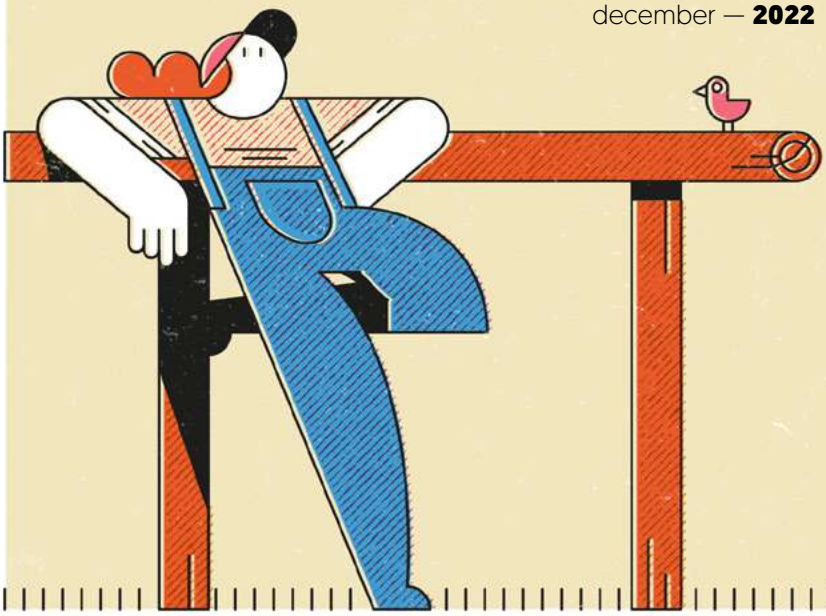

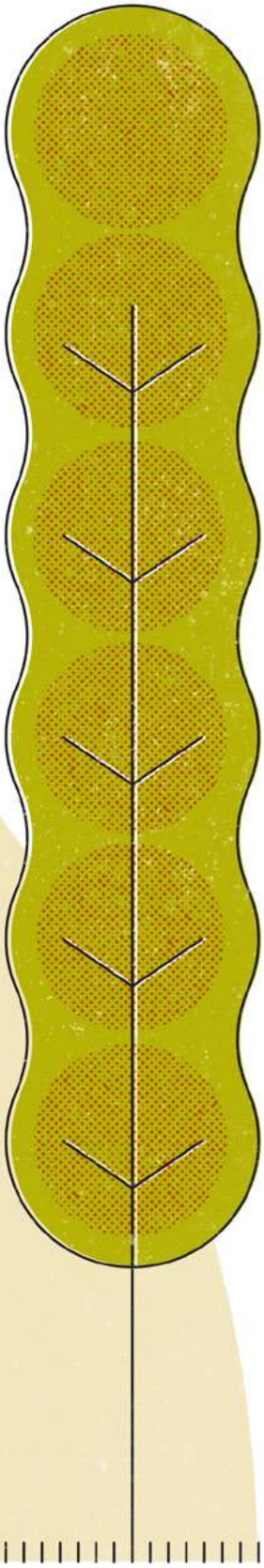

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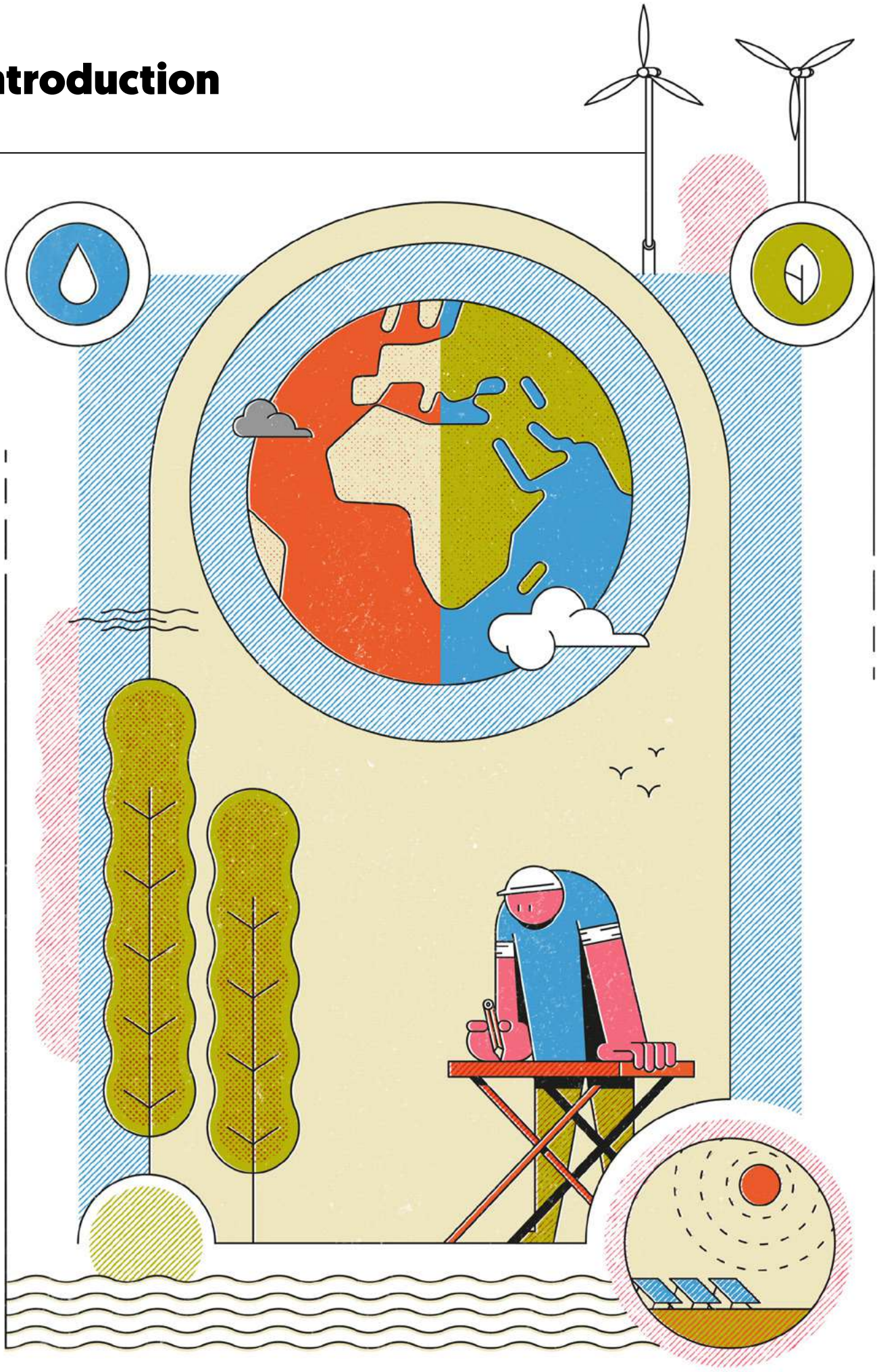


Climate change and emission reductions

Climate change is undoubtedly one of the greatest challenges humanity has ever faced due to its magnitude and global nature. Human activity is unequivocally responsible for the increase in the atmospheric concentration of greenhouse gases since the industrial revolution in the 18th century. Carbon dioxide is the most prominent greenhouse gas and its concentration in the atmosphere has progressively increased from the pre-industrial value of 280 ppm to an annual average of 416 ppm in 2021, the highest value in at least two million years.[1]

As a result, the average global temperature has risen by 1.07 °C and the last four decades have been successively warmer than any other decade since 1850. The global temperature increase has caused effects that are already observable, such as a sea level rise of 0.2 m and an increased frequency and intensity of extreme events: floods, droughts, heat waves, etc.[2], [3]

Against this backdrop, the global economy must decarbonise rapidly, i.e. cut greenhouse gas emissions by half in the next decade and achieve net zero emissions by 2050. Otherwise, the average temperature will rise by at least 2°C, which will have devastating effects, such as 1.7 times more frequent extreme precipitation events, 2.4 times more droughts and 13.9 times more heat waves, as well as around 30-140 million climate refugees from the global south and a sea level rise that will inundate land used by 100 million people today.[2]

Climate change is one of the greatest challenges humanity has ever faced due to its magnitude and global nature.

In order to reduce greenhouse gas emissions, and more specifically CO_2 emissions, all sectors must be reviewed in detail. However, the energy sector is responsible for two thirds of emissions, so it is logical that much of the effort should be focused on this sector. At this point, it is important to remember that merely substituting fossil fuels by renewable energies would miss out on numerous benefits of a deeper and more global ecological transition: reduced consumption and use of materials, energy efficiency, circular economy and more sustainable practices in all areas.

The ecological transition in Spain

Fossil fuels account for 83% of the world's final energy use, and although the share of renewable energy is increasing every year, it stood at only 12.6% at the end of 2021. As these data refer to the overall energy sector, they include consumption that is currently not electrified, such as transport or heating.

If we focus on electricity generation, the figures are better, reaching 26% renewable globally and 47% in Spain in 2021, where wind energy was the generation leader.[4] At regional level, it can be seen that wind power was the leader in only five autonomous communities, while photovoltaic is not the leader in any of them so far.

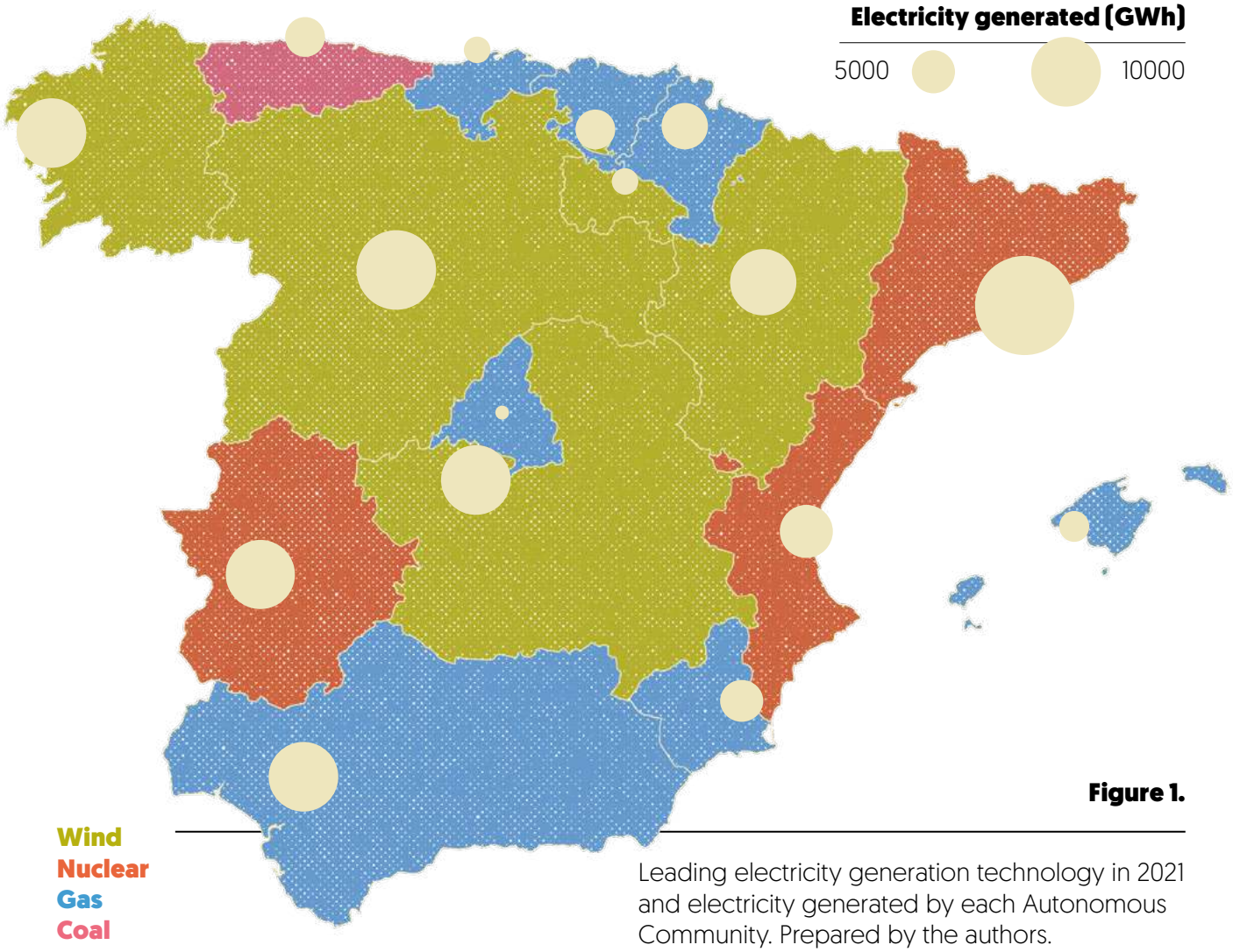
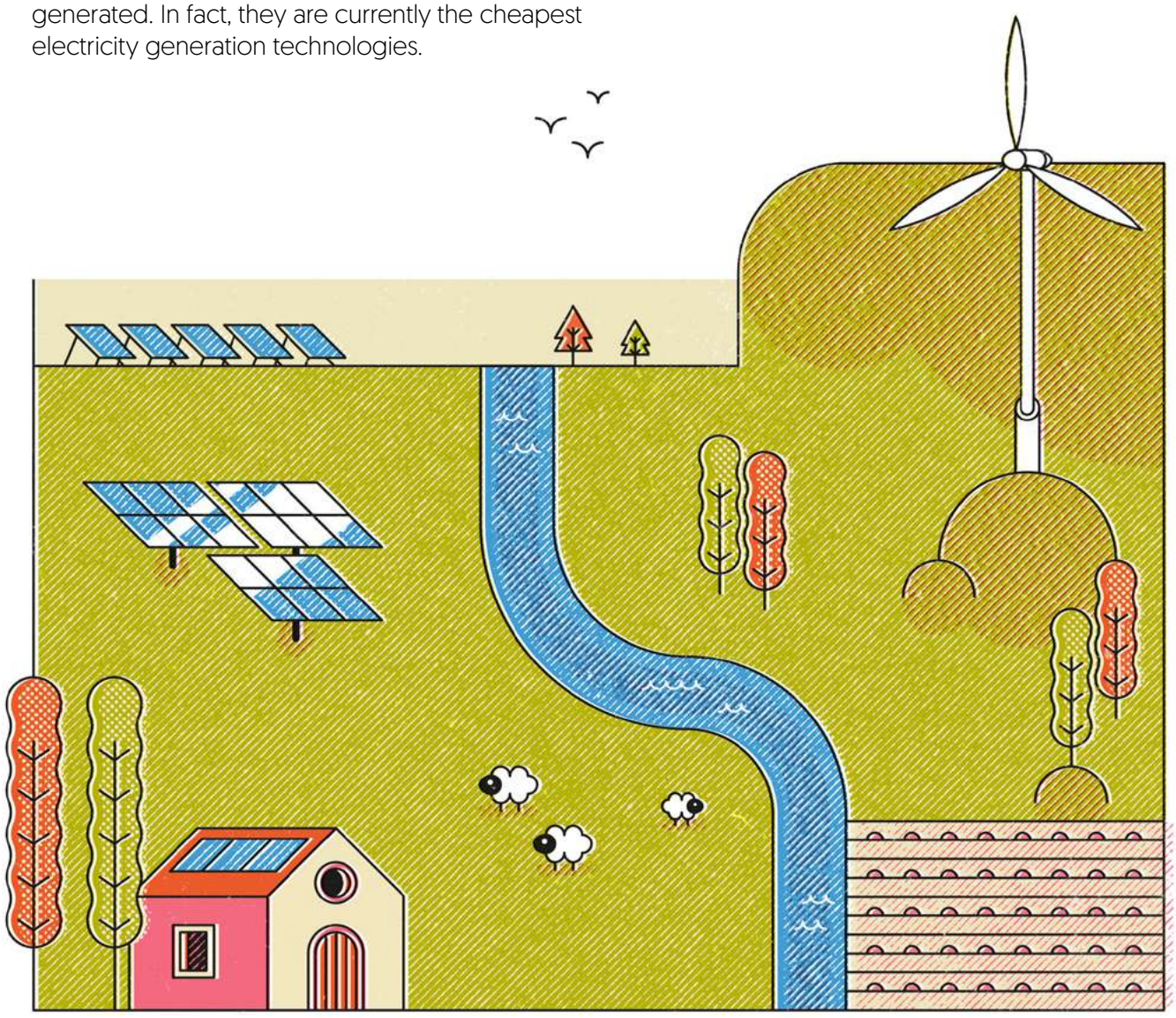


Figure 1.

Leading electricity generation technology in 2021 and electricity generated by each Autonomous Community. Prepared by the authors.

Despite the necessary reduction in energy consumption, it is also essential to increase renewable sources of generation, mainly electricity. In the specific case of Spain, the National Energy and Climate Plan (PNIEC) foresees 74% renewable electricity generation by 2030, a figure that is expected to be modified upwards during the plan's current revision phase. To replace non-renewable sources, new clean generation logically needs to be installed. In the case of Spain, there are hardly any viable new developments for hydro or geothermal energy and ocean technologies are either at an early stage of development or are far from being commercially competitive. Therefore, most of the installation effort corresponds to wind and solar technologies. Among them, onshore wind and solar photovoltaic stand out for their technological maturity and the cost of the energy generated. In fact, they are currently the cheapest electricity generation technologies.

The PNIEC proposes an electricity mix for 2030 with 50.3 GW of wind and 39.2 GW of photovoltaic, in addition to 14 GW of photovoltaic solar self-consumption in the high penetration scenario considered by the Self-consumption Roadmap of the Ministry for Ecological Transition and the Demographic Challenge. Taking into account that the current installed capacity (December 2022) is 29.7 GW and 18.5 GW for wind and solar PV respectively, this means approximately doubling the wind and PV capacity. Assuming a constant installation rate, 2600 MW per year of wind and a similar amount of solar PV capacity needs to be installed in the period 2023-2030.



Integrating environmental and socio-economic aspects

Once the electrical power needs to be installed have been defined, the question arises as to where to install it. This is simple for PV self - consumption, which is already being installed on rooftops or in small installations on land adjacent to industries and homes. It is extremely likely that the 14 GW of self-consumption foreseen in the most optimistic official scenario for 2030 will be exceeded; however, Spain's rooftop potential is far from providing the full amount of PV capacity needed. Therefore, dedicated power generation plants should be installed in specific areas selected not only on the basis of economic and technical criteria, but also on environmental and social criteria. Fortunately, the whole of Spain has a great solar photovoltaic potential and although, logically, the regions with the greatest insolation stand out, most of the territory has a solar potential of 1400-1600 kWh/kWp, as shown in the following map.

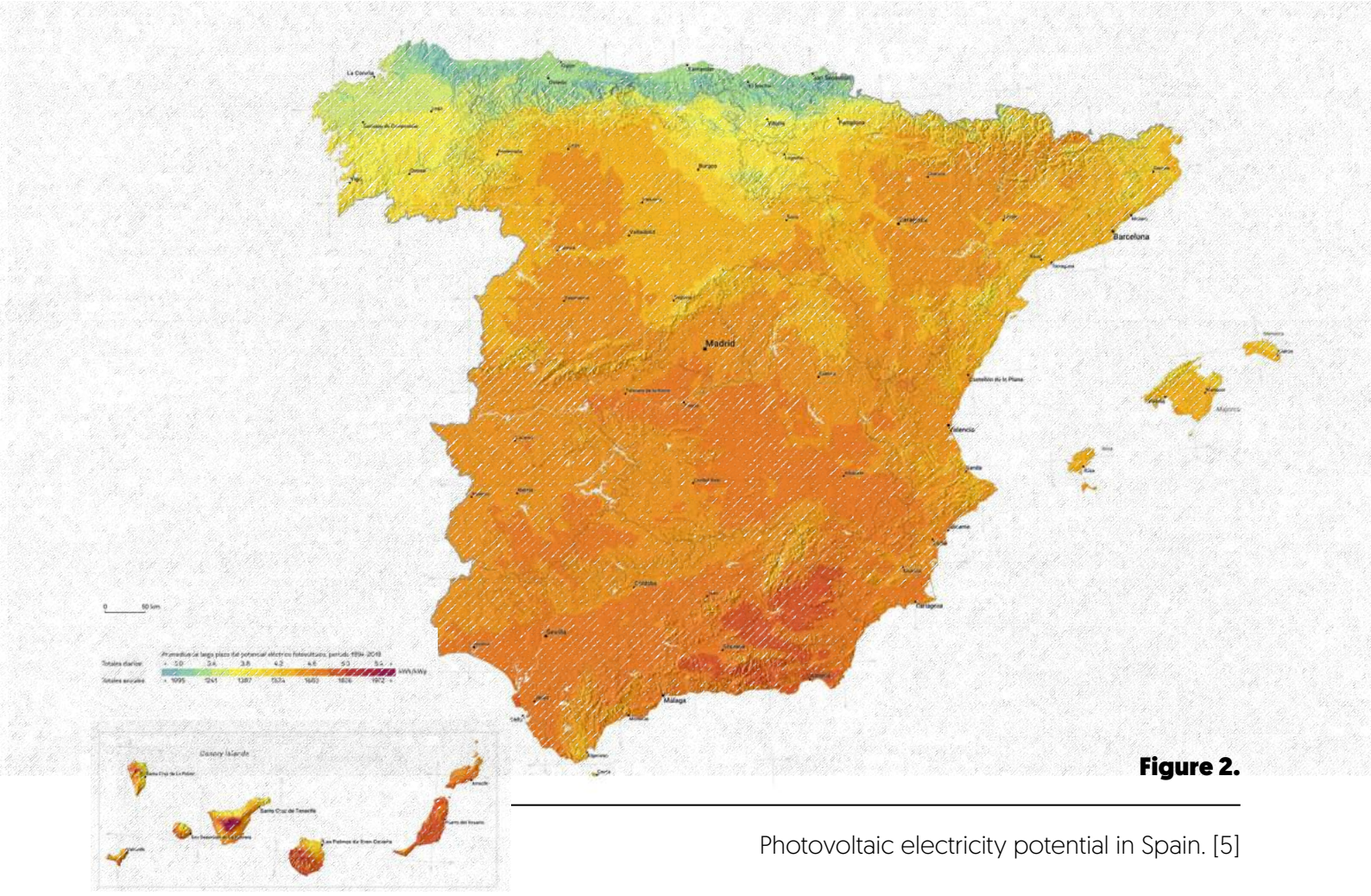


Figure 2.

Photovoltaic electricity potential in Spain. [5]

In the case of wind energy, wind is the resource used for electricity generation. Unfortunately, in this case its distribution is very uneven, as the average wind speed is highly dependent on topographical variables. Thus, there are regions with a large amount of wind resources, while others have hardly any possibility of generating electricity using this technology.

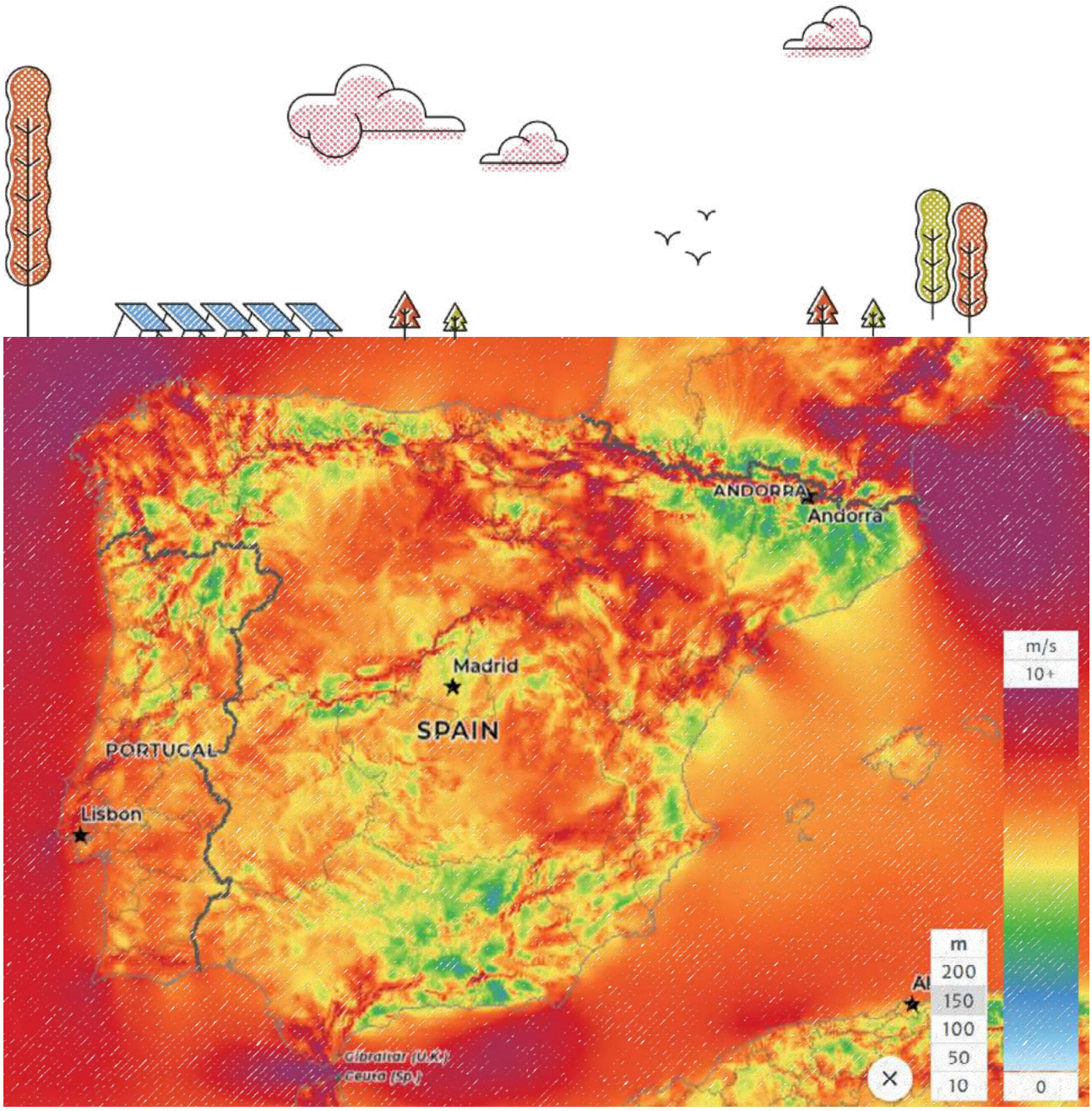


Figure 3.

Average wind speed over the Iberian Peninsula. [6]

In any case, given that the installation of renewable energies is part of the solution to climate change, their implementation must avoid causing other problems that may be just as serious, if not greater. Firstly, biodiversity must be respected by including this variable in land selection, which cannot be done solely on the basis of economic performance or technical constraints. Furthermore, the planning of renewable installations must take into account the opinions and needs of the inhabitants of the territory to be occupied.

The oblivion that has often been suffered by what is now known as "empty Spain", together with the number of projects in different stages of processing, are some of the reasons that have led some of the inhabitants of the regions where renewable energy projects are being considered to take a stand against them. In addition to these legitimate demands, there are sometimes subjective ones, such as the refusal of any unknown element or any element that modifies the landscape.

In many places, projects for the installation of large renewable energy installations are causing social tension, breaking up coexistence between neighbours and increasing polarisation in the affected territories. The usual way in which land is leased for the development of such infrastructure means that sometimes there are only a few who benefit financially (the landowners), while many other neighbours see little improvement in their situation. In many cases, companies are very concerned about obtaining the official licence for the project, without worrying about or getting involved in social acceptance.

When there are conflicts in the territory, there is a need to establish a mechanism for finding feasible alternatives through dialogue with the local population and mediation processes. In addition, the implementation of proposals that are in line with the environmental, social and cultural values of the territories would be favoured. Renewable energies must be an element of progress and not generate a loss of value in economic activities such as agriculture, livestock farming, forestry management or tourism.

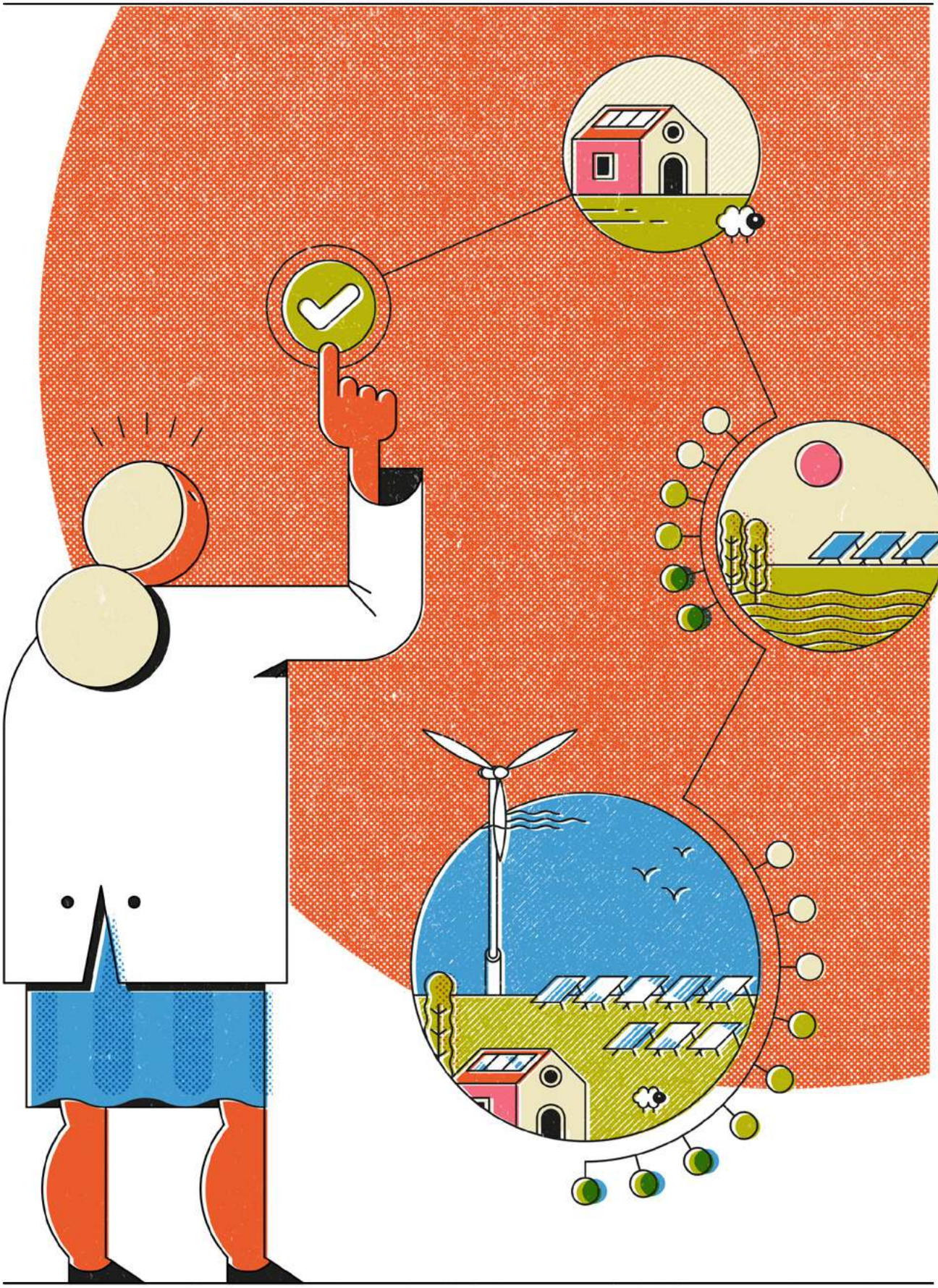
Projects that demonstrate that they are compatible with the protection of society and improve the local socio-economic fabric in the areas where they are implemented will play a major role.

There should also be greater communication and active collaboration between the developers and the actors involved, as well as advisory mechanisms to support the municipalities in the management of aid, the taxes collected or their active participation in the project.

The autonomous communities should offer an effective service providing information, advice, support and training to the municipalities receiving renewable energy plants.

The necessary decarbonisation of the electricity sector together with the governmental impulse and the low prices of renewable technologies have led to a veritable avalanche of projects. These projects must have, in addition to an administrative licence, an environmental and social licence. In this context, projects that demonstrate that they are compatible with protecting society and improving the local socio-economic fabric in the areas where they are implemented will play an important role.

Objectives

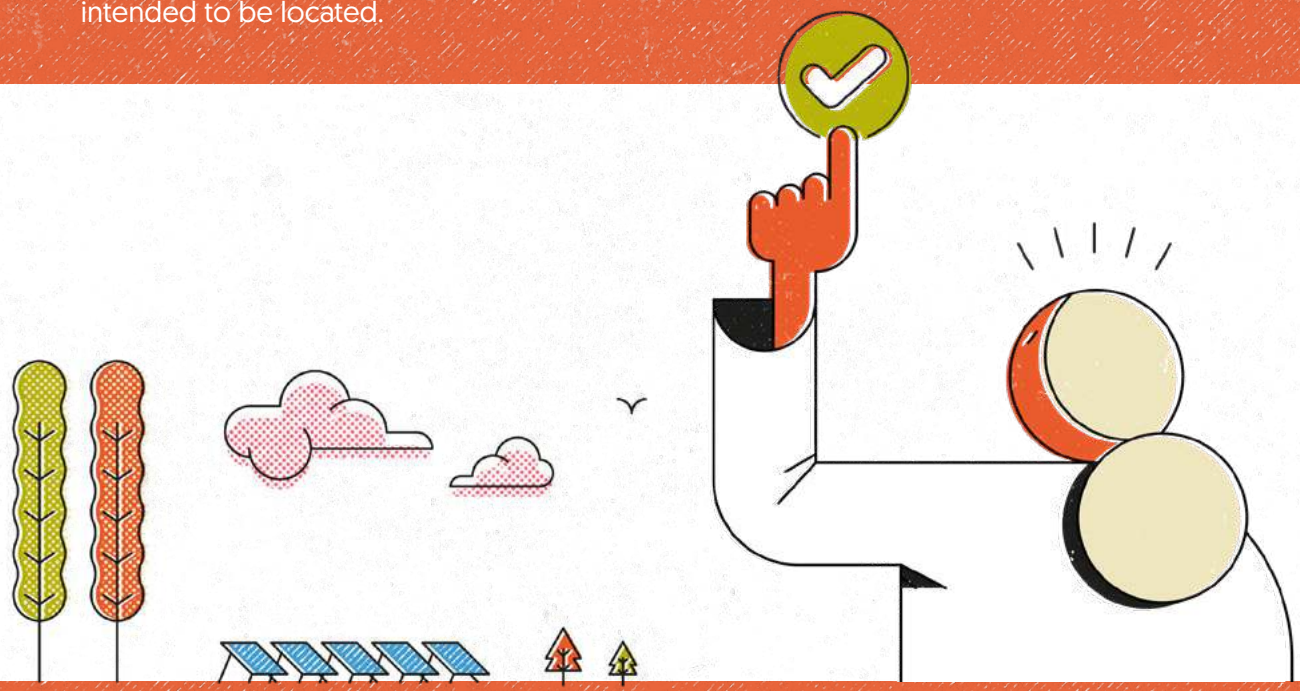


This research project aims to contribute to the knowledge of key socio-economic and environmental aspects, helping to conceptualise and design renewable energy deployment models with high social acceptability. In this way, it will contribute to designing projects for the decarbonisation of the national energy system that simultaneously establish synergies with the local population, integrating their needs and proposals.

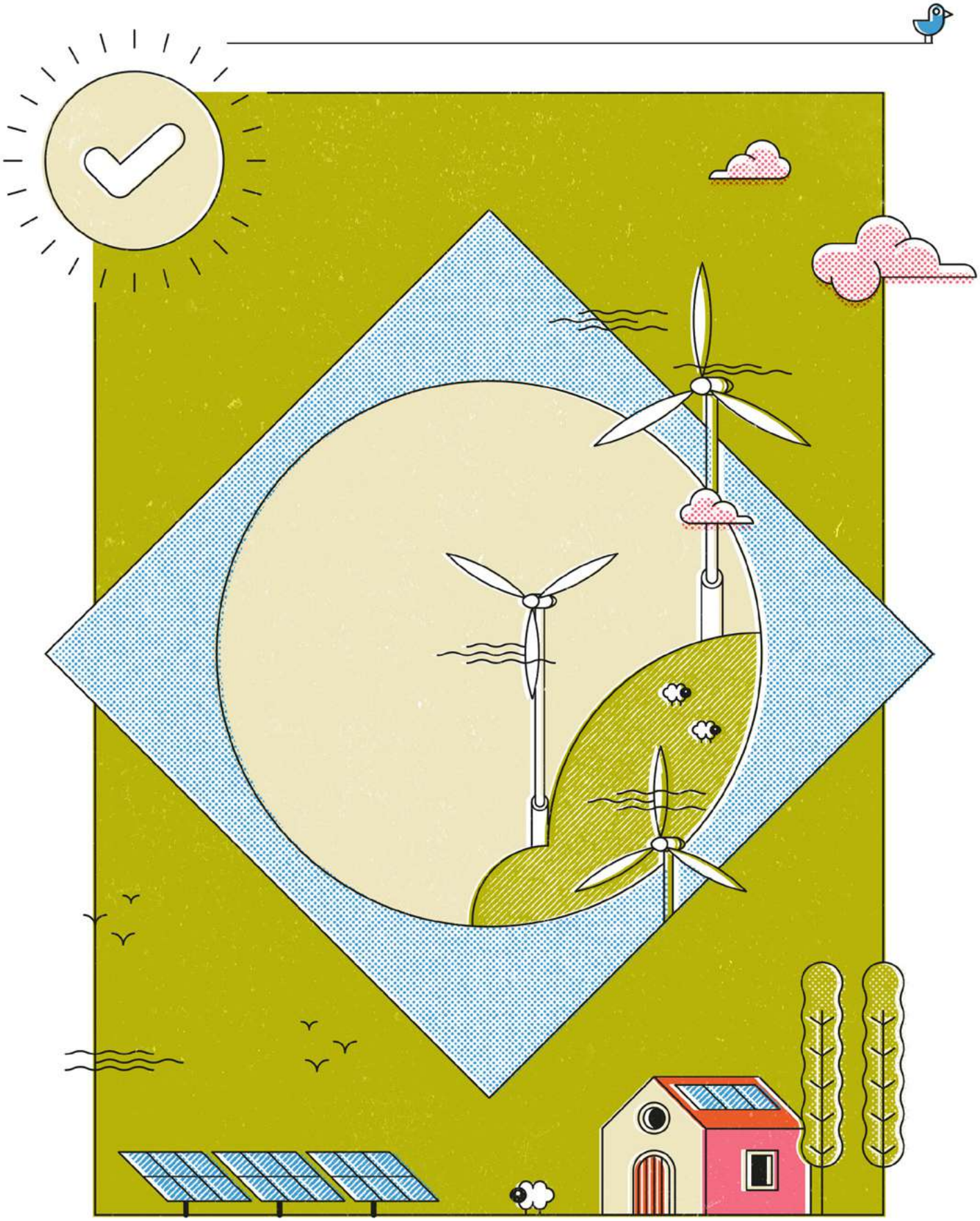
The main objective is to identify the most relevant aspects that guarantee the protection of biodiversity and the socio-economic balance of the areas where renewable energy projects are to be deployed, as foreseen by the PNIEC for the 2021-2030 period, in order to ensure harmony between these renewable energy projects and the territory where they will be installed.

To this end, a number of **specific objectives** have been described:

- Identify, study and diagnose real success stories where photovoltaic and wind energy generation projects have been widely accepted for their positive impact on biodiversity conservation and socio-economic benefits at local level.
- Identify the elements that have contributed to guaranteeing the acceptance of the projects in the territory where they are to be installed, both of a photovoltaic and wind nature.
- Determine whether these elements can be extrapolated to the national, regional or local level, taking into account the similarity of the ecosystems and territories in which the projects are intended to be located.



Success stories

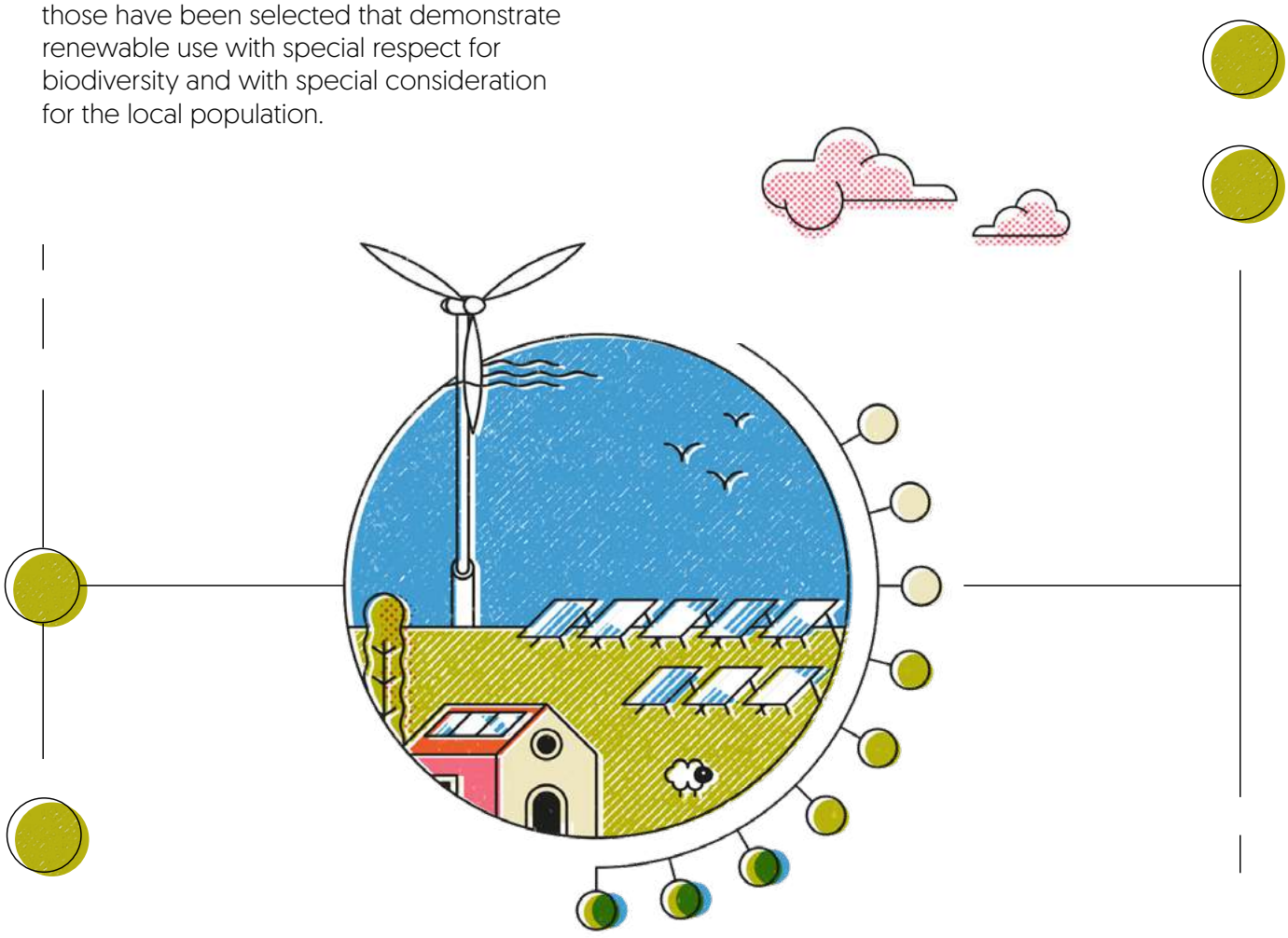


Renewable energy implementation success stories

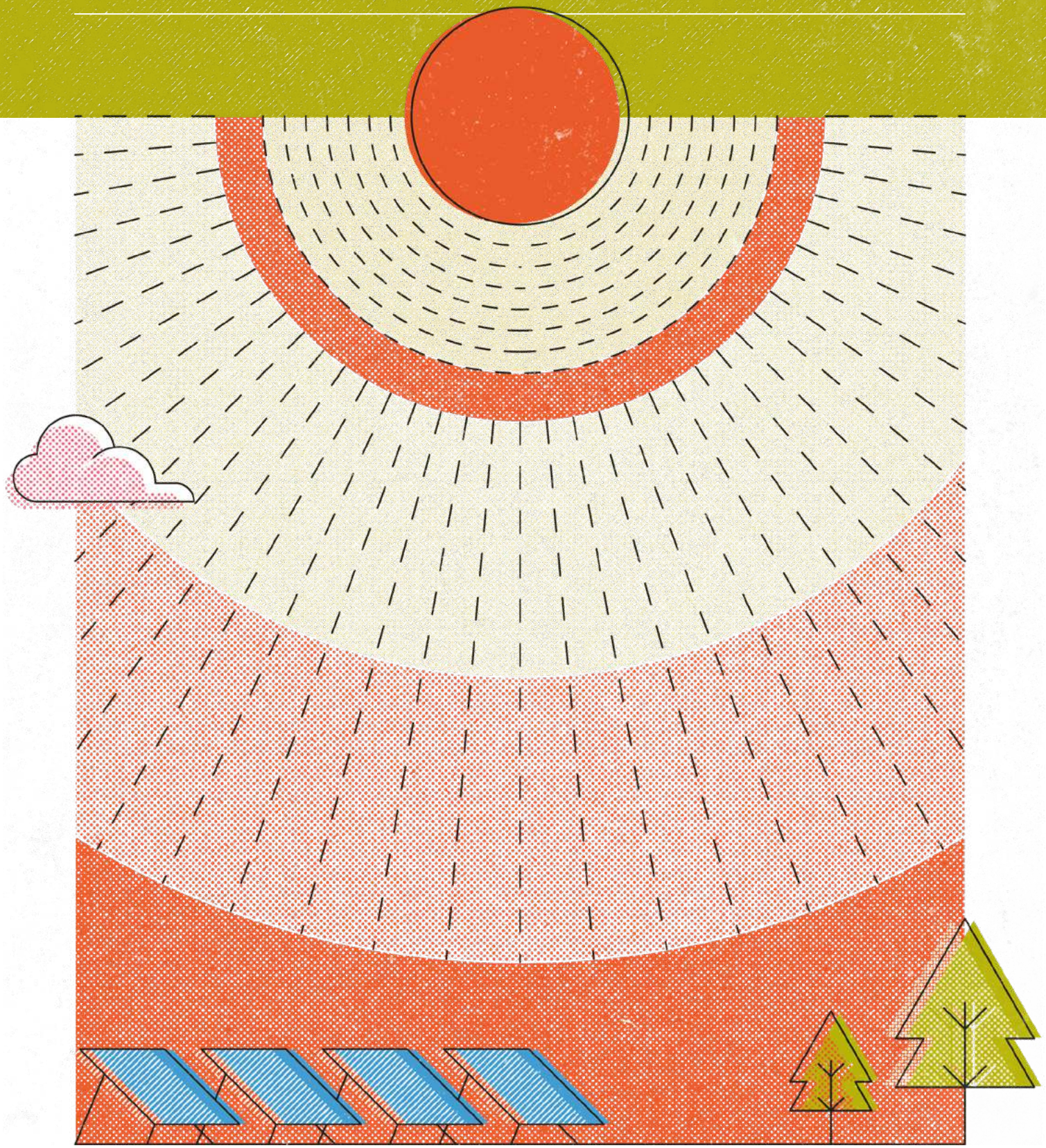
Given the current situation of rejection of renewable energies in part of Spain, the Ecology and Development Foundation [ECODES] has commissioned the Rey Juan Carlos University [URJC] to detect and analyse successful cases in the implementation of renewable energies. A wide range of projects has been assessed on the basis of consultations with relevant public and private persons and organisations in the renewable energy field, as well as the previous experience of the working team. From these, those have been selected that demonstrate renewable use with special respect for biodiversity and with special consideration for the local population.

In order to show a complete picture of each project, the companies promoting each project and the municipalities that host them, as well as regional administrations and environmental organisations in some specific cases, have been consulted.

A number of photovoltaic and wind projects that have stood out for their innovative and environmentally and/or socially relevant features are detailed below.



Photovoltaic solar energy



Belorado I photovoltaic power plant
— Burgos

In the municipality of Belorado, located in the province of Burgos, the Belorado I photovoltaic power plant is in the process of being processed. This municipality had a population of 1,754 inhabitants in 2021. The project belongs to the company Aurinka Photovoltaic Group and will have a capacity of 57 MWp and will occupy an area of 135 hectares. It is currently in the final phase of the Environmental Impact Assessment and is scheduled to be connected to the grid in 2024.

In conversations with Álvaro Eguiluz, mayor of Belorado, tells us that the current government team of Belorado Town Council "analysed and understood from the very first moment the renewable energy potential of their municipality and in particular of photovoltaic solar energy". Under this premise, they contacted the developer of the future Belorado I (Aurinka PG). The initial proposals of Belorado Town Council regarding the development of this project were to promote activity in the area, to stop depopulation and to promote employability and investment.

For its part, the developer, Aurinka, comments that "the project began by applying its own methodology through a preliminary study of land within a radius of 10 km from the electricity substation where the most suitable location is sought, choosing land with minimum environmental and agricultural impact and maximum social benefit. The intention is not to occupy land of special value (environmental, agronomic or social). Aurinka's methodology also includes previous environmental, agronomic and archaeological studies that allow for the selection of the optimal land.

After several meetings where several locations were proposed, the current location was chosen, with a low level of agricultural production and some proximity to the discharge point. It is worth noting that the plant was even shifted from the original proposal to occupy only land of negligible agricultural productivity. According to the mayor, from the first meetings held with the company, their predisposition and collaboration, together with their willingness to build a project in the area, have made the relationship between the corporation of Belorado and Aurinka very good.

On the basis of these initial studies, contact was then initiated with municipalities with potential for implementation. In order to make this contact, Aurinka hired specialised personnel based in the area. In the case of Belorado, a forestry engineer specialist from the same village was hired. This person was in charge of presenting the project to the local authorities and negotiating with private landowners with potential interest. This is in line with the objectives of the developer, which encourages as much local recruitment and investment in the area as possible. They have also sought to identify the plant as something that belongs to the people living in Belorado, involving the whole population and promoting visits, interpretative guides, etc.

Throughout the process, the Town Council and Aurinka have made the project their own, in such a way that the procedures with private individuals to lease the plots or with the regional government (Junta de Castilla y León) have been joint, to the point that the local government has participated in meetings or even facilitated them at a high institutional level. Likewise, the Town Council has learned first-hand about the progress made in leasing plots of land, previous geotechnical, heritage or environmental studies, as well as the corrective measures for the possible impact of the plant on the flora and fauna of the surrounding area.

Credit: Aurinka

Land on which the Belorado I photovoltaic power plant is to be built

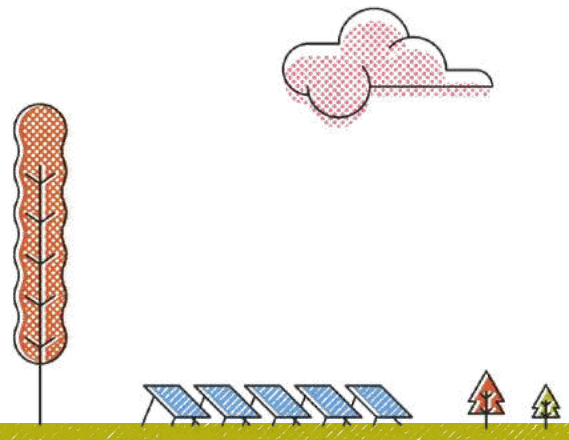
The most significant environmental and social impacts in this project are the usual ones for this type of installation, but minimised thanks to the study and previous work carried out for the location of the installation and adaptation to the surroundings. Studies of birds, bats and archaeology bordering on scientific research were carried out in great detail while collecting field data. The people recruited for this work were experts who also brought a wealth of knowledge of the study area. The main impact of the project can be considered as habitat loss due to the occupation of part of a breeding and potential nesting area for target species. To minimise effects, compensatory measures equivalent to the 50 hectares of lost harrier habitat now occupied by the photovoltaic panels will be adopted. In particular, the developers undertake to rent land or buy locally sourced grain to encourage long-term fallow and organic farming. It is also planned to monitor the nesting of harriers with the aim of carrying out an annual campaign to protect up to 10 nest sites, in collaboration with farmers in the area.

In addition, no significant impact on other nearby municipalities is foreseen for most of the power line (not even visual) and there are no significant effects on birdlife. In its last supports, the power line initially needed to cross a riverbed in an area already affected by crossings of other previously planned lines. In order to avoid any type of impact, it was planned to bury the line in this area where it crosses the riverbed. However, thanks to the archaeological studies carried out by Aurinka, it was proposed to move the electricity substation to the other side of the river, without having to go near the most affected natural area, radically improving the environmental impact of the line in its most negative area.

Although no special raptor breeding areas are affected, in anticipation of potential future displacements or changes in wildlife habitats, it is planned to equip the lines with all available corrective measures, such as swinging and neoprene staggered bird guards, additional insulating protectors, anti-poaching designs, etc.

What is more, the developer states that no social or environmental problems have arisen with the population of the affected municipalities during the processing of the project, and that only reticence and lack of speed in processing have been observed, which have been solved in the end. To achieve this, it was decided to explain the project and the actions that were being considered by means of an on-site visit and meeting. There is a possibility that the regional administration of Castile León will require the burying of the entire power line, as is customary in this autonomous community, with the potential impact this would have on the environment and on the acceptance of the project, as this would lead to the need for expropriation. In this regard, Aurinka has carried out an extensive study of birdlife, concluding that this line can be aerial, and is therefore negotiating with other projects in the area to share an evacuation line. The developer is particularly keen to present this alternative to the competent administration in order to maintain the airway as an evacuation corridor with minimum impact and maximum transport load. In any case, the intention would be to resort as little as possible to forced expropriation, trying to reach an agreement with the owners of the land affected by the power lines in case they have to be buried.

Finally, in order to prevent social and environmental problems from arising with the population of the affected municipalities during or after the construction of the project, Aurinka aims to keep the municipalities and the administration itself updated on the progress of the project and its implementation, with an exhaustive monitoring of the construction and commissioning activities.



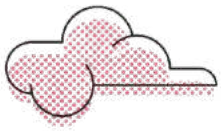
As can be seen, the developer has considered the environmental and social variables from the very selection of the land itself, within a policy that sets out a differentiated line of action, and the work carried out has been of high quality and rigorous, bringing transparency to the whole process and generating confidence in it on the part of residents and authorities. As an example, the birdlife field study alone used 12 fixed observation stations in the plant area and another 20 within the line buffer, complemented by transects, carrying out censuses 4 times a month for about 12 hours a day. This work has generated more than 900 observations of birds of 22 different species, with more than 1,000 individuals observed, and with a data quality that is unprecedented in the area.

The project has been studied and designed under the premise of minimum environmental impact and maximum integration, so it goes beyond the usual measures and proposes a real integration of the photovoltaic plant that improves an area affected by very aggressive intensive agriculture (with already very low productivity) and generates added environmental value. To this end, action has been taken in all **environmental** fields:

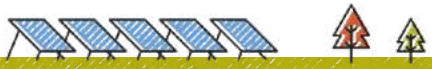
- **Compensatory measures** and habitat promotion in the area: go far beyond what is customary, even beyond what the authorities ask for.
- **Remedial action** to avoid future impacts on fauna and flora.
- **Minimal impact on the land:** use of existing roads and accesses, reservation of the vegetation cover and use of the material removed for the creation of ridges.
- **Design of permeable perimeter enclosures**, with gates and markers.
- **Creation of a living hedge** with autochthonous woody species to integrate the plant into the environment.
- **Restoration of natural vegetation in the interior** with the provision of seeds of indigenous species and growth control using locally sourced livestock resources.
- **Increased biodiversity in the area:** By the regional government's own admission, the measures taken in this regard are noteworthy. It is planned to implement 2 ponds, 13 cairns, 13 perches for birds of prey, 13 nesting boxes for titmice, 2 for owls, 3 for kestrels, 15 insect hotels and 7 nesting boxes for bats in the project area and surrounding areas. It has even been proposed that a large part of these actions should form part of an environmental awareness and training activity in nearby towns, inviting the population to workshops for creating nest boxes and visit the photovoltaic plant for their installation.
- **Maximum material recovery:** Aurinka has been looking for a long time to act in the entire photovoltaic cycle, seeking both the production/recovery of panels and the recycling of components and materials with technology that allows for maximum material recovery (something that is not very common in development companies).
- **Glass recycling project** for packaging and repair together with local vocational training personnel. Planned for the future.
- **Return the land to its original state:** In the lease contract approved by the plenary, it is established that the developer is obliged by law to provide a guarantee or surety in the name of Belorado Town Council or the Junta so that, once the installation is dismantled, the land is returned to its original state.

From a social point of view, the public response is very favourable, and no platforms or demonstrations have arisen against this type of plant. According to the mayor, the inhabitants of Belorado and the surrounding area understand that the environmental damage that may be caused by this project, always taking into account good environmental practices, is more than compensated by the economic advantages, the generation of stable and quality employment in the area and the dynamism promoted in the municipality. Furthermore, it should be noted that the area foreseen for the plant is of low agricultural interest, so that its installation does not harm a fundamental activity. The measures taken from the **social** point of view include the following:

- **Conducting training courses:** to promote work in the area in connection with the photovoltaic plant, both for direct and indirect work.
- **Job creation:** according to the mayor of Belorado, during the construction of the plant, the impact on employment will be significant and will have a corresponding effect on local economic activity, especially in the hotel, retail and real estate sectors. In the medium and long term, with the plant already in operation, the employment generated will be lower, around 5-10 people, which, without being a very important figure, still has a positive impact.
- **Guided tours and talks:** The social impact has been so positive that they are even seeking to involve the population in the plant, and among their compensatory measures they want to promote guided tours and talks.



According to the mayor, the biggest difficulty facing the installation of photovoltaic plants is the bureaucracy/ red tape required for their commissioning. The number of reports and the administrations and departments involved do not facilitate the rapid processing of these plants. He asserts that "While understanding the need for all reports and public information periods, the design of the system makes the process longer than it should be. This contradicts the urgent need to change our energy system and, more importantly, scares away potential investors who could transform the territory."



From an **economic** point of view, this project has brought several benefits to the municipality:

- **Leasing low-production land:** 135 hectares will be used, of which 56 hectares belong to the municipality and the rest to individuals with whom the company has negotiated separately. The lease will be for a term of 35 years, with 3 possible extensions of 5 years, i.e. a total of 50 years. The price for leasing the land, according to the agreement approved by the plenary session of the Belorado municipal council, will be 1,200 euros (plus VAT) per hectare per year, and will be updated every year with the consumer price index (CPI) with a minimum of 0.75%. This price is much higher than what the municipality is currently receiving for the lease of agricultural land. Today, one hectare is yielding €400-500 profit, with a very low production from a very hard-hit dry land. In addition, the company proposes to pay above-market wheat prices to farmers whose land is outside the plant, provided they agree not to use pesticides. This promotes nesting of birdlife such as bustards.

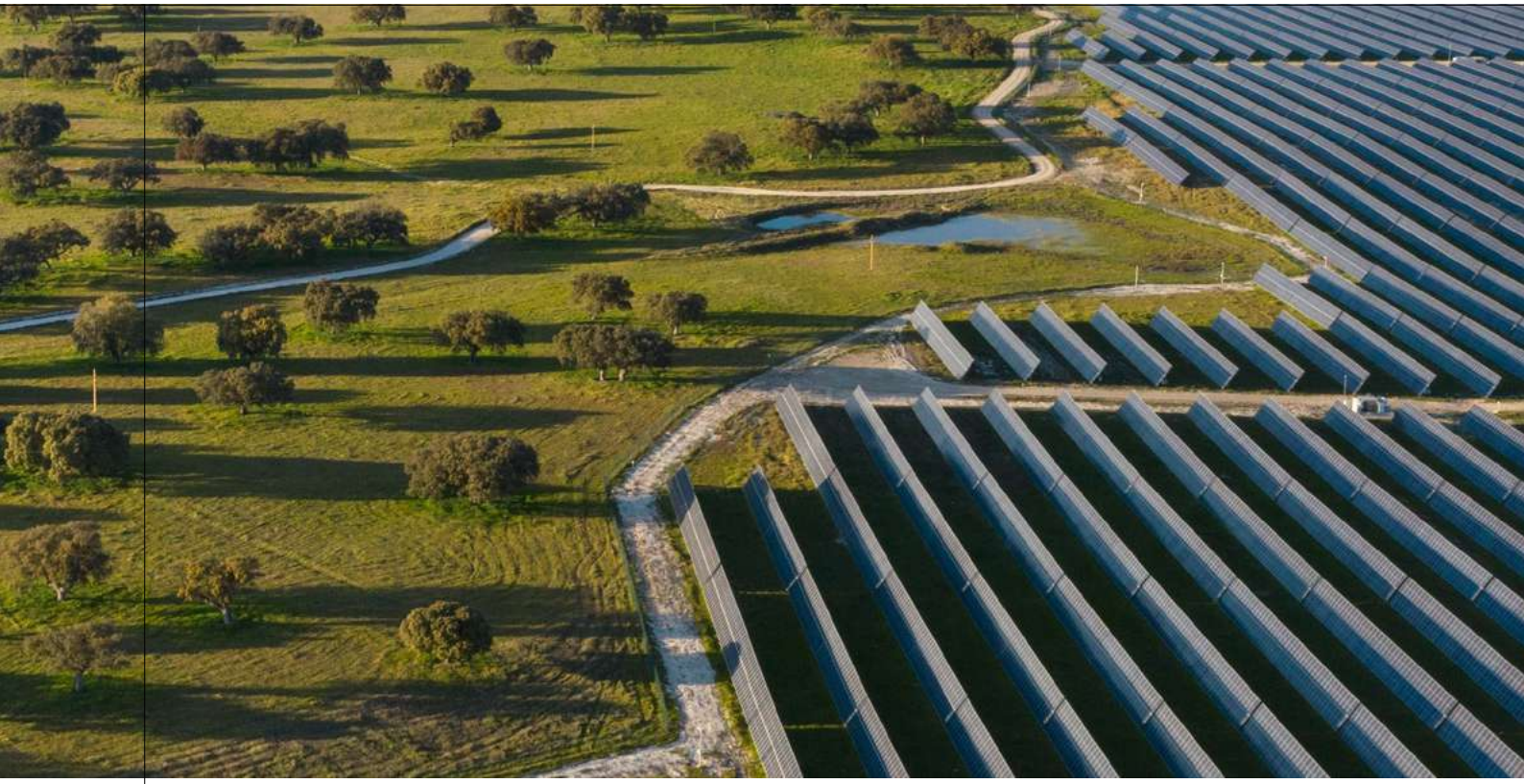
- **Direct income for the municipality:** a distinction must be made between two types of taxation:
  - Taxes from the construction of the plant: Tax on Construction and Building Installations and Works (ICIO), which would represent an extraordinary income for the municipal coffers and would be used for investments (chapter 6 of the municipal budget). For example, it could be earmarked for street repairs, urbanisation or expansion of the industrial estate, improvement of public buildings, etc. Another idea also put forward by the mayor of the municipality in relation to this extraordinary income from the ICIO is to promote a municipal subsidy of a small budget item for the installation of solar panels for self-consumption in SMEs and homes.
  - Taxes generated during energy production: constant income over time, such as plot rental, property tax or business tax. This revenue would be used mainly for current expenditure (chapters 1, 2 and 3 of the municipal budget). These expenses could include personnel expenses, services to citizens, supplies or maintenance of facilities.

- **Publicity and positioning of the municipality:** The start-up of this project means great publicity and positioning of the municipality of Belorado in terms of renewable energies, especially in photovoltaic energy, as it would be the largest 50 MW solar power plant in the province of Burgos, one of the main producers of renewable energy in the country. According to the mayor, this publicity and positioning is an advantage in order to continue attracting investments of this type and to continue positioning Belorado as an important location for the national photovoltaic industry.

- **Investment in the municipality:** The last major business investment made in Belorado dates back to the 1980s and, therefore, the planned investment in this plant will be the largest investment in almost 4 decades. This in fact sends a message of optimism and positivity to the residents of the municipality when they see that a company from a leading sector is interested in their town and is investing in it.

Talayuela Solar and Talayuela II photovoltaic power plants — Cáceres

Talayuela Solar is one of the largest photovoltaic solar energy projects in Europe and is located in the municipality of Talayuela, in the province of Caceres. Construction began in January 2020 by the British company Solarcentury, later acquired by Statkraft Development Spain S.L., and opened in January 2021. With more than one million photovoltaic panels and an area of 820 hectares, it has an installed capacity of 300 MWp and generates approximately 600 GWh per year. With this high power output, it is capable of supplying 150,000 households with energy per year, avoiding the emission of 190,000 tonnes of CO_2 into the atmosphere. The project development and engineering was carried out by Norwegian energy company Statkraft, using technology so innovative that it ranks among the most advanced solar power plants in the world.



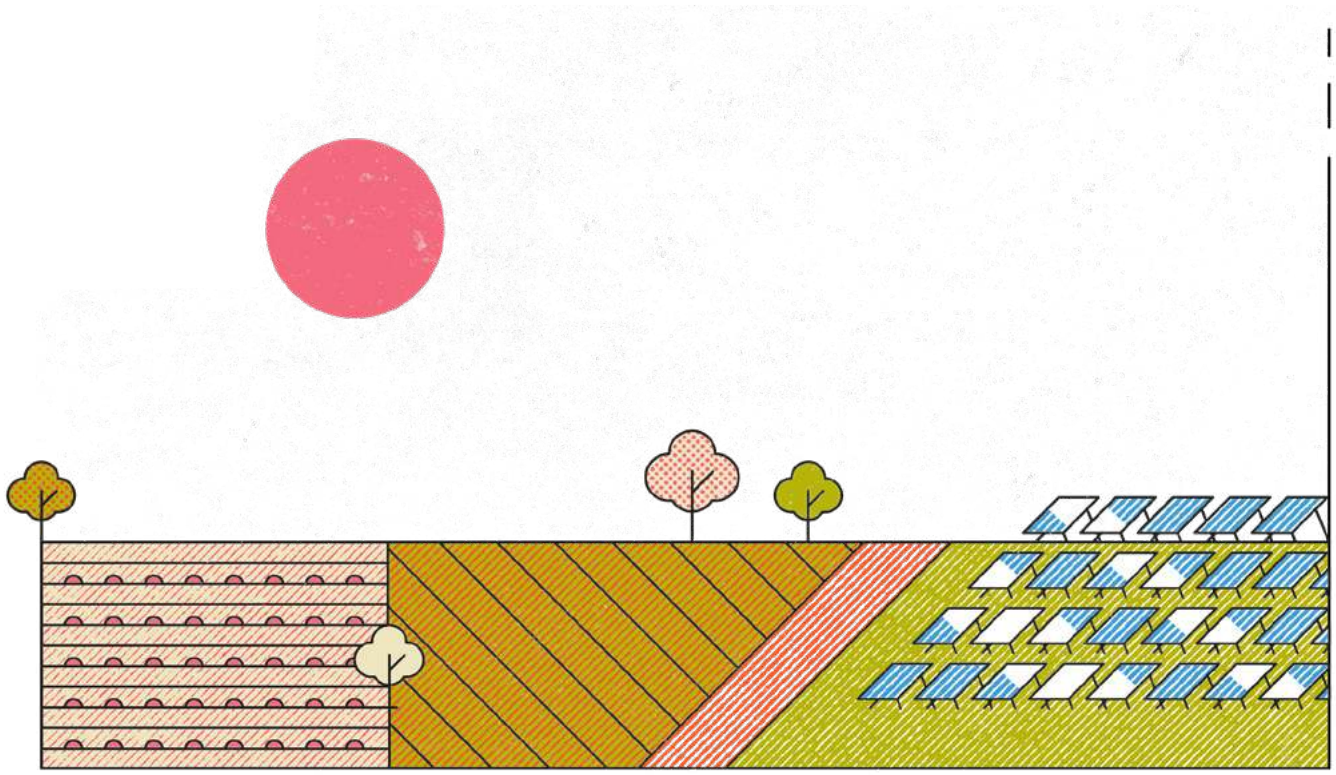
Credit: Statkraft

Talayuela Solar photovoltaic solar plant (Cáceres).

From the earliest stages, the developers held numerous meetings with both local actors and the mayor of Talayuela to prepare collaboration agreements and facilitate the integration of the project. This has also been done with other decision-makers or organisations that have interests and/or competencies linked to the project and the area. In addition to the Municipality of Talayuela, the project has built relationships with several local stakeholders, generating multiple socio-economic benefits and strengthening Statkraft's commitment to local communities. Highlights: Publimain S.L., Holafibra Talayuela S.L., Automatismos Talayuela S.L., Complejo Estévez S.L., Catering Tahón S.L., Restaurante La Tabla, Grupo FYERA S.L., Neumáticos Jose S.L., Hotel OYO Valles de Gredos S.L., Deportes Pro-Sport S.L., C.P. Talayuela, Farmacia Esteban, Buhersa S.L., Urbano García S.L., among others. Other agents that have competences and/or work on a different scale, such as the Junta de Extremadura or Extrepronatur, have also been taken into account.

Talayuela Solar has generated positive impacts in different environmental, economic and social areas both during construction as well as operation and maintenance thanks to the preventive, corrective and compensatory measures established in the EsIA (Environmental Impact Study) and in the DIA (Environmental Impact Statement), as well as the commitment acquired after signing a public-private partnership agreement whose impact translates into a high number of local hires, development of a training plan, local investment, as well as participation with different agents in the territory through sponsorships.

During the construction of the plant, environmentally friendly equipment was used, with special care taken with the equipment that makes up the photovoltaic power plant, such as the use of voltage transformers filled with vegetable ester instead of mineral ester, as the former is biodegradable in soil and water due to its naturally occurring composition. In addition, for the plant's maintenance work, a commitment was made to electric mobility with 0% emissions, including two fast charging points for the vehicles used, which were recharged with the clean energy generated in the photovoltaic plant.



In addition, **environmental measures** worth more than one million euros have been implemented. The most noteworthy of these, among other actions carried out as part of the Environmental Monitoring Plan to improve the habitat and ecosystem of the space occupied by the solar plant, are detailed below:

Soil compatibility: introduction of sheep as natural ground clearers. It is therefore an initiative to make the land compatible between the production of clean energy through solar panels and traditional livestock farming, thus generating a mutual benefit for both parties. This avoids the use of machinery, herbicides and chemical pesticides.

Crédito: Statkraft

Sheep grazing inside the Talayuela Solar photovoltaic solar power plant.

Increase in vegetation cover:

- Planting of 5,000 acorns per year for a period of 5 years, with the aim of increasing the number of holm oaks in the area.
- Establishment of a vegetation screen with autochthonous species that reduce the visual impact.

Transfer of fauna: hunting fencing covering the installation.

Species protection: with a high ecological potential of the genus "Trifolium", where insects proliferate and provide food for small mammals and reptiles.

Adaptation of waterlogging:

- Existing livestock and wildlife ponds, such as fountains, troughs and pylons.
- Adaptation of two natural Mediterranean ponds of 0.5 hectares each with a depth of 70 cm - a habitat of Community interest threatened in Spain – to protect various species of animals sensitive to the lack of water.

Animal shelters: construction of 25 reptile shelters inside the plant to naturally control potential pests and promote biodiversity. Placement of nest boxes on poles for orthopteran control.

Credit: Statkraft

Adaptation of waterlogging and reptile shelters within the solar plant.

- **Promotion of local wildlife:** placement of rabbit breeding nuclei.
- **Construction of three belvederes:** to carry out census surveys of cranes.
- **Funding:** to the Grus-Extremadura group for the common census during the wintering season.
- **Creation and management of a Nature Classroom:** to receive visitors, interactive exhibition and demonstrative training classroom.

Credit: Statkraft

Cranes inside the solar plant.

From the **social** point of view,
a number of actions should be noted

Dissemination: launch of a web platform with all the information on the Talayuela Solar project in order to show transparency and disseminate the main characteristics of the project.

Local job creation: On the same platform as above, a section for the registration of job seekers was set up so that those interested in being part of it could attach all the documents required to enter the selection process.

Training: A Training Plan was developed by Statkraft's technical and engineering staff, which promoted six training sessions with the aim of providing the knowledge of plant operation and installation criteria in order to be able to work on the project.

Signing of commitments: a public-private partnership agreement was signed with the Talayuela Town Council with the aim of promoting local employment, as well as investment in local businesses.

Sponsorships: of the local football team, Club de Fútbol Talayuela, through a financial contribution to develop the sports club.

Donation: support for the food bank with a donation of €15,000 to combat the difficulties caused by the health alert following COVID-19.

The project has generated a visual impact on the three municipalities and plots of land that the evacuation line crosses until it reaches the Arañuelo substation. This impact has been mitigated by planting a vegetation screen with autochthonous species, as mentioned in the previous environmental measures. As for the plant, as part of the Environmental Impact Study, an examination of alternatives was carried out, and the most environmentally viable ones were chosen. In this case, the impacts on endangered wildlife populations near the plant, but not within it, such as the crane roosts in the Ejido Nuevo Lagoon Complex SPA, were minimised until it connects with the existing 400 kV high-voltage power line, which runs parallel to it until it reaches the substation.

In addition to the environmental measures already mentioned in the previous section, the most important measures carried out to reduce the impact of the evacuation line are summarised below:

- **Evacuation line for future projects:** the design of both the Talayuela Solar's elevator substation and evacuation line was carried out in order to be able to connect another seven solar projects with an additional capacity of 320 MWp without the need to make any type of modification to the line. Therefore, future projects could use this evacuation without additional impacts.

- **Avoid protected areas:** the line, its supports and other related actions do not take place within any SACs, SCIs or SPAs. This implied a prior study and delimitation of the closest protection figures: SAC "Cañada del Venero" to the west, SCI-SPA ES0000168 "Llanuras de Oropesa, Lagartera y Calera y Chozas" to the east and SAC "Cañada del Venero".

- **Well-designed evacuation line:**
  - The evacuation line crosses the Cañada Real de Merinas, the Colada del Camino de los Conejos and the Colada del Camino de Las Lomas in flight, with the supports away from them, so that it does not affect them in any way.
  - A parallel design of the line from support 38 to its connection with Red Eléctrica has been carried out. It runs entirely in parallel and along the same route as the existing 400 kV Arañuelo-Morata double-circuit power line owned by Red Eléctrica.

- **Preventing the felling of trees:** the laying of the line's cables is carried out with the opening of corridors to facilitate the pruning of adjoining tree vegetation if necessary. Therefore, pruning has been favoured over felling trees.

- **Archaeological Feasibility Report:** an archaeological study of both the area of the plant and the line has been carried out for the Regional Ministry of Culture and Equality, which has issued an Archaeological Viability Report.

- **Bird savers:** bird coils are set up along the entire route to avoid bird collisions.

- **Placement of nesting boxes:** two boxes per support, for a total of 114 boxes.

As well as protecting the environment from an environmental point of view, the Talayuela photovoltaic plant has also given an economic boost to the business fabric of the area. Proof of this is that during the construction of the solar plant alone, the company invested more than 1.2 million euros in local companies. The contribution to the municipal coffers in the form of Special Property Tax (BICE) (€100,000 per year) and Tax on Economic Activities (IAE) and direct actions of collaboration with the residents must also be added. According to statements to the media by Ismael Bravo, Mayor of Talayuela, the plant has increased its total budget for 2021 by more than 50%, obtaining around 2.5 million euros per year from the facility. However, it would have liked to see more consideration given to local businesses.

The plant sells its renewable energy under a bilateral contract or PPA. The future implementation of a storage facility is envisaged, through which they will be able to manage in real time and regulate production according to the needs of the grid and the project.

According to the developer, the success of the project is evident in the social and economic results that have had an impact not only on the municipality of Talayuela, but also on its neighbouring municipalities. On the social and employment front, it has managed to register 757 job applications, training 102 local people with no experience to work on the project. The most striking result has been the creation of 326 jobs for local residents during the construction phase. In addition, they have marked the beginning of a turning point in a traditionally male-dominated sector, with women occupying 25% of the posts, a much higher percentage than in other similar projects. Furthermore, a greater inclusion of immigrants and the Roma community, both sectors that experience labour market insertion difficulties, has been achieved, with 35% of the jobs. This is a significant figure, as Talayuela had one of the lowest per capita incomes in Spain at the municipal level.

In environmental terms, of the 820 hectares of land, 312 hectares have been set aside for environmental protection, maintaining all the holm oaks in the area and recovering species that had disappeared. It should be noted that all the holm oaks that were present prior to construction have been respected, thus allowing islands of biodiversity to be maintained within the plant and avoiding breaking the continuity of the natural spaces that favour the presence of fauna and flora. It is therefore a differential element and a source of oxygen that enriches and improves the habitat, proving, in turn, that the correct implementation of large renewable plants is possible in areas marked by socio-economic difficulties such as continuous ageing, depopulation and high unemployment figures.

Credit: Statkraft

Holm oaks around the solar plant.

To complement this solar plant, the same Norwegian company, Statkraft, has started the construction of a new 55 MWp solar photovoltaic plant, Talayuela II, in the same municipality in Extremadura. Its construction involves the installation of 84,480 modules on a 115-hectare lease of land. The annual energy generated will reach 110 GWh, enough to supply around 34,000 households and avoid the emission of 21,000 tonnes of CO_2 into the atmosphere each year.

Like Talayuela Solar, this new project also has a strong environmental, economic and social commitment. From the **environmental** point of view, the project has an environmental integration plan that includes different actions that help to minimise the impact on the environment, the protection of the environment and biodiversity:

- **Increase in vegetation cover:** planting of a perimeter screen of native species along the fence.
- **Construction of a pond:** spanning 5,000 m² to encourage the breeding of bee-eaters and Sand Martins.
- **Promotion of local wildlife:** introduction of European pond turtles in the area, as a breeding nucleus and with the aim of reinforcing the populations in the area.
- **Animal shelters:** installation of nest boxes, as well as shelters for the conservation of owls, kestrels, reptiles and arthropods.
- **Biodiversity study:** to compare the state of the soil between the northern area, where more than 400 sheep act as a natural clearing area over an area of 331 hectares, and the southern part of the plant and thus draw conclusions on the impact that the presence of sheep has on this type of facility. This study will be carried out by Extrepronatur, in collaboration with Statkraft.

From the **social** point of view:

- **Local employment generation:** 200 jobs at the peak of construction, mostly in Talayuela and other nearby municipalities.
- **Dynamisation of the business fabric** of the area.
- **Developer-administration collaboration:** the developer works with local communities and administrations to see how they can respond to their needs in a sustainable way.

Finally, from an **economic** point of view, this project will bring in around 1.4 million euros in taxes to the municipal coffers, to which will be added 100,000 euros per year during the 30-year life of the plant, in the form of taxes on real estate with special characteristics.

Credit: Statkraft

Sheep grazing inside the Talayuela II photovoltaic solar power plant.

Las Corchas and Los Naranjos photovoltaic power plant — Sevilla

The Las Corchas and Los Naranjos photovoltaic power plants are located between the Spanish towns of Carmona and La Rinconada (Seville). The two plants have a combined capacity of 100 MWp and generate 202 GWh per year, enough to power 25,500 homes per year, which is equivalent to the annual energy consumption of a town like Carmona, while avoiding the emission of 94,000 tonnes of CO_2 into the atmosphere per year. They are made up of 258,120 bifacial photovoltaic panels, which allows solar radiation to be captured from both sides, optimising their use. In addition, 14 transformer stations, two electrical substations and 45 kilometres of underground networks have been built for its operation. The investment in the plants amounted to 70 million euros and covers an area of around 281 hectares.

Credit: Enel Green Power España

Las Corchas and Los Naranjos photovoltaic farms (Sevilla).

Promoting the local economy: with training actions, a commitment to local hiring and the promotion of initiatives in the primary or tertiary sector linked to the project that can generate greater economic activity and employment in the area, always relying on people and companies in the municipality, in this case, Carmona. This axis encompasses initiatives that are proposed within the facility under the slogan of sharing and not competing for land use so that it does not lose its primary character, while generating greater economic activity and employment. Highlights:

- Endesa's Solar Apiary: a pioneering project in Spain in the hybridisation of beekeeping and renewable energies, which is the first commercial initiative for the production of solar honey inside a photovoltaic plant. Ten hives were installed in a fenced and secure environment close to the plant and close to aromatic plants of agro-pastoral cultivation. Apiary bees pollinate aromatic plants and produce honey with a designation of origin: "solar" honey. It is a guarded and secure site, as is the photovoltaic installation, free from theft and a protected habitat for the Iberian bee, free from herbicides and chemical products. It is managed by a family from Carmona with a long tradition in beekeeping (Loramiel). In addition, the product acquires high visibility and media coverage as it is part of something innovative and opens up new sales outlets.

Credit: Enel Green Power España

Solar Apiary.

Agrovoltaic project: consists of an organic cultivation of aromatic herbs (3 hectares) between the solar panels of the plant, synergistic with the beekeeping activity due to its high degree of pollination.

Credit: Enel Green Power España

Agrovoltaic project.

Training courses: the developer offers them to the local population, free of charge. Two training courses in renewable energies (assembly of panels and operation of renewable plants), with 115 beneficiaries, and a first beekeeping course in collaboration with the Town Council and the Friends of the Bees Foundation, with 16 beneficiaries (1 per year is planned). These courses will facilitate the retraining of the local population in new sectors with potential, such as renewables. In addition, this measure means a reduction in the cost of labour for the developer by having people trained to work in the project environment.

Beekeeping activities:

- Sustainable tourism packages with a guided tour of the plant and immersion in the solar apiary, a visit to the Loramiel packaging and labelling facilities, a sightseeing tour of the old town of Carmona and an exhibition/tasting of local products. The first edition took place on 1 October 2022 (planned to be held once a year).

- Participation in the 10th CicloRinconada Half Marathon, a long-standing tradition in this municipality, with a flying finish line inside the solar plant and a refreshment point (with solar honey in the runner's bag).

Grazing under solar panels: carried out by a shepherd from Carmona, which benefits not only livestock, but also the clearing and cleaning of the soil, which is also necessary for photovoltaic installations.

Credit: Enel Green Power España

Sheep grazing under the solar panels.

- **Sustainable municipality:** with measures that encourage the municipalities where the projects are located to also be sustainable in terms of consumption, thus becoming reference models in the energy transition. In this case, the following stand out:
  - Monitoring of energy consumption in 20 municipal buildings.
  - Installation of solar self-consumption in the Carmona multi-purpose building.
  - Installation of two electric vehicle charging points (local police and nursery).
  - Installation of LED lighting in streets and public buildings in the municipality.

Environmental and social impacts are proactively managed by Endesa's Sustainability area, with early communication and the use of the CSV methodology, which makes it possible to anticipate and manage impacts sufficiently in advance. With regard to the environmental aspect, the plant does not affect any Protected Natural Space, neither within the Andalusian Protected Space Network nor the European Natura 2000 Network. Habitats of Community Interest are not affected either. The measures taken with the aim of minimising the impact during the construction and maintenance phase are summarised below:

- **Planting of vegetation screen:** with native vegetation.
- **Planting of shrub islands:** several copses of natural vegetation have been included, scattered throughout the solar plant.
- **Installation of nests:** 30 nesting boxes for birds and bats have been installed on each of the floors.
- **Protection of nests in the province:** 22 Montagu's harrier nests have been protected in several municipalities in the eastern part of the province of Seville during the 2020 Steppe Bird Conservation Campaign.

The CSV accompaniment project for the Las Corchas and Los Naranjos photovoltaic solar plant is a pioneering project in Spain, an example of public-private partnership, which manages to maximise the positive impact on the local environment in a lasting way under the logic of shared value creation and the active involvement of a large number of local agents. Thanks to this project, a photovoltaic plant model that respects and promotes the biodiversity of its environment and local socio-economic development is achieved. This model is being implemented in all of the Endesa Group's PV plants in Spain and abroad, regardless of the scale or size of the PV plant.

Some of the characteristics that make these photovoltaic plants a success story in terms of social acceptance and respect for the environmental and cultural values of the territory are due to the fact that these are:

- A training space, aimed at young people who want to start their professional development in the field of renewable energies and/or entrepreneurs who want to get started in the world of beekeeping (the first workshop was held in June 2021 and there are plans to hold one a year).
- An additional tourist attraction for the municipality of Carmona, as a series of beekeeping activities are carried out in this apiary in collaboration with the Carmona City Council and its tourist office, with visits also to the solar plant.
- A space for innovation, with the collaboration of two startups (Protofy and Smartbee) that have implemented hive sensing technology to help beekeepers and make their operations more efficient (weight, temperature, humidity and GPS location).
- A space for relations and synergy with the local commerce of Carmona since, thanks to the mediation of the City Council, part of the honey produced has been and is acquired by a famous local bakery in Carmona for the production of bread, and also for the production of sweets by a well-known congregation of nuns.
- An inclusive space, with the involvement of the "El Alcázar" Occupational Centre in Carmona, a reference in the area for people with disabilities, which has already participated in the fastening of the solar panels during the construction phase, and has also been responsible for the design of the labelling of the honey containers.

These projects are becoming a benchmark in the field of renewables due to their innovative nature as a renewable and sustainable, environmentally and socially responsible plant model:

- It shares the use of the land while preserving the primary character of the land.
- It conserves biodiversity and combats soil desertification.
- It promotes local socio-economic development as an element of population fixation in rural areas, where most of the projects are located.

In addition to the solar apiary and the agrovoltaic project, in Carmona, a crop is being coordinated with the Innovation team of the developer, which will be implemented on an area of about 3 hectares, and will last for about 2 years, during which time its viability and impact on the productivity of the plant will be analysed. At the end of this innovation phase, the developer is in talks with a local company to extend the cultivation to the entire plant.

Enel Green Power España has made a commitment to continue and renew the CSV plans for the 25 years that the plant will be in operation.

Minglanilla photovoltaic power plant
— Cuenca

The Minglanilla photovoltaic power plant is located between the municipalities of Graja de Iniesta and Minglanilla (Cuenca) with a capacity of 100 MWp and an area of approximately 200 hectares. This installation generates more than 172 GWh per year, which avoids emissions of 114,000 tonnes of CO_2 per year. The developer, Enel Green Power España, started construction in March 2022 and is currently connected to the grid.

Credit: Enel Green Power España

Minglanilla photovoltaic power plant (Cuenca).

This project, like the previous case, is part of Endesa's sustainability strategy of "Creating Shared Value" (CSV). The CSV plan to accompany the Minglanilla renewable plant incorporates a series of initiatives in the 3 aforementioned lines of action:

- **Sustainable engineering during the construction phase:** measures have been implemented that go beyond what is required by regulation. These include the following:
  - Installation of two solar panels of 10 kWp each on the huts to cover the energy needs of the construction site. Once the work was completed, the panels were donated.
  - Installation of three hunting drinking troughs (donation on completion of work).
  - Four defibrillators (donation on completion of the work).
  - Installation of two charging points and use of an electric vehicle.
  - Use of an efficient lighting system.
  - Waste recycling and wood donation and composting of the organic fraction. Minimisation of plastic consumption on the construction site.
  - Carbon footprint measurement for the reduction of greenhouse gas emissions.
  - Early communication of the project to the community (panel site and open days).
- **Promoting the local economy:** in this area, the following measures stand out:
  - Training courses. The developer has carried out the training among the local population: 35 people have received the "panel assembly" course and 50 will receive the "operation and maintenance of renewable energy plants" course.
  - Promotion of local procurement: people and companies in the municipalities of Minglanilla and Graja de Iniesta. The minimum local hiring commitment is 30%.
  - Facilitating purchases and services to local SMEs.

Sustainable municipality: energy efficiency initiatives in the municipality, currently under study, are included, such as.

- LED lighting, efficient lighting in public buildings, energy audits, solar panels for self-consumption and pumping, electric mobility and digitalisation systems.

- As for the local community, actions have also been carried out:

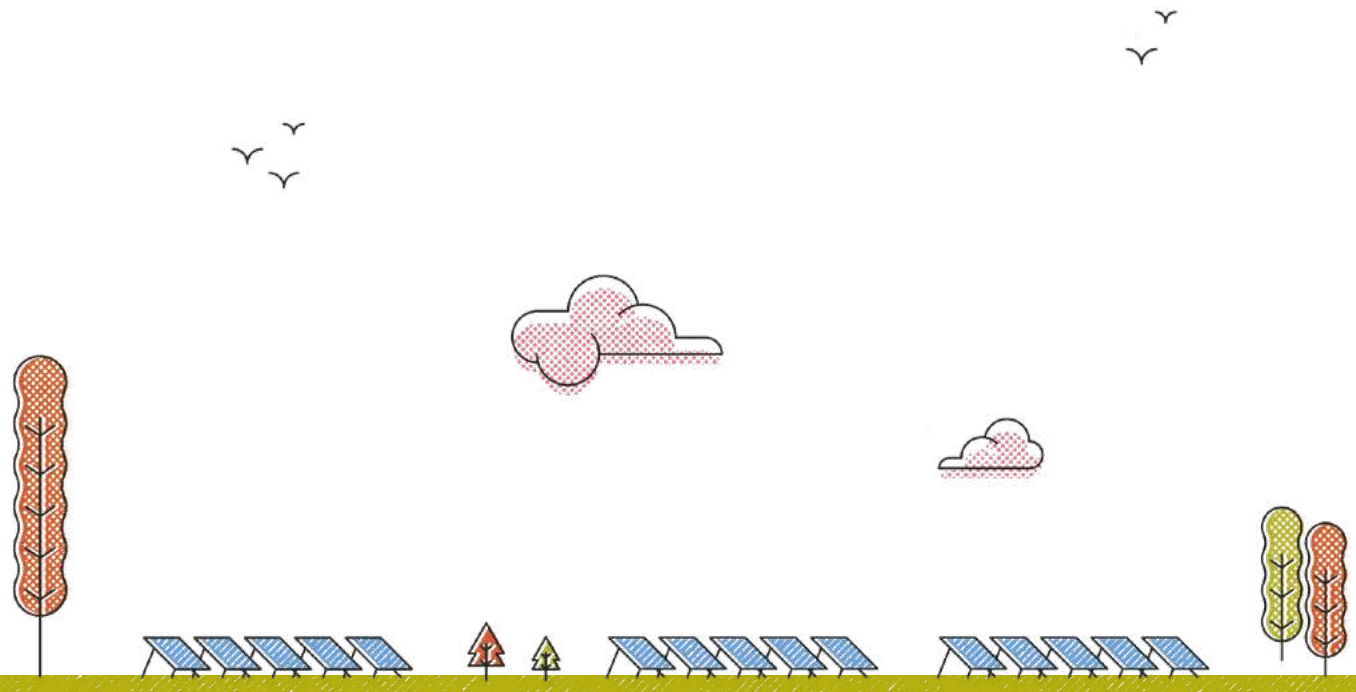
  - x Awareness-raising and involvement of local actors: early communication to the local community, workshop on screws with the Alzheimer's Association and other dementias "Valle del Cabriel" in Minglanilla, development of environmental actions around a shelter for insects created from waste materials from construction sites (wood, bricks, cardboard, etc.), Open Day on completion of the work, invitations to schools, associations, town councils and local companies and press releases on the various actions.

  - x Land-use sharing partnerships:

Agrovoltaics.
Bealar S.L., a benchmark in the world of saffron production and marketing. Traditional cultivation of "Azafrán de la Mancha" will take place. The use by groups at risk of social exclusion is under study.

Beekeeping.
Nómadas de la Miel, fifth generation of beekeepers from Minglanilla. As an innovation measure, it is proposed to place sensors in the hives to monitor parameters related to the production cycle. From an environmental point of view, bees will promote the pollination of crops and the development of biodiversity.

In-plant grazing.
The extensive grazing of 430 manchega sheep is a sustainable way of enriching the soil and biodiversity.



The CSV accompaniment plan for the Minglanilla renewable energy project is aimed at achieving the maximum benefit for the inhabitants of this municipality. The design and implementation of this plan has been carried out in a participatory manner with the local community, with the collaboration of 10 agents, as detailed below:

- Minglanilla and Graja de Iniesta town councils as the main driving forces, together with the promoting company (Endesa), of this accompanying project as a factor of revitalisation and fixation of the population.
- Developer, Endesa.
- ADIMAN: association for the integral development of La Manchuela in Cuenca.
- Castijorge Cooperative Company.
- Champigranja.
- Cooperativa Agrícola Santísimo Cristo de la Salud.
- Bodegas Altaman.
- Graja de Iniesta Women's Association.
- Alzheimer's Association and other dementias Valle del Cabriel.
- Association for the Love of Art.

Environmental and social impacts are proactively managed by Endesa's Sustainability area, with early communication and the use of the CSV methodology that makes it possible to anticipate and manage impacts sufficiently in advance. With regard to the environmental aspect, the plant does not affect any Protected Natural Space, neither within the Castile – La Mancha Protected Space Network nor the European Natura 2000 Network. Habitats of Community Interest are not affected either.

Like the photovoltaic solar plant Las Corchas and Los Naranjos, this plant is a pioneering project in Spain, an example of a public-private partnership, which achieves the creation of shared value and the active involvement of a large number of local agents. Some of the specific measures of this project have been:

- Training for the local community and provision of 20 computers.
- Inclusive workshop on screws.
- Full use of the soil for agriculture (saffron), livestock and grazing.
- Provision of an insect hotel, possibly the largest in the world, which promotes sustainable pest control.
- Collaboration in the energy efficiency of the municipality with planned self-consumption installations in various municipal buildings.

In this case, the developer has also made a commitment to provide continuity and renew the CSV plans for the 25 years that the plant will be in operation.

Cordovilla photovoltaic power plant
— Pamplona

The Cordovilla photovoltaic power plant will be located in the Autonomous Community of Navarre, in the municipality of Ibargoiti. This small municipality has a population of less than 300 inhabitants. The developer of this project is Esparity Solar and it will have a capacity of 150 MWp and a surface area of 254 hectares. The project is currently being processed and is scheduled for completion in late 2023 or early 2024. During its life cycle, it will achieve emissions savings of more than 2,000,000 tonnes of CO_2, with energy generated per year equivalent to the consumption of 80,000 households.

Initially, preliminary meetings were held with the mayors in order to obtain their agreement with the location of the solar photovoltaic plant on land in their municipality. Meetings were also held with general directorates of the Autonomous Community of Navarre, prior meetings with the owners of the land, with associations close to the area and proposals for the establishment of collaboration agreements with them. The initial proposals offered by the developer included the provision of certain services according to the needs of the municipality where the plant is located, the training of unemployed people or people with difficulties in finding work, job offers to the local population, improvements to existing services (roads, paths, etc.) and electricity services for the affected localities. Throughout this process, the most relevant actors were the mayors of the municipalities affected, the directors of the regional and state departments involved in the licensing procedures (environment, industry and energy, land planning, etc.), the owners of the land where the facilities are to be installed and the population of the affected towns.

According to the developer, the most relevant environmental impacts of the construction of this photovoltaic plant are the usual ones for this type of installation and are related to the possible loss of biodiversity where the plant will be built. In order to minimise these impacts, a multitude of compensatory measures have been taken, including the following: hunting fencing for fauna to pass, compensatory measures in favour of the bearded vulture (adaptive release of species and canine patrol against poisoning affecting necrophagous species), measures to favour the maintenance of biodiversity and the installation of birdwatching huts in the Celigüeta pond - located within the plant's polygonal area - monitoring of bird species of high ecological interest, incorporation of beekeeping in the polygonal area or educational trails. It should be noted that the visual impact of this project is nil, as the location of this plant has been optimally selected. Specifically, the plant is located on private land in a valley with restricted visibility from roads and public areas, achieving optimal landscape integration, which has led to the plant being classified as "low visual impact".

As for the impacts of the project on other municipalities, the most significant would be the visual impact of the evacuation line, which is some 20 km long, as well as the occupation of plots of land through which it crosses and the effect on birds that may pass through the area. To minimise these impacts, various measures have been taken, such as locating the supports on the boundaries of plots of land to minimise the impact on their owners, burying the sections that cross urban centres, placing bird guards along the entire section of the line to protect the birds that could be affected and locating the line parallel to other lines already built and motorways, because these areas are already anthropised.

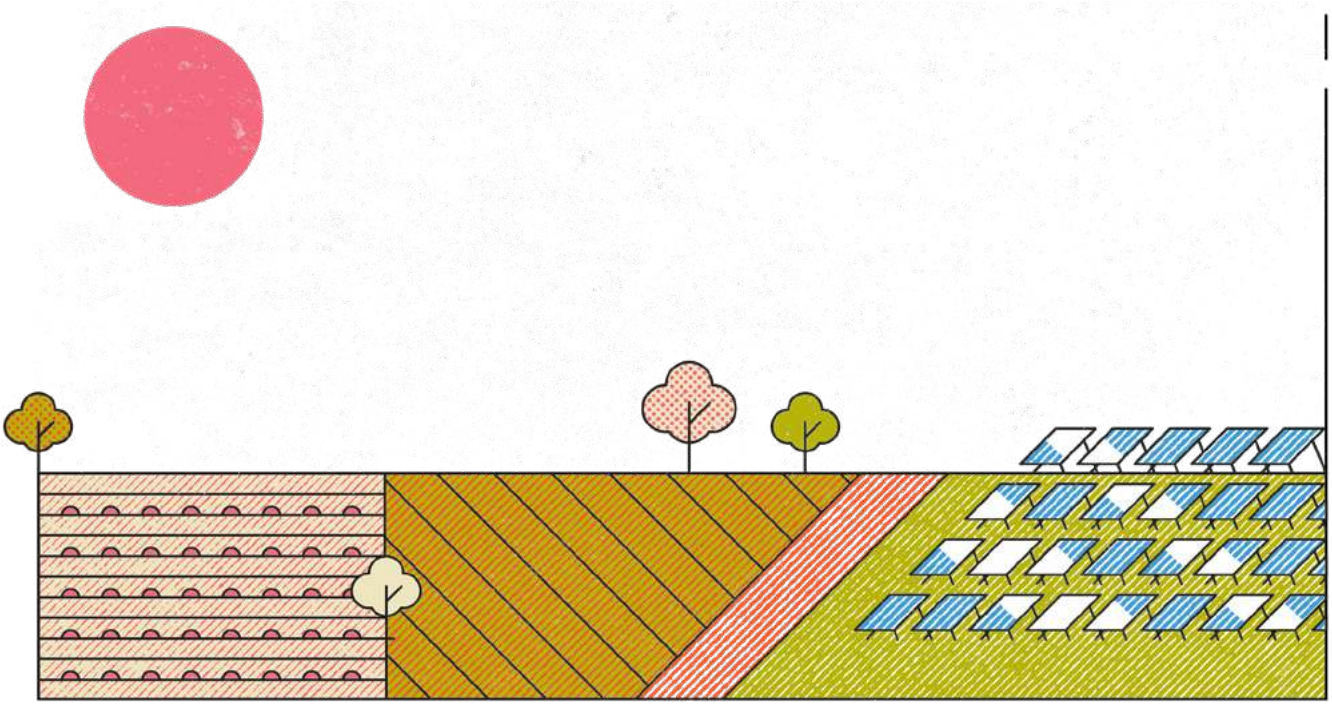
According to the developer, during the processing of the project they have had practically no problems with the population of the affected municipalities, due to the lack of visual impact on the neighbouring towns. The only allegations received were environmental and social allegations about the route of the evacuation line and the loss of biodiversity and fragmentation of the habitat due to the occupation of the plant by some environmental associations and the Regional Biodiversity Service. As previously mentioned, Esparity Solar has taken action in this regard: a multitude of compensatory measures, location of the evacuation line in already anthropised areas and taking advantage of an existing corridor and location of the supports on the boundaries of the affected plots so as to produce the least possible effect on them, and elimination of the collector substation. All these measures have been agreed with the territorial services with environmental competence in Navarre.

In summary, the best examples that can be drawn from this project are:

- Low visual impact of the photovoltaic plant.
- All compensatory measures to compensate for the loss of biodiversity and which aim to enhance certain species.
- Social improvements through agreements with associations and populations affected by the plant, which will benefit both environmentally and socially from all the investment and the good management of the processing of the evacuation infrastructures.
- Measures for the conservation of the Celigüeta reservoir and for the protection and support of the bearded vulture.
- No compulsory expropriation of the land has been carried out and full agreements have been reached with the four owners in the project area, in addition to obtaining the approval of the town councils affected by the generator plant and the town councils affected by the route of the evacuation line.
- Positive social impacts related to the generation of direct and indirect employment (creation of around 500 jobs in the development, construction, operation and maintenance phases), the establishment of population in rural areas and the local contracting of service provision.

Credit: Noticias de Navarra

Implementation of apiaries in the Cordovilla project (Pamplona)



Herrada del Manco photovoltaic power plant — Murcia

The Herrada del Manco photovoltaic power plant, commissioned in 2019 and located in Yecla (Murcia), is a small installation prepared to supply 1,155 homes in the municipality. With 6,000 panels and 2 MWp of power, it offers several unique features, both in terms of its innovative engineering and the socialisation of ownership. It belongs to SINLIMIT SOL, S.L., a limited company made up of 80 partners, individuals and small companies in the area who have become its investors through a company engaged in promoting, constructing, operating and maintaining wind farms. Therefore, this project is a totally different initiative to those that are being implemented in Spain, as it is a small plant spanning 4 hectares and integrated into the environment, which also benefits family economies and the territory.

Initially, preliminary meetings were held with the City Council, the Directorate General for the Rural Environment of the Autonomous Community of the Region of Murcia and the Directorate General for Energy and Industrial and Mining Activity of the Autonomous Community of the Region of Murcia. These meetings were intended to be educational, explaining the project, the local character of all the partners, the measures to be taken to avoid impacts, as well as the benefits for the area. The initial proposals are summarised below:

- Commitment to hire local companies. Local employment generation.
- Transfer of land for reforestation and environmental compensation.
- Prior authorisation and coordination of the technical aspects of the installation.

This project complies with all environmental regulations: respect for the landscape, the environment and biodiversity, with a slight environmental impact, especially on the landscape, due to the installation of the photovoltaic panels. As compensatory measures, 6 hectares of land were acquired, although the installation only occupies 4 hectares, and the remaining area has been ceded to the Directorate-General for Rural Affairs of the Autonomous Community of the Region of Murcia for repopulation with native species.

As the plant is very close to the connection and evacuation point, the evacuation line is short, only 140 metres, which limits environmental impacts despite being overhead. In both the design and construction phases, all aspects relevant to the protection of birdlife against collision and electrocution were taken into account.

The project was financed with around 100 shares of €20,000 each and was the first solar plant to win a renewable auction without power

limits. Specifically, this project obtained a fixed energy price in the July 2017 auction, which awarded more than 3,900 MW of solar PV with a connection commitment prior to 2020, and in which it competed with companies such as Cobra (a subsidiary of ACS), Enel and Gas Natural Fenosa. [9]

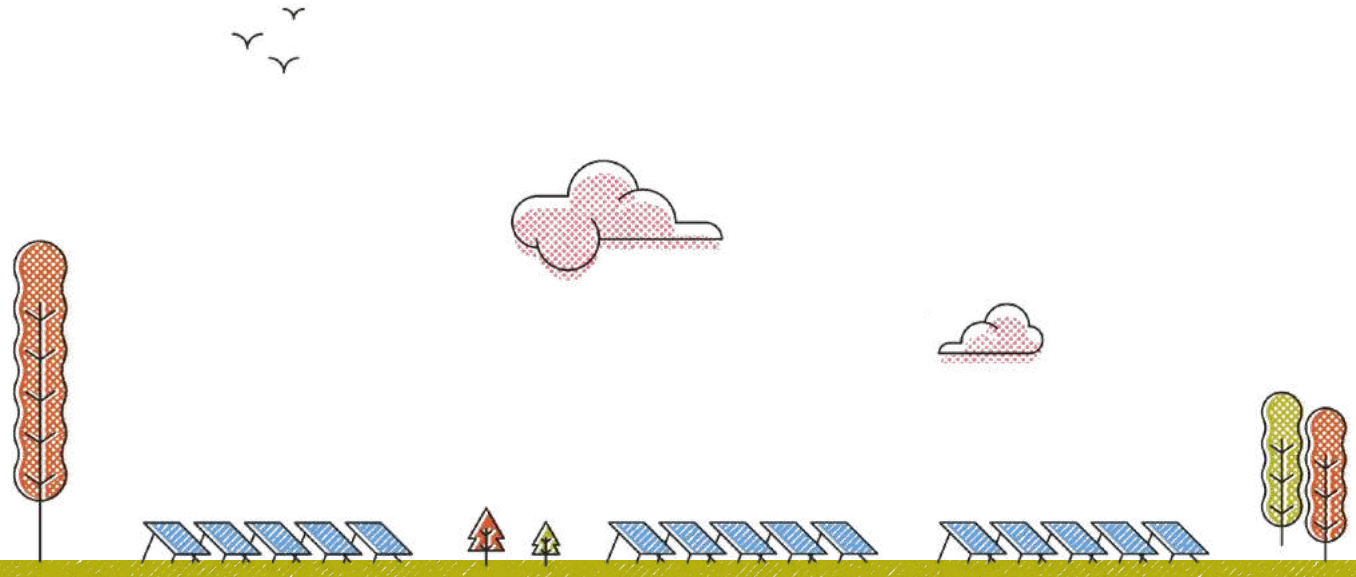
In this case, an environmental group commented in the media that the selected site was of special interest because of the presence of the vulnerable skylark. [10] Although it has not been possible to contact the environmental association for further details, in conversations with the developers they have indicated that the presence of this bird is not assured in this location and, nevertheless, as a compensatory measure for the possible impact, it was decided that the 2 hectares not occupied by the facility would be planted with esparto grass, which seems to be a good habitat for this species.

This small project can be considered a success story for three reasons:

- The solar resource is shared among local families and SMEs, so the socio-economic benefits accrue to the area as a whole.
- It is a small project, so the environmental impact is small. In addition, all environmental regulations have been complied with.
- The connection point is close, which means an optimisation of the installation and a reduction of energy losses. Consumption of energy produced in close proximity is achieved.

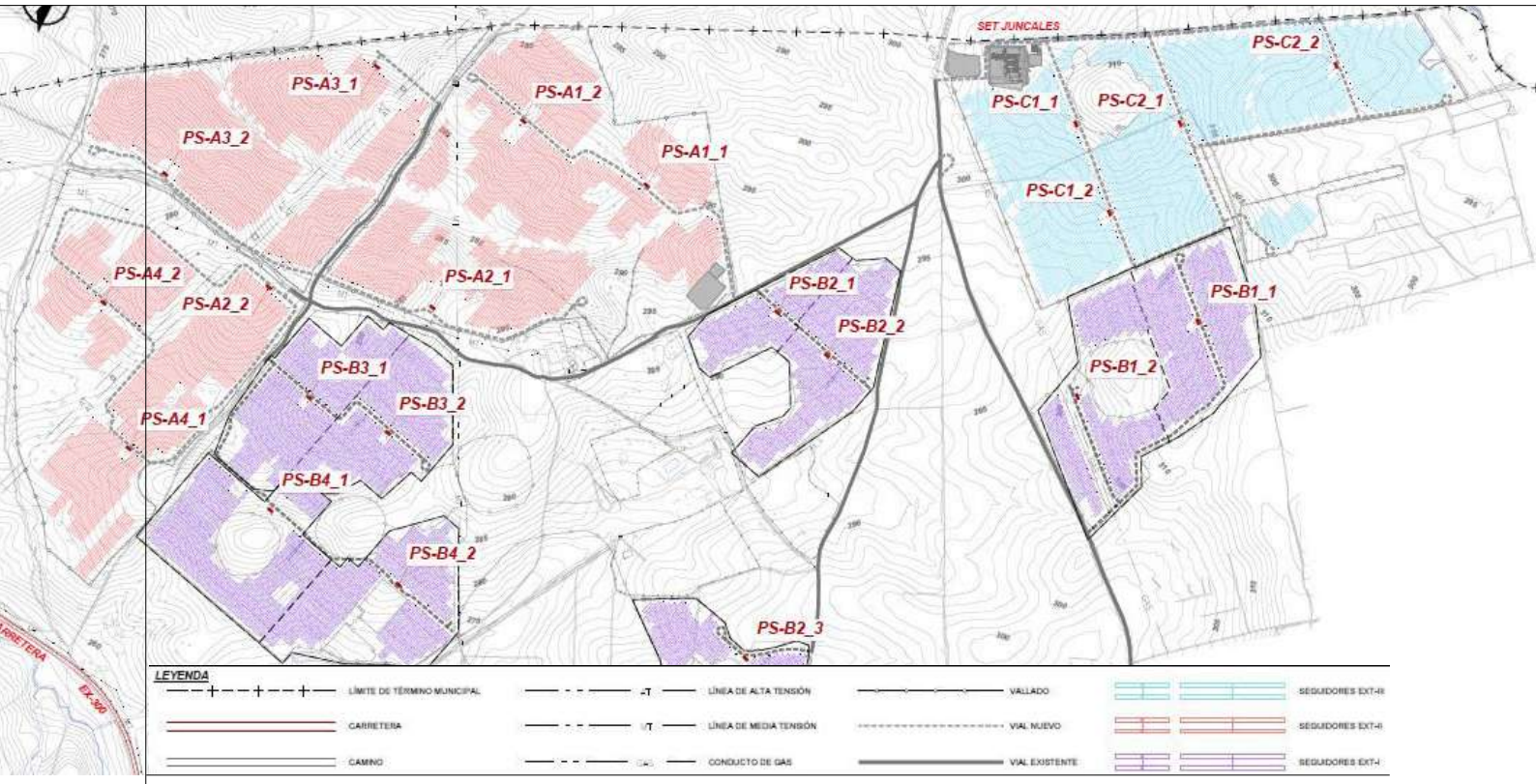
In summary, the most relevant measures and features of the project would be:

- Educational work.
- The transfer of land for reforestation and environmental compensation.
- The generation of local employment and the optimisation of the facility.
- The promotion of the project by local partners, citizens and SMEs in the area.



Extremadura I, II, III photovoltaic power plant — Badajoz

The Extremadura I, II and III photovoltaic project consists of the installation of three solar photovoltaic plants with single-axis trackers. This project, carried out by the company Acciona Generación Renovable, is located in the municipality of Almendralejo (Badajoz) and has 125 MW of power distributed over a total area of 300 hectares. Construction of the solar complex began in November 2021 and consists of a total of 234,640 PV modules of 540 Wp each in Extremadura I and 535 Wp in Extremadura II and III, which will produce an average of approximately 257 GWh of electricity per year, equivalent to the consumption of 65,000 households. This project will prevent around 112,000 tonnes of CO_2 being emitted into the atmosphere each year.



Credit: Acciona Generación Renovable.

Location of the Extremadura I, II, III photovoltaic plant.

At the beginning of the project, several meetings were held with the public administration as well as with business and environmental associations. With regard to the first, meetings were held with various departments of Almendralejo City Council (Sports, Internal Regime, Citizen Participation and Transparency, Parks and Gardens, Environment and ODS, Training, Employment and Industry). In addition, a number of meetings were held with business associations: Corporación Empresarial de Almendralejo (CEAL), Asociación de Empresarios Vinícolas de Extremadura (ASEVEX), the association Hostural de promoción turística y de restauración and the Comunidad de Labradores y Ganaderos de Almendralejo. In addition, meetings were held with environmental associations: Association for the Defence and Study of the Environment (DEMA) and Ecologists in Action (Extremadura and Tierra de Barros).

As initial actions, a Social Pre-feasibility Study was carried out at a very early stage of development, followed by a Social Impact Study. These studies collect information on the environment, stakeholders, social risks and impacts and their corresponding mitigation/ enhancement measures, a social investment plan and a stakeholder communication plan. In the initial stages, it also helped to promote local procurement by working closely with the City Council to supply local companies that could service the site. At the same time, e-mail addresses were made available to the population through the City Council, where those interested could send their CVs. In addition, a telephone number and email address were set up to collect any concerns, questions or suggestions from the community. According to the developer, there have been no social problems with the population of the affected municipalities, neither while processing the project nor during its construction.

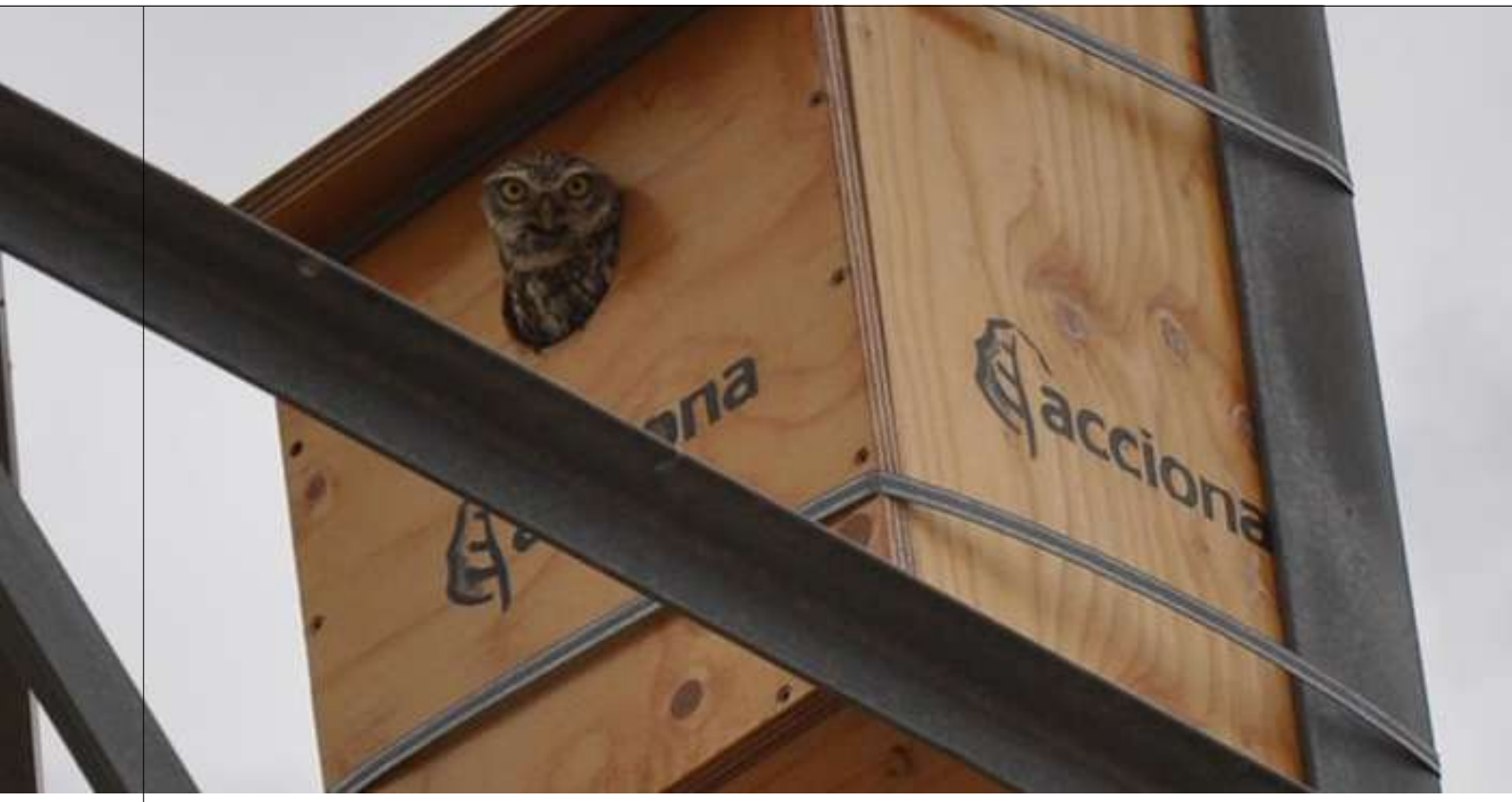
The location of the project is the result of rigorous environmental studies aimed at minimising the impact on the environment, flora, fauna and existing archaeological sites. Nevertheless, a number of potential environmental and social impacts have been identified and are summarised below:

- Potential impact on steppe birds due to habitat occupation.
- Potential impact on birds due to disturbance during construction and operation.
- Potential impact on other faunal groups.
- Potential impact on inventoried and non-inventoried heritage.
- Potential impact on flora.

In order to minimise these impacts, a series of preventive, corrective and compensatory measures will be developed to offset the impact on plants, animals and archaeological sites, such as:

Fauna:

- Creation of steppe bird reserves (50 ha), installation of nesting boxes and perches for birds of prey.
- Marking of nests and delaying work until breeding is complete.
- GPS bird marking.
- Monitoring of noise levels.
- Creation of amphibian crossings.
- Installation of reptile shelters and insect hotels.
- Creation of waterlogging areas.



Credit: Acciona Generación Renovable.

Installation of nesting boxes as a compensatory measure to compensate for the effect on birds.

Flora:

- Beaconing of sensitive area for Narcisus sp.population, beaconing of all holm oaks and riparian vegetation.
- Monitoring of dust accumulation on vegetation and periodic watering of paths.
- Creation of a protected flora reserve (3 hectares).
- Transplanting of about 100 olive trees to the plot indicated by the Almendralejo Town Council.

Credit: Acciona Generación Renovable.

Transplanted olive trees.

Heritage:

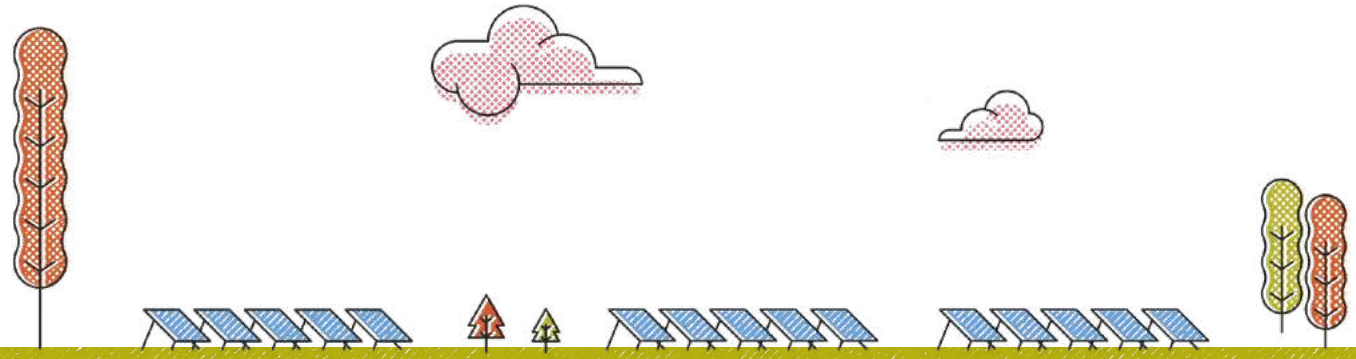
- Archaeological clearance, archaeological monitoring of the work and redesign of the plant during the work.
- Excavation of 11 archaeological sites.

In relation to other nearby municipalities, the greatest impact generated by the development of this project is the visual impact of the photovoltaic plant. To minimise this impact, a double fence will be created to encourage the presence of natural vegetation, creating a screen of native vegetation. The aim is also to respect the olive trees and holm oaks for a better integration of the plant.

This project can be considered a success story in terms of respect for cultural values in the way it manages the appearance of archaeological remains. In addition, it has had great social acceptance thanks to early engagement with the territory, dialogue with stakeholders to socialise the social management plan, the dissemination of information about the plant through brochures and posters, and the promotion of the hiring of local labour and local companies that could service the needs during the work. In addition, the construction of the project will result in a contribution in local taxes and fees that will have an impact on the well-being of the community.

In summary, the most relevant measures implemented in this project after gathering the interests and needs of the population would be:

- **Dissemination of information:** on the project and socialisation of the main findings of the social studies carried out by an independent social consultant.
- **Promotion of local procurement:** the construction of the installation will involve generating local jobs (approximately 20% of the personnel recruited by subcontractors), while 4 stable jobs will be created during the operation phase.
- **Social investment:** Acciona Generación Renovable's commitment to invest a percentage of sales in social projects to be determined after assessing the needs of the area and in agreement with neighbourhood representatives. The social investment commitment is for at least the first 10 years of the plant's life. The Colabora Almendralejo project is currently being developed, a programme for the development of a community of young talents and local companies that promote sustainability, social welfare and boost employability in Almendralejo.
- **Development of a plan of preventive and corrective measures** to minimise environmental impact..
- **Full funding** of the excavation and the development of the research of the archaeological remains brought to light.



1 Belorado I (Burgos)
Capacity: 57 MWp
135 hectares
Minimal impact on the territory.
Creation of live hedges for integration with the environment. Involvement of the administration and the local population from the very beginning.

2 Talayuela Solar (Cáceres)
Capacity: 300 MWp
820 hectares
One of the largest and most innovative projects in Europe.
Extensive livestock to clear the land.
Promotion of local employment.

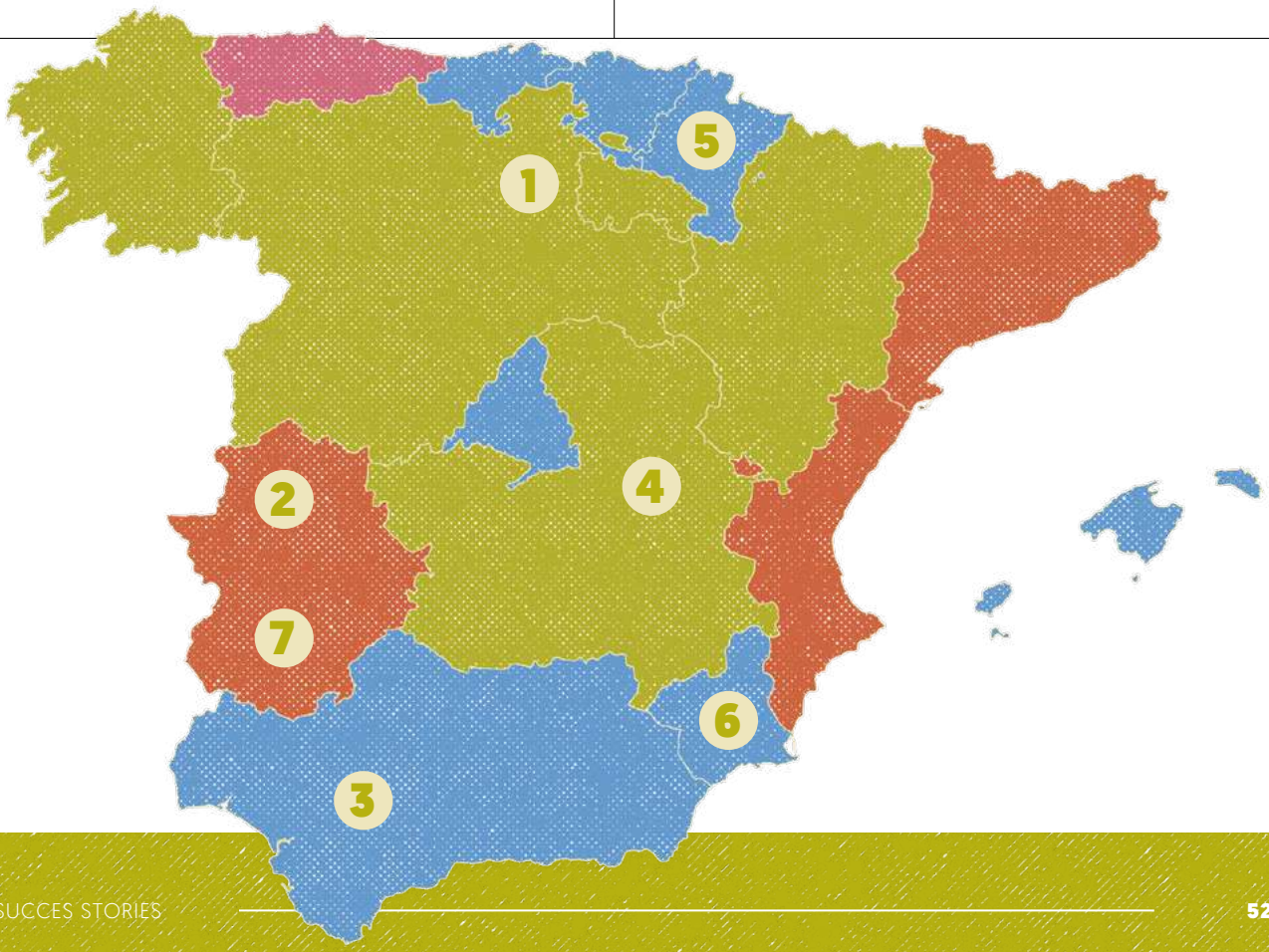
3 Las Corchas y Los Naranjos (Sevilla)
Capacity: 100 MWp
281 hectares
Pioneering initiative of beekeeping and ecological cultivation of aromatics inside the plant. Active involvement of the local population.

4 Minglanilla (Cuenca)
Capacity: 100 MWp
200 hectares
Land use shared with saffron cultivation and grazing. Sensitization of the local population and promotion of sustainable measures.

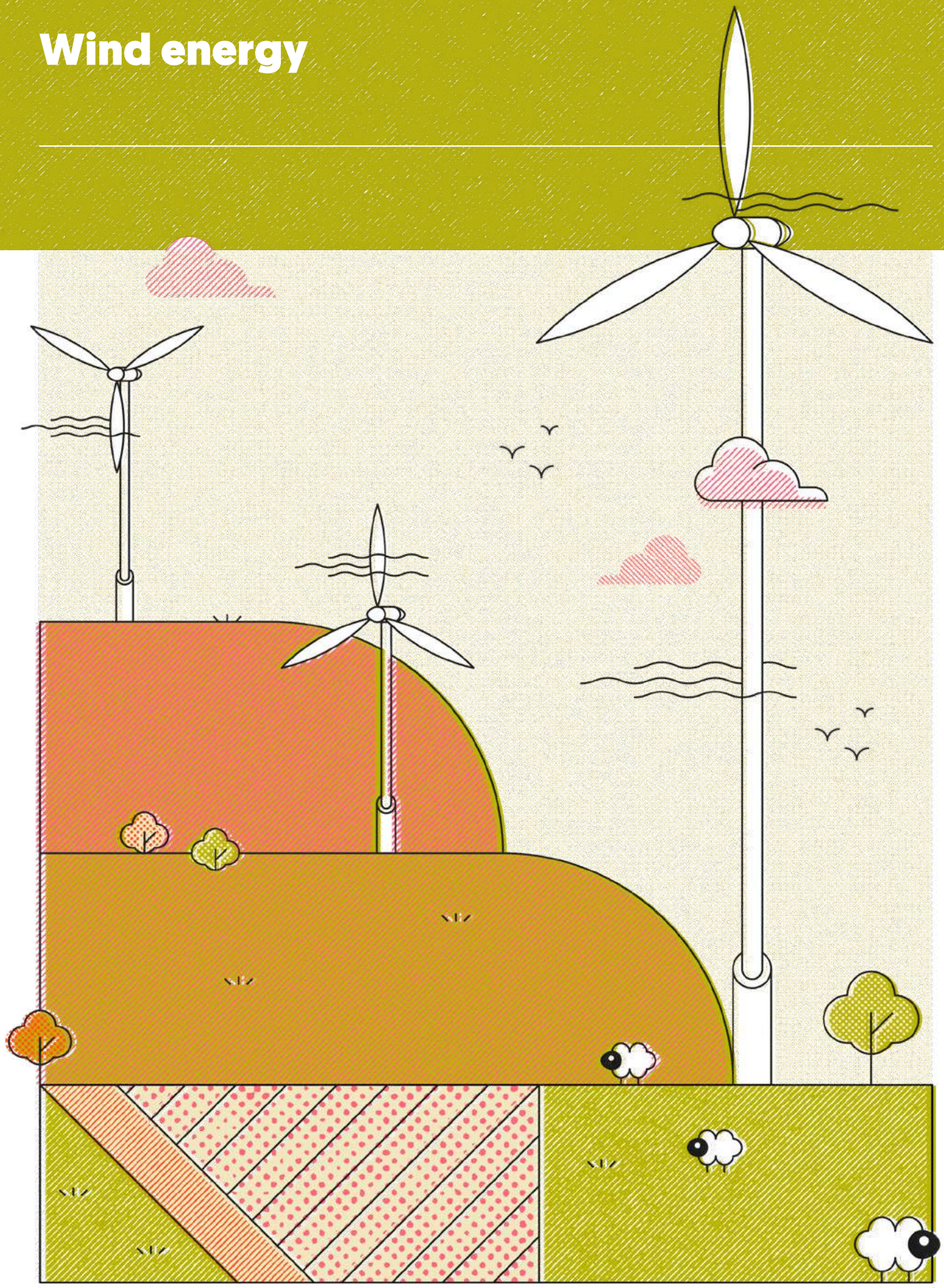
5 Cordovilla (Navarra)
Capacity: 150 MWp
254 hectares
Low visual impact.
Bearded vulture conservation measures.
Stimulation of local employment and fixation of population.

6 Herrada del Manco (Murcia)
Capacity: 2 MWp
4 hectares
Promoted by 80 individuals and local companies.
Integration in the environment. The distribution of socioeconomic benefits remains in the area.

7 Extremadura I, II, III (Badajoz)
Capacity: 125 MWp
300 hectares
Creation of reserves for steppe birds and protected flora.
Excavation of archaeological sites.
Vegetable shielding of the perimeter.



Wind energy



Wind farms in Muras
— Lugo

Muras is a municipality (concello) in the province of Lugo with 611 inhabitants. In the regional context, the province of Lugo is the second Spanish province with the most wind power generation, with 73 wind farms, and Galicia is the fourth autonomous community with the most installed capacity (3,866 MW in 2021). [13]:

- **Muras I**
  with 37 wind turbines with a unit capacity of 660 kW Gamesa G47/660
  with a total of 24.42 MW.
- **Bustelo**
  with 76 wind turbines with a unit capacity of 330 kW Made AE-32
  with a total of 25.08 MW.
- **Ventoada**
  with 30 wind turbines with a unit capacity of 750 kW NEG-MICON NM 750/44
  for a total of 22.5 MW.
- **Lomba**
  with 30 wind turbines with a unit capacity of 750 kW NEG-MICON NM 750/44
  for a total of 22.5 MW.
- **Silán**
  with 20 wind turbines with a unit capacity of 660 kW Made AE-46/I
  with a total of 13.2 MW.
- **Pena Grande**
  with 26 wind turbines with a unit capacity of 660 kW Made AE-46/I
  with a total of 17.16 MW.
- **Leboreiro**
  with 32 wind turbines with a unit capacity of 660 kW Made AE-46/I
  with a total of 21.12 MW.
- **Coruxeiras**
  with 31 wind turbines with a unit capacity of 1,670 kW Ecotecnia 74
  with a total of 51.77 MW.

In the farms listed above, all the installed capacity is located in the municipality of Muras (197.75 MW), while in the remaining farms it is shared with neighbouring municipalities (235.02 MW):

- **San Xoán**
  with 48 wind turbines with a unit capacity of 330 kW Made AE-32
  with a total of 15.84 MW.

- **Nordés**
  with 27 wind turbines with a unit capacity of 750 kW NEG-MICON NM 750/44
  for a total of 20.25 MW.

- **Refachón**
  with 28 wind turbines with a unit capacity of 750 kW NEG-MICON NM 750/44
  for a total of 21.00 MW.

- **Soán**
  with 26 wind turbines with a unit capacity of 750 kW NEG-MICON NM 750/44
  for a total of 19.50 MW.

- **Soán Ampliación**
  with 29 wind turbines with a unit capacity of 750 kW NEG-MICON NM 750/44
  for a total of 21.75 MW.

- **Pena Luísa**
  with 33 wind turbines with a unit capacity of 660 kW Made AE-46/I
  with a total of 21.78 MW.

- **Carba**
  with 30 wind turbines with a unit capacity of 660 kW Made AE-46/I
  with a total of 19.80 MW.

- **Muras II**
  with 37 wind turbines with a unit capacity of 660 kW Gamesa G47/660
  with a total of 24.42 MW.

- **Goia Peñote**
  with 37 wind turbines with a unit capacity of 850 kW Gamesa G52/850
  with a total of 34.00 MW.

- **O Chao**
  with 4 wind turbines with a unit capacity of 2 MW Enercon E82/2000
  with a total of 8.00 MW.

- **Vilachá**
  with 1 wind turbines with a unit capacity of 900 kW Enercon E44/900 with a total of 0.90 MW
  and 3 wind turbines with a unit capacity of 2.3 MW Enercon E70/2300 with a total of 6.90 MW.

- **Pedra Chantada**
  with 33 wind turbines with a unit capacity of 660 kW Made AE-46/I
  with a total of 21.78 MW.

These wind farms have been developed by Acciona, Endesa, Gamesa, HE del Arnoya SL, Iberdrola, Norvento and Sociedad Eólica de Ourol.

In conversations with residents of the municipality, we can observe practices of dubious ethics in the initial stages of the projects, such as the sale of land for wind farms at very low land prices (30-100 pesetas per m^2) and threats of expropriation, without any solutions being provided by the regional administration at the time.

During this first phase, several local companies took control of most of the territories and concessions, which they then sold to other companies, depriving citizens of the benefit that these lands could have brought them over the last 20-25 years. The current government of Muras, which inherited this negative context, is an example of how to redirect an unfavourable situation to improve the quality of life of its residents with this extra income in the best possible way.

The construction of the plants began in 1995, with no other plants in nearby municipalities at that time, and ended in 2009 with the construction of the last one. The development over the years has always relied on the cooperation of neighbours, companies and municipal authorities, which was rewarded in 2021 with the Eolo Award for rural integration. It seems that, after a 10-year hiatus, repowering may begin, but it must be borne in mind that part of the 164 km^2 of this Concello form part of the Red Natura 2000 park and the Miño River Biosphere Reserve.

As in other rural areas discussed later in this document, the development of wind farms has been a boost to the area's economic and social development. This municipality based its economic activity on agriculture and livestock farming throughout the 20th century. With the implementation of the farms, 5 direct jobs were generated for the inhabitants of Muras and approximately 40 additional jobs for the inhabitants of the area. Although more jobs were created during the construction stage, as local people were hired to develop the structures and accesses, as the mayor of Muras, Manuel Requeijo, commented. However, unlike other projects, Muras has lost population at a very high rate, with its population halving since 1998.

Muras's income comes mostly from the wind energy sector, either from Business Tax and IBI (900,000 euros) or subsidies (such as the 500,000 euros they received in 2021 through the Environmental Compensation Fund). It is worth noting that in 2018 the GDP of Muras was the second highest in the province and has an annual budget of 1.8 million euros. Part of this income has been used to increase the quality of life of the residents of Muras, with these measures listed by the mayor:

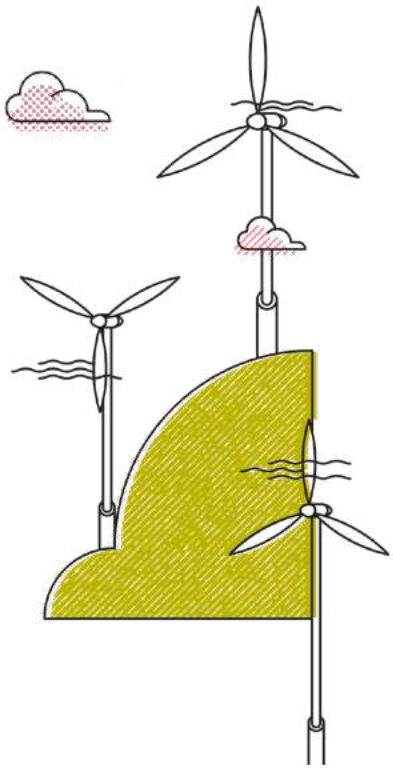
- Financial assistance to pay electricity bills for SMEs and households (depending on income) of a maximum of 1,500 and 600 euros respectively.
- Birth aid: basket of pharmacy products valued at 300 € and purchased in the municipality to promote local commerce.
- Improved social benefits.
- Infrastructure improvement.
- Construction of a drinking water network that reaches the municipalities eight neighbourhoods.
- Construction of an observatory.

Hybrex. Photo of a wind farm in Muras.

Wind farms in Higueruela
— Albacete

Albacete is a province that has made a strong commitment to wind energy and has 83 wind farms, giving it fourth place in terms of provincial wind power production in Spain in 2021. Castile-La Mancha is the community with the third most installed capacity (3954 MW in 2021).

With a capacity of 161 MW, the five wind farms in Higueruela (Albacete) have been an example of the integration of renewable energies since 1999, when construction began as the first wind farm in Castile-La Mancha. The farms in the municipality of Higueruela are:



- **Higueruela**
  with 57 wind turbines with a unit capacity of 660 kW.
- **Virgen de los Llanos I**
  with 40 wind turbines with a unit capacity of 660 kW.
- **Virgen de los Llanos II**
  with 35 wind turbines with a unit capacity of 660 kW.
- **Cerro de la punta**
  with 37 wind turbines with a unit capacity of 660 kW.
- **Malefatón**
  with 74 wind turbines with a unit capacity of 660 kW (built in 2000).

The five wind farms at Higueruela have a total of 243 Gamesa G47/660 wind turbines. At the time of their construction they were considered the second largest wind farm in the world and the largest in Europe. The location of the farms can be seen in the image below.

Credit: Iberdrola Renovables Castilla - La Mancha S.A.

Situation of the wind farms in Higueruela.

The implementation of wind energy in Higueruela has been recognised with the Eolo 2022 prize for rural integration, awarded by the Asociación Empresarial Eólica, which rewards municipalities that have been able to use the wealth that wind energy has brought them and integrate it into their environment, valuing socio-economic factors and the well-being of their inhabitants.

In conversations with members of the government team, we were informed that at the time of the construction of the complex in 1999, there were no regulations in force for this type of project in Castile-La Mancha. Subsequently there was a ruling that excluded these farms from adhering to the Environmental Impact Statement because they were already under construction. However, Iberdrola avoided building wind farms in areas classified as Red Natura and carried out continuous environmental monitoring of the environmental impact of the wind farms built for five years, although this was not mandatory at the time. It should be noted that during the initial phase of this project there was an open dialogue between Iberdrola Renovables Castilla-La Mancha S.A. and the landowners in the area. In view of the landowners' requests, the land acquisition (purchase) model was changed to a land lease model.

From the moment the wind farms were built, life in this village of 1,200 inhabitants, who were mainly engaged in agriculture and livestock farming, was turned upside down.
The council's budget has increased by 40% since its construction and, although there have been several changes of government since then, the commitment to wind energy and to passing this additional income on to the villagers has been maintained.

The Town Council has invested the money in the following actions:

- Construction of an old people's home with 55 residents and 10 people in day care, which has also created employment, especially for women
- Opening of a school canteen
- Free transport for high school and university students every day to their respective educational centres in Albacete
- Construction of a new sports complex
- Opening of a games library
- Opening of a nursery school
- Active ageing programme
- Reduced taxes for its inhabitants

It is worth noting that the construction of these farms put a stop to the depopulation of the municipality, which is characteristic of empty Spain. However, in the last 10 years the population has decreased by about 20 people per year, so this problem has not been completely eliminated. However, the construction of the wind farm employs in the area one person in the Energy Classroom, 11 people from Iberdrola in Operation and Maintenance (O&M) and 30 people from contractors for these same tasks.

Iberdrola Renovables Castilla-La Mancha S.A. has also contributed to the development with the construction of a training classroom, called "The windmill house", the first Iberdrola Energy Classroom in Spain where training sessions are held for schools and other entities free of charge. Iberdrola also collaborates in research by financing university work at the recently discovered 11th century Muslim archaeological site of "La Alquería".

Credit: Iberdrola Renovables Castilla-La Mancha S.A.

Photo of the Iberdrola Windmill House - Energy Classroom.

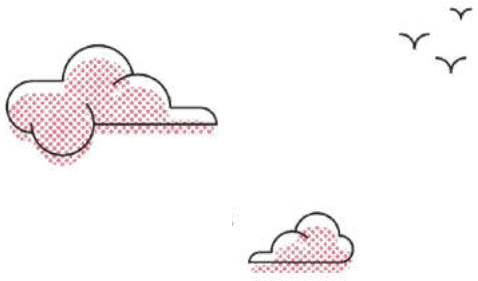
Credit: Iberdrola Renovables Castilla-La Mancha S.A.

Foto del yacimiento arqueológico “La Alquería”.

In conversations with the mayoress, Isabel Martínez Arnedo, she conveyed the balanced coexistence of a protected lagoon with the development of wind energy, seeing the development opportunities for the community. Even though there was some opposition from environmental groups in the province in the initial phase of development of these farms, this has now been alleviated, in her opinion, as the coexistence of the environment and the farms has been demonstrated for 23 years.

The relationship between the developer, Iberdrola, local government sources tell us, has been good throughout the process due to a transparent, participatory and respectful dialogue to find a balance between both parties. The mayoress also points out that the population has become sensitive to the environment and to achieving a sustainable town.

In the conversations held with the developers, they also emphasise the work they carry out to maintain the accesses to the wind turbines and other adjacent roads at the request of the neighbours, as these accesses are very useful for their agricultural, livestock, leisure, hunting, etc. activities.



Crédito: Iberdrola Renovables Castilla-La Mancha S.A.

Photo of one of the wind farms in Higueruela.

Wind farms in Fuendetodos
— Zaragoza

Fuendetodos is a municipality in the province of Zaragoza, Aragon, with a population of 142 inhabitants. In the national context, Aragon is the second autonomous community with the second highest installed wind power capacity at the end of 2021, with almost 4,700 MW, and Zaragoza is the Spanish province with the highest wind power generation in 2021.[13] The town of Fuendetodos has three wind farms:

- **Fuendetodos I**
  with 23 wind turbines with a unit capacity of 2 MW Gamesa G80/2000 for a total of 46 MW.
- **Entredicho**
  with 18 wind turbines with a unit capacity of 2 MW Gamesa G80/2000 for a total of 36 MW.
- **Fuendetodos II**
  with 56 wind turbines with a unit capacity of 850 kW Gamesa G58/800 with a total of 47.6 MW.
- **Loma Gorda**
  with 5 Gamesa G132 wind turbines with a unit capacity of 3.465 MW and 2 wind turbines with a unit capacity of 3.3 MW for a total of 24 MW.

These wind farms have a capacity of 154 MW and are managed by Iberdrola, with the exception of the last one, which is managed by Enel Green Power Spain, Endesa's renewables subsidiary. The first three farms were implemented in 2004 and the one in Loma Gorda in 2019. There are currently two other farms in the pipeline in the locality: Maria 1 and Maria 2. The integration of wind energy in its territory earned it the Eolo award for rural integration in 2014.

Of the older projects, just over half of the land occupied by the plants is publicly owned and the rest is privately owned, according to information provided by the mayor of Fuendetodos, Enrique Salueña. The income generated during these years has been invested in:

- Recruitment of municipal staff.
- Renovation of streets and subsidies to residents to repair façades.
- Creation of the Energy Classroom to attract schools in the region, with 25,000 visits per year.
- Construction of the tourist branch and the future construction of the Goya costume museum.

In the construction of the Loma Gorda plant, 463 direct and indirect jobs were created.

ENEL has also contributed to the development of the area through:

- Courses for 60 residents to work on the maintenance of the farm.
- Heritage restoration (stone refrigerators) and Botanical Garden.
- 140,000 for social plans in the area.
- Improvements to the hiking route to the wind farm.
- Subsidy for the construction of a water tank in the forest to be able to extinguish fires that may occur in the pine forest area.

According to the testimony provided by the government team, there is no rejection of the wind farm among the residents, but there is concern about the installation of an associated substation with wiring that is not buried, which, according to the residents, generates a visual impact and may affect the fauna (vultures).

Another complaint from the government team is the loss of power of the Town Council, because these projects are of general interest in Aragon. For example, the paths of the new farm have not respected the existing farms and their paths, as the first farm did. The community hopes to be able to negotiate better benefits and subsidies during the construction of Maria 1 and Maria 2 and during the repowering of the old farms in the following years.

Credit: eldiario.es

Photo of the wind farms in Fuendetodos.

El Cabrito wind farm
— Cádiz

Tarifa is a municipality in the province of Cadiz with 18,146 inhabitants and its municipal area has numerous wind farms. Andalusia ranks fifth in terms of accumulated capacity at the end of 2021, with 3,522 MW. Cadiz is the seventh Spanish province in terms of electricity generation by wind energy.[13]

In this case, the repowering of one of the farms in Tarifa will be studied:

El Cabrito
where 90 wind turbines of 330 kW have been replaced by 8 Nordex N200/3000 wind turbines of 3.0 MW each and 4 AW70/1500 wind turbines of 1.5 MW each.

The El Cabrito wind farm came into operation in 1993 and its repowering was carried out in 2019. In this process, Acciona Generación Renovable took into account the following environmental impacts:

- Risk of nuisance to La Ahumada, which is the closest settlement to the farm.
- Risk of interference with the Los Alcornocales Natural Park, which bases its activity on tourism and beekeeping.
- Risk of affecting resident and migrant flying fauna.
- Risk of the works affecting natural vegetation and, in particular, a species of flora classified as vulnerable (Teucrium bracteatum).

According to the documentation provided by Acciona Generación Renovable, during the initial phase of the project, discussions were held with those responsible for the Natural Park, the Tarifa Town Council, the Andalusian Mountain Federation, SEO/Birdlife and the hunting reserve, and the inhabitants of La Ahumada.

One of the initial measures used for the company's communication with residents was establishing a direct channel between the developers and a representative of the residents. In this way, it was possible to solve an initial problem that had caused unease among citizens: the effect of a stretch of road that is shared between the wind farm and the residents of the village. Acciona Generación Renovable repairs this section every year and has also installed mailboxes integrated with the environment for the residents of La Ahumada.

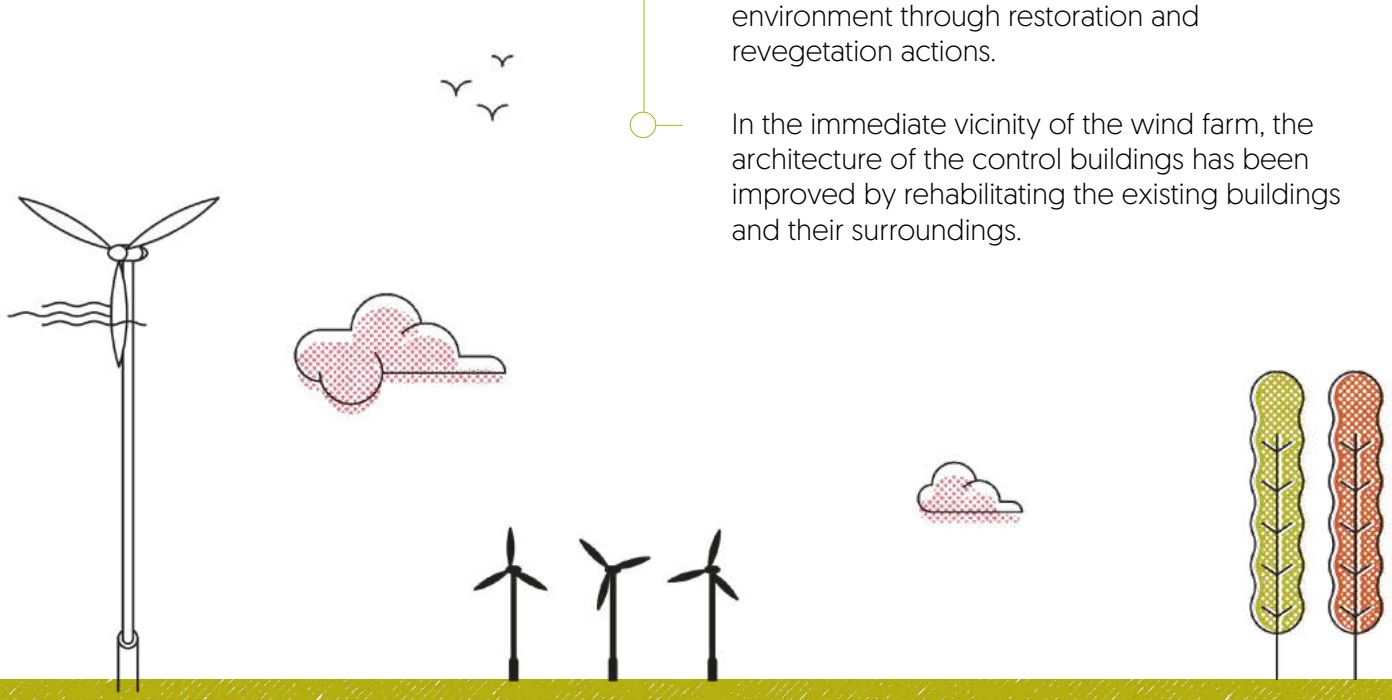
As for the Alcornocales Natural Park, the developer has sponsored the trade fair in 2019 and 2022 and has invested in the maintenance of the Natural Park. It has also invested in activities such as summer camps for socially excluded young people from youth centres organised by Cauce Natura. At the request of the natural park, an area affected by a fire (1.3 ha), Monte de Longanilla, has also been reforested by planting and sowing cork oaks.

The company's actions with regard to the protection of protected flora have been as follows: collection of seeds (about 370,000) for germination in nurseries and their reintroduction by planting 4,000 seedlings and sowing more than 82,000 collected seeds, monitoring what has been planted and what has been sown. A restoration plan has also been implemented through the revegetation of the land affected by the construction of the farm. This revegetation included the planting of native species (14,000 units of shrub and tree species) and the hydroseeding of 55,000 m^2.

The developer is also committed to preserving resident and migratory flying fauna, which is being carried out through an environmental monitoring protocol, where daily watchmen are on duty to detect the presence and risk of bird collisions, and wind turbines are stopped if necessary. This protocol is continuously reviewed and surveillance is reinforced at times of wildlife migration. In addition, a specific application has been developed via mobile phone and/or tablet so that the wind turbines can be stopped remotely and instantly. Acciona Generación Renovable's commitment has also been seen in the recovery of the area potentially most sensitive to the bird migration route through land restitution work, removal of existing infrastructure, revegetation and through non-occupation by new wind turbines. It should be noted that, through this repowering, the surface area affected has been reduced from 90 to 12 machines. The environmental technician from the Town Council reiterates the improvement that the reduction in the number of machines for the passage of birdlife has brought about.

Other measures taken with regard to the environmental impact of repowering include:

- Reduction of the visual impact of the type and number of wind turbines: from 90 lattice machines (old technology) to 12 tubular machines (modern and efficient technology), which greatly minimises the area occupied by the farm.
- Integration of the installation into the environment through restoration and revegetation actions.
- In the immediate vicinity of the wind farm, the architecture of the control buildings has been improved by rehabilitating the existing buildings and their surroundings.



With regard to the income generated by the implementation of wind energy in Tarifa, most of it goes to increase the municipal budgets, while the 10% that belongs to the compensatory allowance for undeveloped land is earmarked, among other things, for public housing (VPO).

Credit: Diario Renovable

Repowering of the El Cabrito wind farm.

Wind farms in Falces
— Navarra

Falces is a municipality in the province of Navarre with 2,316 inhabitants. In Navarre there are 1,302 MW of wind power installed, which in 2021 gave it sixth place among all the autonomous communities.[13] Falces is a municipality that has historically focused its economy on agricultural activity, above all the cultivation of garlic. The following wind farms are currently located in the municipality:

- **Moncayuelo**
  with 32 wind turbines with a unit capacity of 1.5 MW Acciona AW-1500/77 for a total of 48.00 MW.
- **Vedadillo**
  with 33 wind turbines with a unit capacity of 1.5 MW Acciona AW-1500/77 for a total of 49.50 MW.
- **Vedadillo Experimental Area**
  with 3 wind turbines with a unit capacity of 3.0 MW Acciona AW-3000/100 for a total of 9.00 MW.

All these wind farms are managed by Acciona Generación Renovable, with a total of 106.5 MW installed, the construction of which began in 2004.

During the construction phase of these three wind farms, 265 direct jobs and 70 indirect jobs were generated.[17] Currently, operation and maintenance employs around 20 people in the area. This wind development contributed to the award of the Eolo prize for rural integration in 2015.

In the construction of these farms, integration with the tones of the landscape has been taken into account, especially in the Moncayuelo farm, whose design bears the name of the Navarrese painter Pedro Salaberri and is in shades of green and ochre, as can be seen in the images shown below.[18] This integration was also taken into account in Vedadillo, where the substation is built with regional architecture in stone and adobe.[19] An old oven was also built as a monument to the traditional uses of the land.

The Town Council has an additional income of approximately one third of the total general budget. These revenues have been invested, among other things, in:

- Constructing a civic centre, "Pedro Iturralde", a centre for socio-cultural activities and a retirement home.
- Building shops for basic necessities, restaurants, etc.

Credit: Diario de Navarra

Image of the Pedro Iturralde Civic Centre.

Credit: wind turbine models

Photo of wind turbines at the Moncayuelo wind farm.

Credit: energiasrenovables.com

Vedadillo substation.

Barásoain wind farm
— Navarra

Barásoain is a municipality in Navarre with 621 inhabitants that has the following wind farms installed in its territory:

Barásoain
with 12 wind turbines with a unit capacity of 3.0 MW Acciona AW-3000/132 for a total of 36.00 MW.

Barásoain experimental
with 1 wind turbine with a unit capacity of 3.0 MW Acciona AW-3000/116 and 4 wind turbines with a unit capacity of 3.0 MW Acciona AW-3000/100 for a total of 15.00 MW.

These two wind farms are managed by Acciona Generación Renovable. It began to be constructed in 2003, while the experimental part became operational in 2013. The regional context can be found in the Falces project. In 2019, Barásoain received the Eolo award for rural integration for its development of this technology, not only with wind farms, but also with industrial facilities.

This development has meant an increase in income for the town, around 10% of the total, according to discussions with the mayoress, Rita Delia Roldán Murillo. With this extra income it has been possible to maintain the infrastructure and services of the village in good condition, e.g. by repairing streets, benches and gardens. It has also been possible to restore a pine forest area near the village and refurbish the pelota court facilities.

In terms of employment created by the local development of this technology, new jobs have been created not only in the maintenance of the wind farms, but also at the Nordex wind turbine factory, just a few kilometres from the town. In addition, Navarre has Gamesa facilities for the development of wind energy. It should be noted that battery research is also carried out in the experimental plant, which contributes to the creation of additional jobs.

The land on which these farms have been installed is owned by the Town Council. The mayor says that she has not encountered any local opposition to the development of wind energy and that they prefer these plants to solar plants, as they generate the same economic return with less surface area. The only thing they are asking for is that there should be more generalised planning for the farms with common escape routes and that some lines should be buried.

In terms of environmental policy, as it is a place where birds pass through, there is a person who continuously carries out environmental monitoring and when protected species approach, he stops the wind turbines so that they can pass through. [22]

Credit: Diario de Navarra

Wind farm in Barásoain.

1 Muras (Lugo)
Capacity: 432,77 MW
20 wind farms
Involvement of the municipality.
Financial aid for the local population.
Stimulation of local employment
and fixation of population.

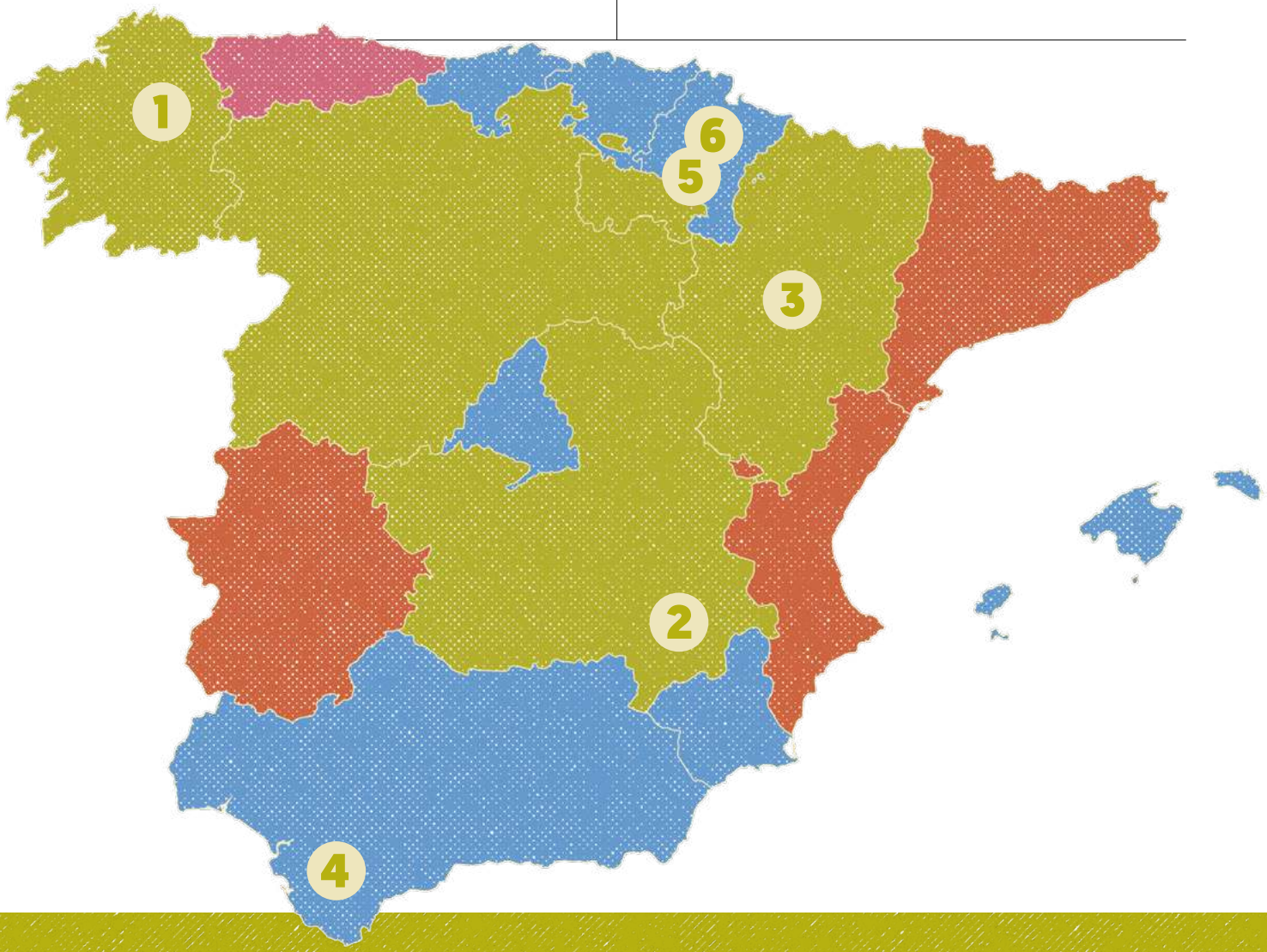
2 Higueruela (Albacete)
Capacity: 161 MW
5 wind farms
Stimulation of local employment
and fixation of population.
Finantial aid for the Muslim site "La Alquería".
Reduction of municipal taxes.

3 Fuendetodos (Zaragoza)
Capacity: 152 MW
4 wind farms
Stimulation of local employment.
Recovery of the botanical garden.
Creation of an “Energy Classroom”.
Restoration of cultural heritage.

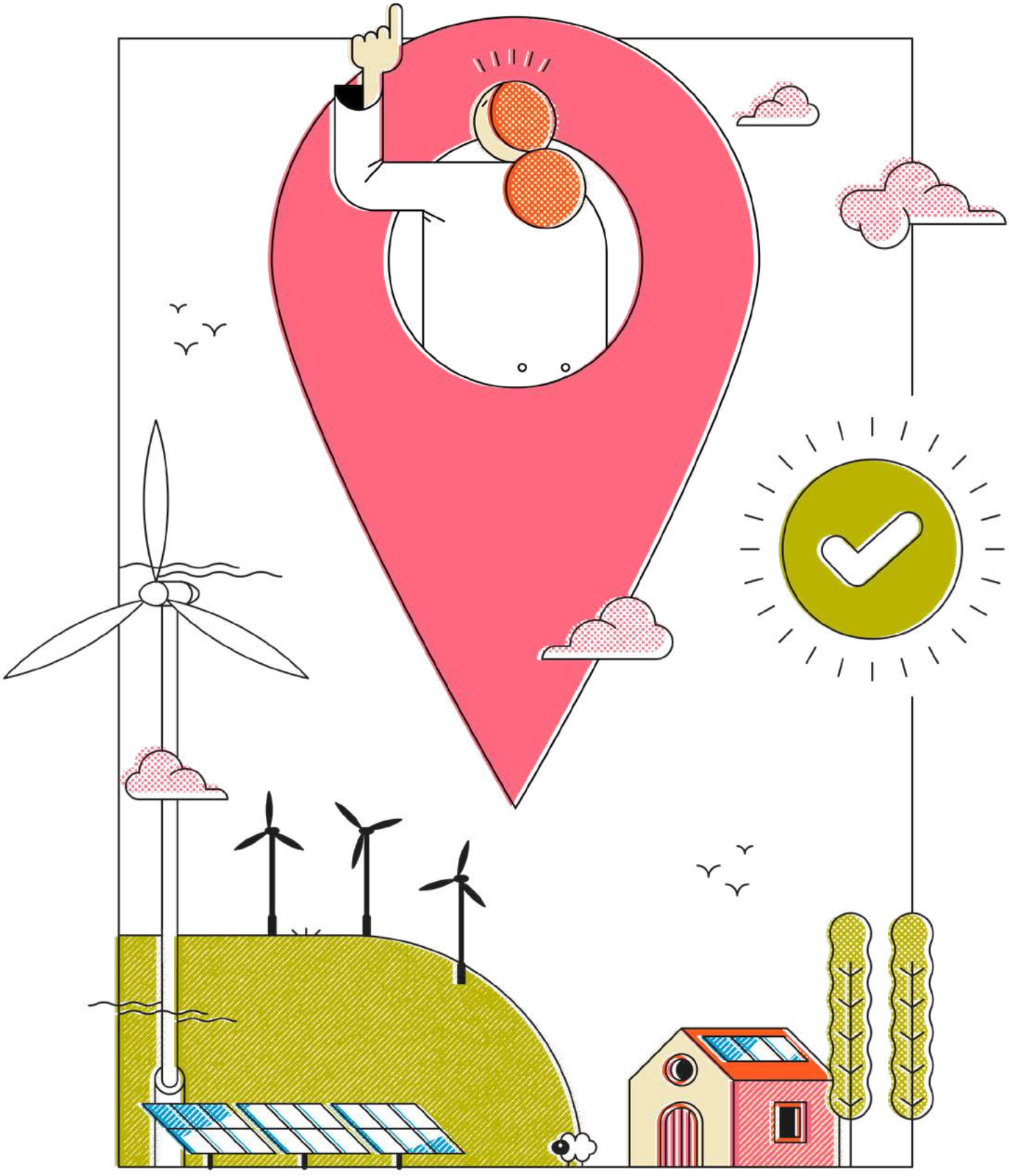
4 El Cabrito (Cádiz)
Capacity: 30 MW
1 wind farm
Environmental surveillance to avoid collisions
between resident and migrant birds.
Revegetation of various areas with native plants.
Promotion of social measures in the municipality.

5 Falces (Navarra)
Capacity: 106,5 MW
3 wind farms
Stimulation of local employment.
Integration with the landscape.
Additional funds for the council to
boost the economy of the area.

6 Barásoain (Navarra)
Capacity: 51 MW
2 wind farms
Stimulation of local employment.
Income for the municipality.
Surveillance to allow the passage
of birds and avoid collisions.
Municipal property land.



Catalogue of good practices



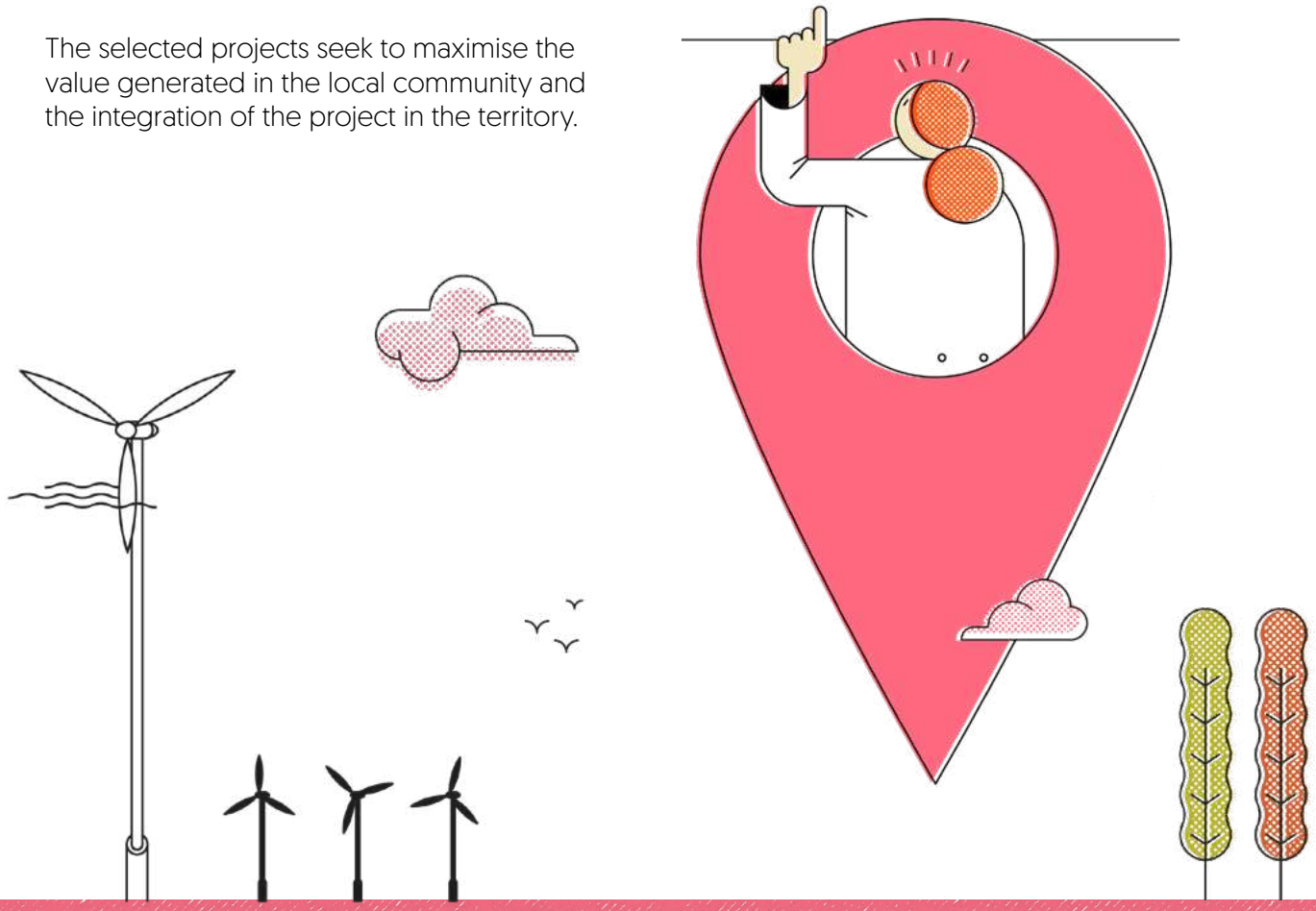
Catalogue of good practices for renewable energy plant installation

Social acceptance is increasingly important for the viability of renewable energy projects in the short term, but also to ensure an adequate speed of deployment in the long term.
This research project has analysed key environmental and socio-economic aspects of a selection of projects that can help conceptualise and design medium and large-scale renewable energy deployment models with high social acceptability. The aim is to contribute to the design of projects for the decarbonisation of the national energy system that simultaneously establish synergies with the local population, integrating their needs and proposals.

The selected projects seek to maximise the value generated in the local community and the integration of the project in the territory.

To this end, it is based on participatory processes with the identified local agents, who are familiar with the project from very early stages, and incorporating the necessary elements and actions that allow them to make the project their own.

The most relevant aspects observed in renewable plants analysed and studied in this report, which can be replicated and transferred to other locations, are presented below:



Site selection

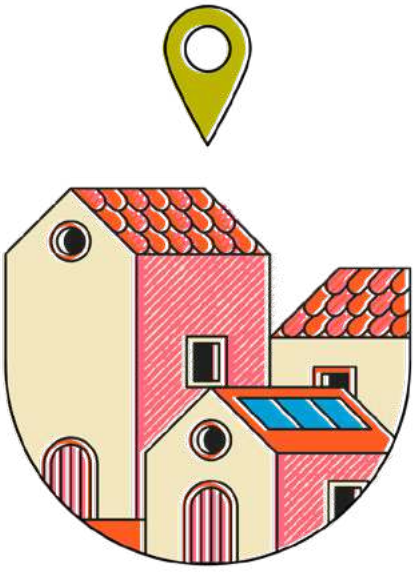
Site selection is by far the most important step in the process of implementing a renewable energy source. This report presents examples of developers and municipalities that have understood this. Some of the most relevant measures observed were the following:

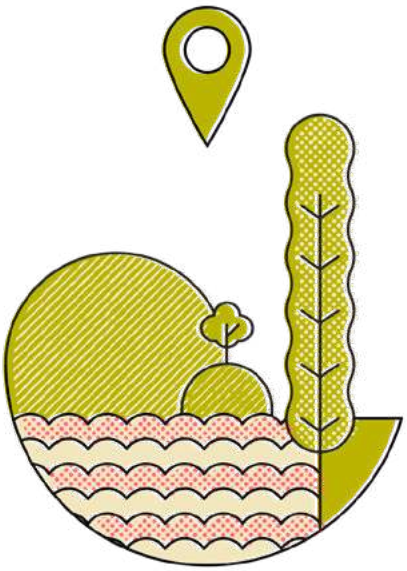
Areas included in the Natura 2000 Network (SACs, SPAs and SCIs) have been avoided, as well as critical areas in zones affected by Conservation Plans and Strategies for Endangered Species and Species under Special Protection Regime. Similarly, no areas of concentration, courtship, breeding and rearing of birds or important feeding areas of threatened birds of prey or areas close to lagoons have been occupied.

The length of electricity evacuation lines has been minimised. Given the difficulty of installing plants in the vicinity of large consumption centres, the most common alternative has been to promote them near the points of connection to the electricity transmission and distribution networks.

The available land has been studied according to its ecological value. In the case of arable land, priority has been given to the use of land with lower agricultural yields, intensive farms or with high environmental impacts, such as high water stress, biofuel or invasive species cultivation, etc.

Other renewable developments built or in the pipeline have been considered and collaboration has taken place to assess cumulative environmental impacts and adopt joint mitigation measures.





Previous actions

The affected populations have been contacted from the outset to present the project to them and to listen to their opinions and suggestions. All neighbouring municipalities have been included, not only those where the future renewable plant will be located, but also others where power lines pass through or have visual impacts due to their location. Similarly, a large number of local actors from different areas and sectors in each municipality, both public and private, have been actively involved. Examples include town councils, environmental associations, local groups with different objectives (cultural, social, etc.), schools and institutes, small businesses, cooperatives and self-employed workers in the primary and tertiary sectors (agriculture, beekeeping, livestock farming, bakery, catering, hotel and catering, etc.) as well as technology and research centres.

In some projects, local experts have been hired to present the project and to collect comments or criticisms from their own neighbours and local associations.

Environmental impact studies are more detailed than usual. As an example, an birdlife field study alone used 12 fixed observation stations in the plant's area and another 20 within the line buffer, complemented by transects, carrying out censuses 4 times a month for about 12 hours a day. This work has generated more than 900 observations of birds of 22 different species, with more than 1,000 individuals observed, with a quality of data that is unprecedented in the area.

Numerous compensatory measures have been taken to conserve biodiversity and promote habitat in the area. In general, the number and depth of measures in these projects are much higher than the usual ones and even higher than those required by the environmental authorities. Examples include:

- If perimeter enclosures (photovoltaic plants) are required, they are designed to be permeable, with gates and markers.
- Living hedges have been created with native woody species to integrate the plants into the environment.
- In the case of photovoltaic plants, the natural vegetation inside the plant has been recovered with the contribution of seeds of autochthonous species. "Shrub islands" have also been planted: natural vegetation copse scattered along the solar plant to fragment it.

- Biodiversity has been increased by building cairns, perches for birds of prey, nesting boxes for birds of different sizes, reptile shelters, insect hotels, bat nesting boxes, rabbit breeding sites and by creating or improving existing ponds.
- Viewpoints have been built for bird surveys by interested third parties.
- Adaptive releases of some bird species have been carried out and a dog patrol against poisoning of necrophagous species has been established.
- The vegetation cover of the area has been increased by planting indigenous trees.

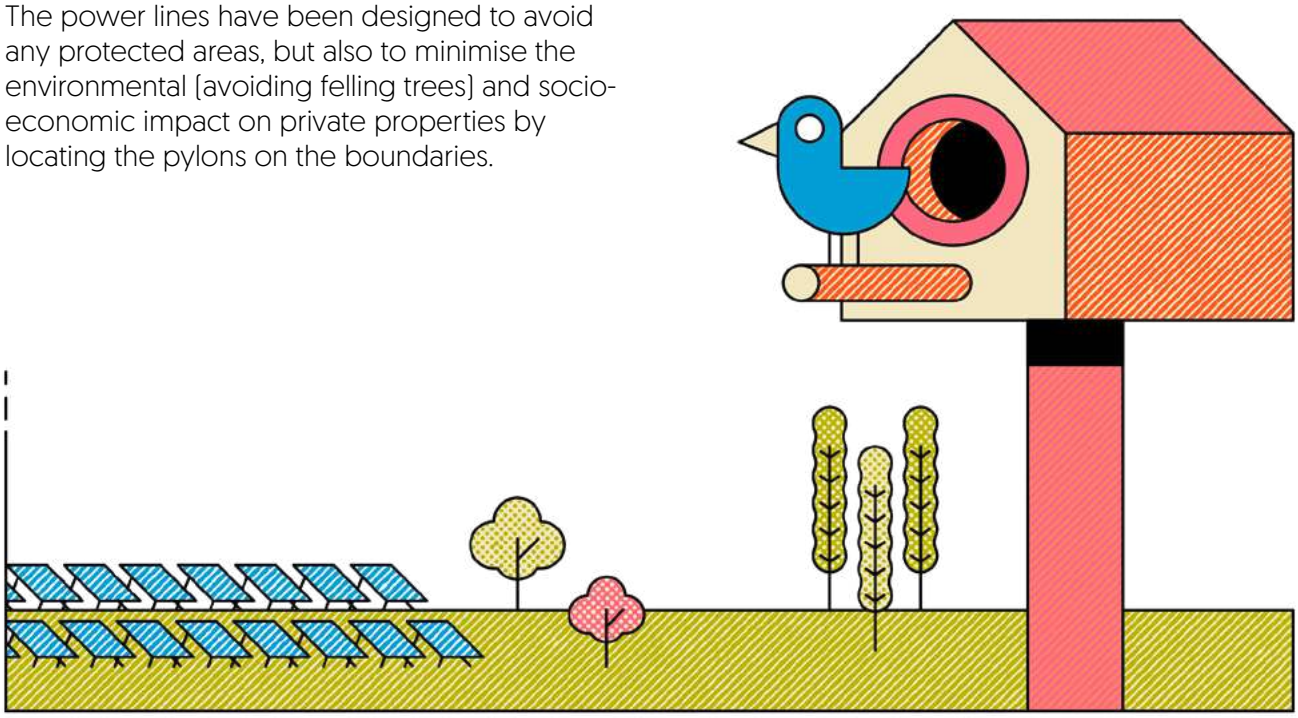
In some cases, although the evacuation lines do not affect special raptor breeding areas, in anticipation of potential future displacements or changes in wildlife habitats, it is planned to equip the lines with all available corrective measures, such as swinging and neoprene staggered bird guards, additional insulating protectors, anti-poaching designs, etc.

The power lines have been dimensioned in such a way as to be able to evacuate the electricity generated by future renewable energy sources, if they are already foreseen.

The power lines have been designed to avoid any protected areas, but also to minimise the environmental (avoiding felling trees) and socio-economic impact on private properties by locating the pylons on the boundaries.

Agreements have been reached with all owners to avoid forced expropriation.

One of the solar plants has been built by a company made up of 80 partners, including private individuals and small companies in the area, who have become direct developers. This company has even managed to win an auction for renewables without a quota reserved for small plants.



Construction phase

During the construction of the cases we consider successful, the developers have carried out training processes for the local population, both for the installation and for the operation and maintenance of renewable plants. Public job offers have been communicated in collaboration with the municipalities in the area, using local notice boards, municipal or specific websites, etc. Thanks to these measures, it has been possible to employ a significant proportion of local labour. Some companies have even self-imposed minimum local employability quotas (30%).

The recruitment of sectors of the population most affected by unemployment (women, migrants, Roma community, etc.) has also been encouraged.

In addition to direct employment, indirect employability has been promoted, which has a beneficial impact on the area, facilitating purchases and services to local SMEs.

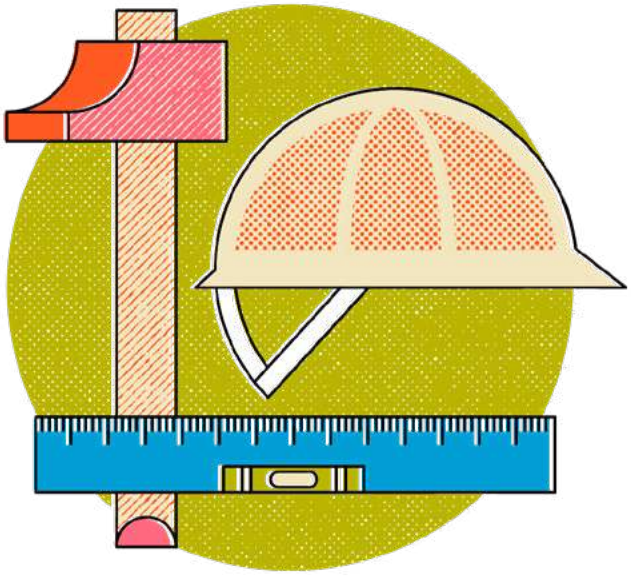
The impact of the construction phase has been minimised by taking advantage of existing roads and accesses, reserving the vegetation cover and using the material removed to create ridges.

Sustainable engineering has been carried out during the construction phase, with measures aimed at reducing energy consumption, CO_2 emissions, water consumption and waste through the recycling of construction site elements.

The life cycle of the energies implemented has been taken into account, using technologies that maximise material recovery and recycling of components, which is not very common.

A container glass recycling and repair project has been planned together with local vocational training staff.

It has collaborated with administrations and universities for the excavation and study of archaeological remains found, even creating a university chair.



Electricity generation phase

Partnerships have been established to share land use with activities relevant to the community. This is easy to do in wind energy, where the actual land use is minimal and the distance between wind turbines is very large. In the case of photovoltaic plants it is more complex and therefore several actions have been carried out:

- The cultivation of certain plant species (olive trees) has been maintained or new plantations (aromatic plants, saffron, etc.) have been planted between the rows of panels, an activity known as agrivoltaic.
- In regions with a tradition of beekeeping, the installation of beehives in the vicinity of plants has been facilitated in order to encourage pollination of cultivated plant species and simultaneously provide a source of food for the bees.
- The use of sheep has been encouraged for the regular cleaning and clearing of the interior of the photovoltaic plants.

Synergies have been generated with other land uses, such as the solar honey designation.

The shared use of the land has made it possible to preserve the primary character of the land used, while at the same time conserving biodiversity and combating desertification. In addition, local socio-economic development has been promoted as an element of population fixation in rural areas, where most of the projects are located.

In several PV cases, additional land has been leased to space the installations as buffer zones for biodiversity. In other cases, this additional land has been left fallow for long periods or planted with crops of interest to species that have suffered habitat loss. Sustainable agriculture has also been promoted, for example by buying grain at above market value from farmers who commit to avoid plant protection products.

The collaboration of several Spanish startups has been facilitated through an open innovation model.

Environmental education and energy education

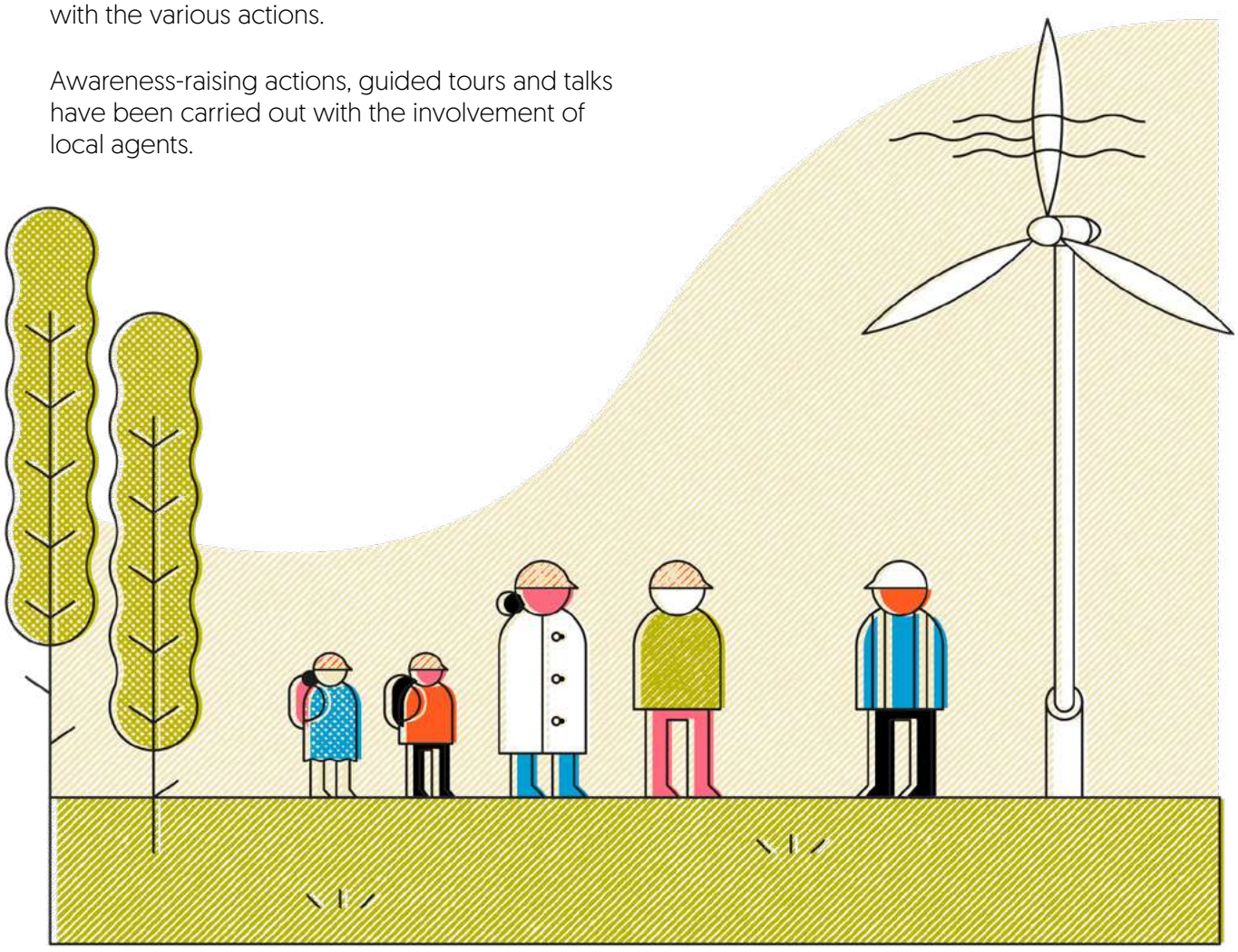
Environmental actions have been developed, such as workshops for making insect shelters or nesting boxes from waste materials from construction sites (wood, bricks, cardboard, etc.).

Open days have been held on completion of the works, inviting schools, associations, town councils and local companies and press releases with the various actions.

Awareness-raising actions, guided tours and talks have been carried out with the involvement of local agents.

In some cases, the developers have built permanent and free Energy Classrooms or Nature Classrooms to receive visits from different educational centres or interested individuals.

Inclusive activities have been developed in collaboration with disability groups.



Socio-economic integration

Various energy efficiency initiatives have been undertaken in the municipalities, such as LED lighting, efficient lighting in public buildings, energy audits, solar panels for self-consumption and pumping in irrigation ponds, charging points for electric mobility, digitalisation systems, etc.

The visual impact of renewable plants has been minimised. In the case of photovoltaic plants, indigenous plant cover has been used as a matter of course, and in a wind farm, the wind turbine towers have been painted in shades similar to those of the surroundings (green and ochre). Electricity substations have also been built to mimic the regional architecture in stone and adobe.

Relevant facilities have been built for the communities, such as civic centres that serve as venues for socio-cultural activities, retirement homes, etc.

Various local activities have been financed, such as bird censuses by ornithological associations. Grassroots football teams have been sponsored, activities have been carried out with local organisations and food banks have been funded during the COVID-19 crisis. Equipment used during the construction work has been donated, such as a photovoltaic system (10 kW) for a multi-purpose building, a water tank (40 m3) for social allotments, defibrillators for sports centres, electric vehicle charging points for the local police, etc.

It is also considered positive to reserve part of the financing of renewable projects for the inhabitants of the municipalities where they are located, either through fixed-term bonds issued by the developers, crowdfunding platforms or similar mechanisms. Although the projects evaluated have not implemented measures along these lines, there are already some regional legislations that make it compulsory. For example, in the Balearic Islands, 20% of the financing of renewable projects larger than 5 MW is reserved by law for individual contributions from local residents.

Sustainable tourism packages have been designed with guided tours of power plants and associated primary economy facilities.

Roads and paths have been made and maintained beyond those necessary for energy activity at the request of the residents of the municipality because it facilitates their agricultural, livestock, leisure, hunting, etc. activities.

We have participated in sporting activities with a long tradition in the municipalities, involving the renewable plant (flying goal inside a photovoltaic plant) and the associated primary economy (solar honey in the provisioning of the sportsmen and women).

In many renewable projects it is easy to return the land to its original state after its useful life. In this case, in some of the selected projects, it has been set out in the lease contracts that the developer is obliged by law to provide a guarantee or security in the name of the local or regional government so that, once the installation is dismantled, the land is returned to its original state.

Finally, the municipal management of the revenues received from the taxes applied to the installed renewable plants (ICIO, IAE and BICE), as well as those derived from the leasing of municipal land where applicable, must be addressed. This is a very important issue in order to consolidate a positive feeling of the local population towards renewable energy projects. Some of the good practices observed in the projects in this report include:

- Construction of infrastructures of interest to the population: sports complexes, toy libraries, homes for the elderly, school canteens, shops for basic necessities, nursery schools, observatories, etc.
- Financial assistance devoted to population stabilisation, such as direct financial assistance for births or free daily transport for (high school and university) students to their respective educational centres.
- Promoting industrial development by lowering the cost of land in the municipal industrial estate to continue to attract companies to the area and to achieve both additional income and population retention.
- Direct and progressive income-based financial assistance for paying electricity bills for SMEs and individuals.
- Improving social benefits and freezing or reducing municipal taxes.
- Improving municipal infrastructures and drinking water networks.
- Funding for programmes such as active ageing and free admission to municipal museums.

1 **Belorado I (Burgos)**
57 MWp – 135 hectares
Minimal impact on the territory.

2 **Talayuela Solar (Cáceres)**
300 MWp – 820 hectares
Extense livestock farming.

3 **Las Corchas y Los Naranjos (Sevilla)**
100 MWp – 281 hectares
Pioneering beekeeping initiative.

4 **Minglanilla (Cuenca)**
100 MWp – 200 hectares
Land use shared with saffron cultivation and grazing.

5 **Cordovilla (Navarra)**
150 MWp – 254 hectares
Bearded vulture conservation measures.

6 **Herrada del Manco (Murcia)**
2 MWp – 4 hectares
Promoted by 80 individuals and local companies.

7 **Extremadura I, II, III (Badajoz)**
125 MWp – 300 hectares
Creation of reserves for steppe birds.

8 **Muras (Lugo)**
432,77 MW – 20 wind farms
IInvolvement of the municipality. Financial aid for the local population. Stimulation of local employment and fixation of population.

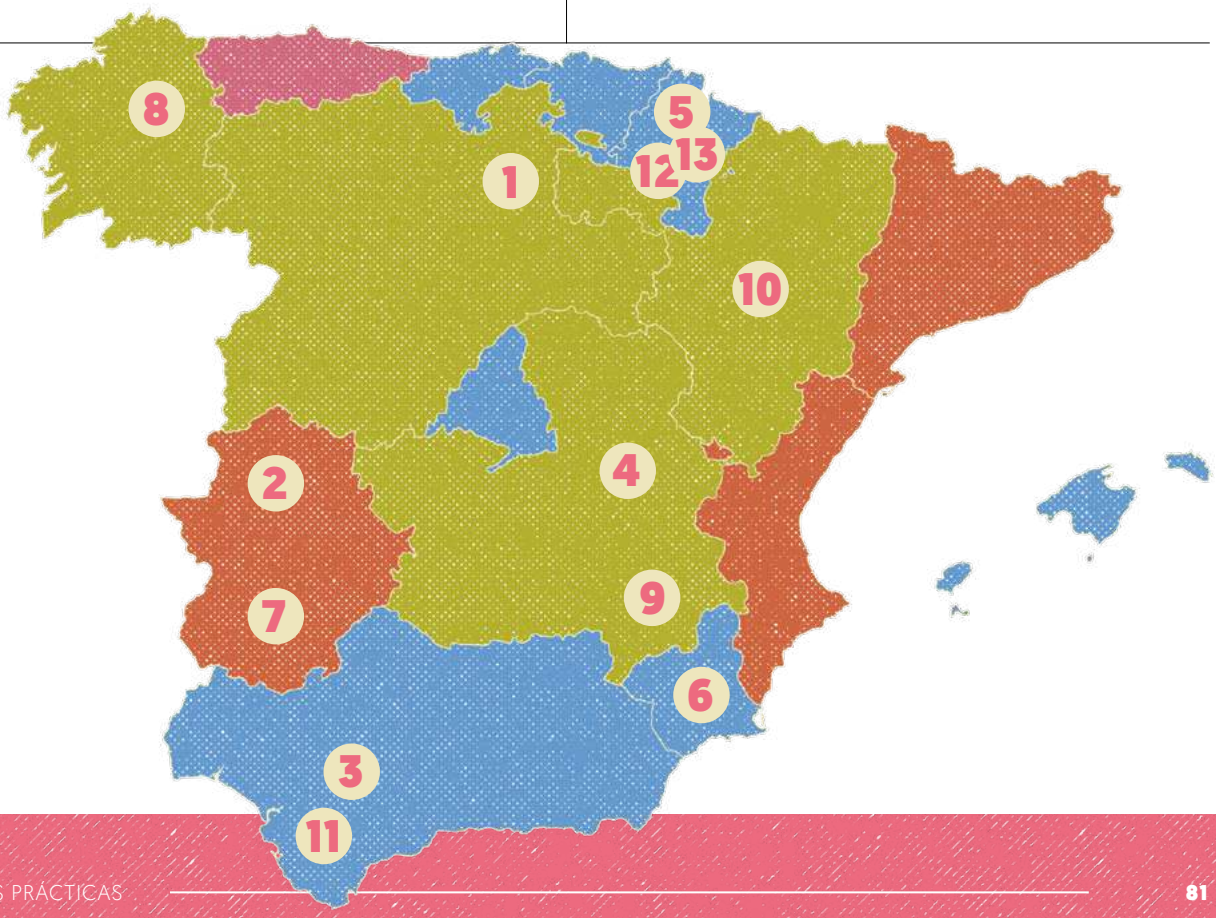
9 **Higueruela (Albacete)**
161 MW – 5 wind farms
Stimulation of local employment and finantial aid for the local population.

10 **Fuendetodos (Zaragoza)**
152 MW – 3 wind farms
Stimulation of local employment and fixation of population.

11 **El Cabrito (Cádiz)**
30 MW – 1 wind farms
Surveillance to allow the passage of birds and avoid collisions.

12 **Falces (Navarra)**
106,5 MW – 3 wind farms
Stimulation of local employment.

13 **Barásoain (Navarra)**
51 MW – 2 wind farms
Surveillance to allow the passage of birds and avoid collisions.



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