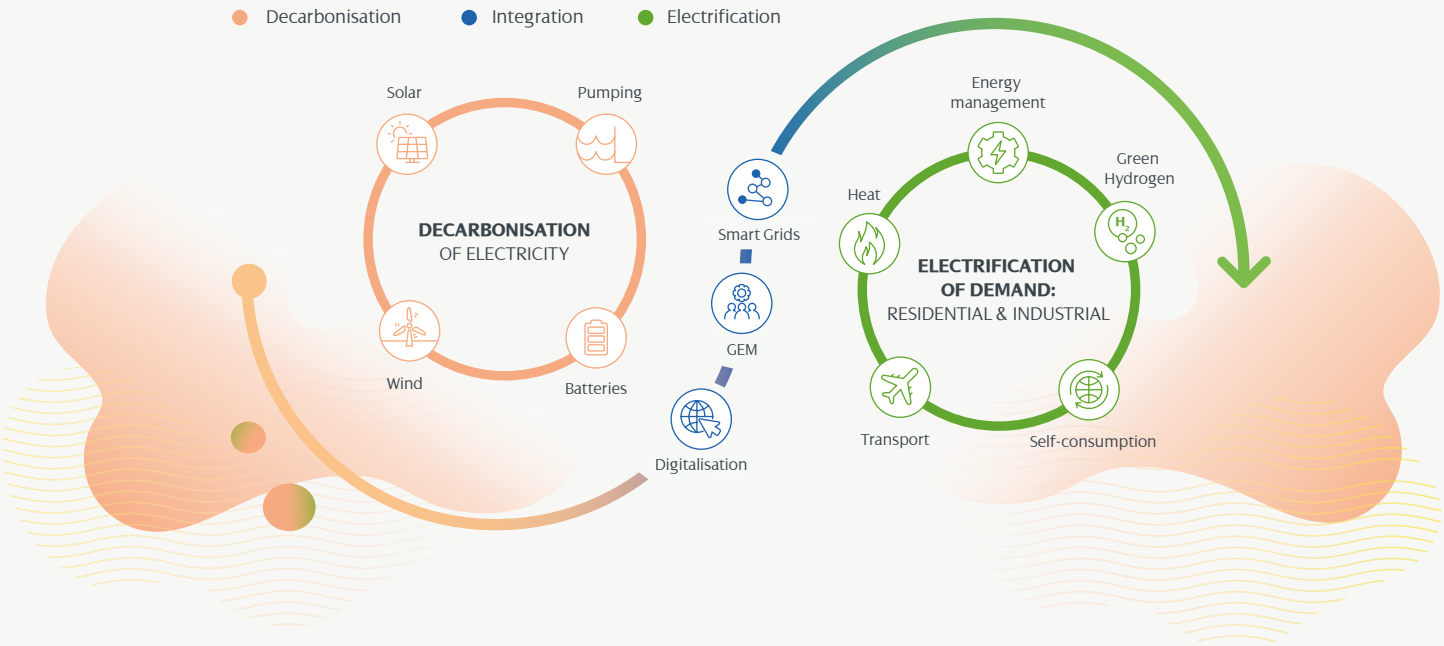
04

Iconic projects

04. Iconic projects

We are committed to disruptive technologies that enable us to meet the challenges of the new energy system.



4.1. Decarbonisation of generation

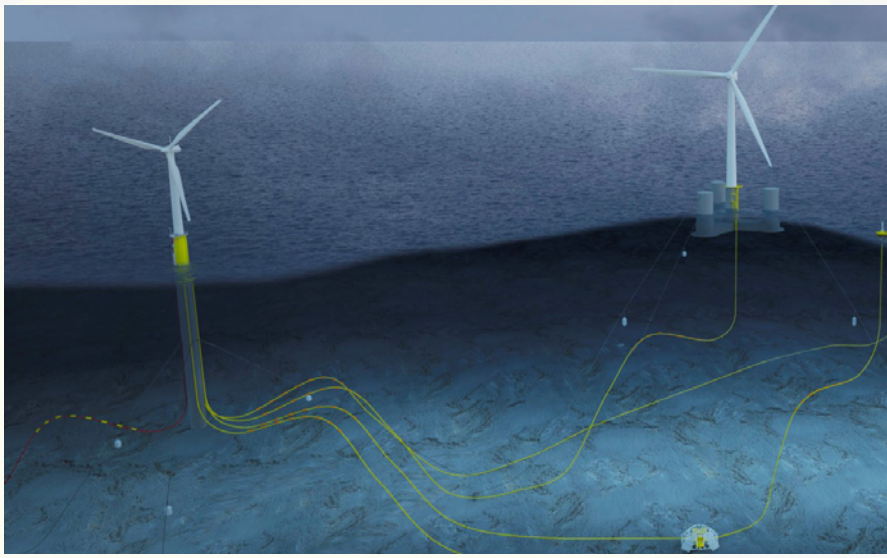
We are moving towards a decarbonised model in which greenhouse gas emissions caused by energy consumption must be phased out so that citizens can meet their energy needs in a sustainable manner, at a competitive price and with security of supply.

The first challenge in order to achieve an efficient energy transition is to decarbonise the electricity sector as much as possible, which is best placed to make this transition immediately and competitively, thanks to its ability **to integrate renewable energies**, while drastically improving the overall efficiency of the energy system.

Wind

Nearly 20 years ago, we were pioneers in onshore wind power generation and, in the same way, we have decided to lead the development of one of the most promising renewable energy sources: offshore wind on fixed foundations. We will do this through a portfolio of projects distributed around three areas: the North Sea, the Baltic Sea and the United States. We currently have 1.3 GW installed, which we will triple with the construction of 2.6 GW. The notable expansion of the portfolio comprising this technology, based on new growth platforms with great potential, such as Japan, Poland, Sweden and Ireland, will allow us to reach 12 GW in operation by 2030.

In addition, at Iberdrola we are committed to the floating offshore wind energy sector, which opens the door to sites further from the coast by allowing the deployment of wind turbines in larger and deeper marine areas with greater wind potential. After 8 years participating in various R&D projects, we have decided to go a step further and launch demonstration projects for this new technology. In particular, we are working on the development of a 10 MW floating offshore wind turbine and a semi-submersible concrete floating structure, at the Met Center in Norway. Both elements will be designed to operate in North Sea conditions and will pave the way for future 500 MW floating wind farms. The project is also an opportunity to test the feasibility of installing them in other locations in the Mediterranean, the Atlantic and the Pacific, and to study the cost and logistical viability of using concrete technology instead of steel.



Solar

FLOATING PHOTOVOLTAIC PLANTS

Solar photovoltaic energy is one of the world's leading and most established renewable energy sources and a main pillar of our growth. In 2020, we installed 874 MW of new solar capacity, contributing to reach nearly 35 GW of installed renewable energy capacity worldwide. We also have the largest operational photovoltaic plant in Europe - Núñez de Balboa (Badajoz), with 500 MWp - and we are planning another even larger one Francisco Pizarro, which will be located in the province of Cáceres, which will have a capacity of 590 MWp.

Historically, photovoltaic installations have been placed in places where the weather was conducive to a good number of hours of sunshine per year and always on the ground or roofs. However, in this way, other very important resources were being discarded: marshes and reservoirs and, lastly, the sea. Thus, the floating photovoltaic system was created, which uses the surface of these important bodies of water to install **floating photovoltaic panels.**

Along these lines, different feasibility studies are being carried out, including those carried out in various ponds and reservoirs both in Spain and in other countries (France, Brazil, Mexico) with the aim of analysing the technical and economic feasibility of this type of installation. This installation will save large areas of land, will help to reduce the evaporation of water from the reservoir and will have a higher panel efficiency due to a lower ambient temperature.

AGROVOLTAISM

At Iberdrola -through the PERSEO International Start-up Programme- we are validating the application of four technological **solutions to make photovoltaic solar generation compatible with activities related to agriculture, horticulture, livestock, fish farming and beekeeping**, so as to improve the efficiency and competitiveness of the installations, the use of the land as well as to protect biodiversity. This is known as **agrovoltaic energy.**

Harnessing solar energy in agricultural areas also encourages photovoltaic self-consumption, since the farms' energy needs can easily be met with the electricity generated.

- **Irrigation:** The Spanish company EcoEnergías del Guadiana has presented a pilot project **to combine the cultivation of tomatoes under fixed or retractable structures that support solar panels,** mitigating plant stress due to heat and hail, saving water and improving harvest results.
- **Viticulture:** The Winesolar project - a collaboration between three Spanish companies: **Techedge** (advanced technological solutions), **PVH** (manufacturer of trackers and structures for solar panels) and **Gonzalez Byass** wineries aim **to protect vineyards by generating shade thanks to a smart tracker.** An artificial intelligence algorithm will control these trackers to adapt them to the physiological needs of the vineyards, and optimise photovoltaic production and collect data to measure humidity, temperature, etc. The panels, carefully integrated into the landscape, will create shade and an ideal microclimate against both thermal and hydric stress.

- **Fruit trees:** France's Ombrea also uses artificial intelligence to create shade. It presents a solution with **solar panels that extend or retract to modulate light and shade**, depending on the weather data collected on the ground through sensors. The aim is to protect plants from heat waves, drought, hail or frost.
- **Animal welfare:** The FarmLife analysis platform and monitoring system for cattle behaviour, from the French company itk, aims to save time and increase productivity **by providing data for decision-making** based on four pillars: reproduction, nutrition, comfort and health.

Batteries

Storage systems are key to addressing the challenge of the energy transition and are set to become an essential element in the electricity system of the future, ensuring the stability and reliability of the grid and integrating and harnessing the energy generated by renewable sources.

In this regard, we have a large portfolio of innovative battery projects, either under construction or secured, with a capacity of 200 MW (some of them already installed), which will reach 300 MW in 2025, mainly in the UK and Australian markets. In total, **the planned capacity of battery storage systems amounts to 900 MW.**

In Spain, several projects have already been implemented. We have installed the first battery in a photovoltaic plant, Arañuelo III (40 MW), in Cáceres, with 3 MW of power and 9 MWh of storage capacity. In the Basque Country, at the Abadiño transformer substation, where the 6MW Oiz wind farm is evacuated, we have installed a battery with a guaranteed storage capacity of 3.5MWh. This project joins the one executed at the Elgea-Urkilla wind farm (32 MW), which has

an installed capacity of 5 MW and 5 MWh of storage capacity. In the Canary Islands, we will install batteries at the Ifara and El Vallito wind farms, which will incorporate a storage capacity of 12 MW.

In relation to the hybridisation of photovoltaic or wind installations with batteries, we have designed **a modular tool to estimate and optimise the storage requirements of each plant**, taking into account how the system interacts with the grid or with the corresponding generation technology. We have also carried out an analysis of how InMS energy management systems enable optimisation in the operation of hybrid storage systems (HESS) operating in conjunction with renewable energy sources.

Pumping

Pumped hydroelectric technology is currently the most efficient and mature system for **large-scale energy storage.** At Iberdrola, we are leaders in energy storage with 4.5 GW of power installed using this technology. By 2022, we expect to reach 90 GWh of storage capacity, which represents an increase of almost 30% compared to 2018: 20 GWh more, equivalent to 400,000 electric car batteries or 1.4 million batteries for residential use.

Along these lines, we are immersed in the **development of new technological approaches in the pumping systems of the Torrejón and Valdecañas reservoirs**, increasing their flexibility, storage capacity and efficiency, without modifying the structural conditions of both hydroelectric plants.

Specifically, two pioneering lines of research are being carried out. On the one hand, at the Torrejón reservoir, **a variable speed turbine and new electronic power units** are being designed, which represents a substantial technological leap, as most

turbines have a fixed speed. Thanks to this, a greater operating range is achieved, implementing rapid changes in active power and allowing maximum use to be made of the water jump of the hydraulic power station. On the other hand, **the electromechanics of the new Valdecañas turbine will be optimised** in order to hybridise it with a parallel battery system, acting mainly on the drivers, which are a key element for flexible operation. This will be accompanied

by a **new control algorithm** that will allow rapid variations in the power injected into the power plant grid and the implementation of a power regulation mode in pump mode and operation over a wide range of heights.

In Portugal, we have also started up the Támega gigabattery, one of the largest hydroelectric projects to be carried out in Europe in the last 25 years. It consists of three dams and three power plants (Gouvães, Daivões and Alto Tâmega) with a combined capacity of 1,158 MW.

Thanks to its pumping capacity, it can store energy to be used when it is most needed. It already provides almost 900 MW of pumping capacity to the Portuguese electricity system, which will mean an increase of more than 30 % over the country's current pumping megawatts. The complex will be capable of producing 1,766 GWh per year and storing 40 million kWh, equivalent to the energy consumed by 11 million people during 24 hours in their homes, making it one of the largest energy storage systems in Europe. Linked to the gigabattery, two wind farms will be built to convert the complex into a hybrid generation plant, whose final power is estimated to reach 300 MW, making it one of the largest wind projects in Portugal.

4.2. Integration of the system: Smart Grids and Digitalisation

In the new energy model, **electricity grids will play a fundamental role as an integrating element** between generation and demand, interconnecting sectors such as electricity and transport that until now have operated largely independently and including new players, such as households, which enter the scene as energy producers.

Their **digitalisation** will be essential for this, which will not only make it possible to offer a wide range of new products and services to customers, but also to improve the quality of supply and facilitate the integration of renewable energies and distributed generation resources (storage systems, electric vehicles and heat pumps, and increasingly active customers).

Technologies such as Big Data, artificial intelligence, machine learning,, cloud computing, IoT, Blockchain are already a reality in all of Iberdrola's businesses, with significant applications and impact in terms of efficiency, economics, and the environment.

In addition, it is essential **to seek solutions that help provide greater flexibility to the electricity system**, as a key element and support for this transformation, facilitating coordination between all actors involved in the provision of services to the distributor, with a special focus on the consumer.

Smart Grids

The massive integration of renewable generation envisaged to achieve the targets set by the European Union for 2050 poses major challenges for the **electricity distribution grid**, which was designed according to the requirements of conventional energy sources. In order to support this new **decarbonised, efficient and, flexible electricity system**, the aforementioned **smart grids** appear, combining equipment, electronic meters and IT and telecommunications systems.

In this sense, **new technologies and simulation models** are being researched to enable a 100% renewable and decarbonised energy mix, efficiently integrated into the electricity system of the future. To this end, the new functions of Distribution System Operators (DSOs) are being defined, researching the new technological **developments needed to increase efficiency by taking advantage of the flexibility** provided by both own and third-party resources, while maintaining the **overall security and stability of the system.**

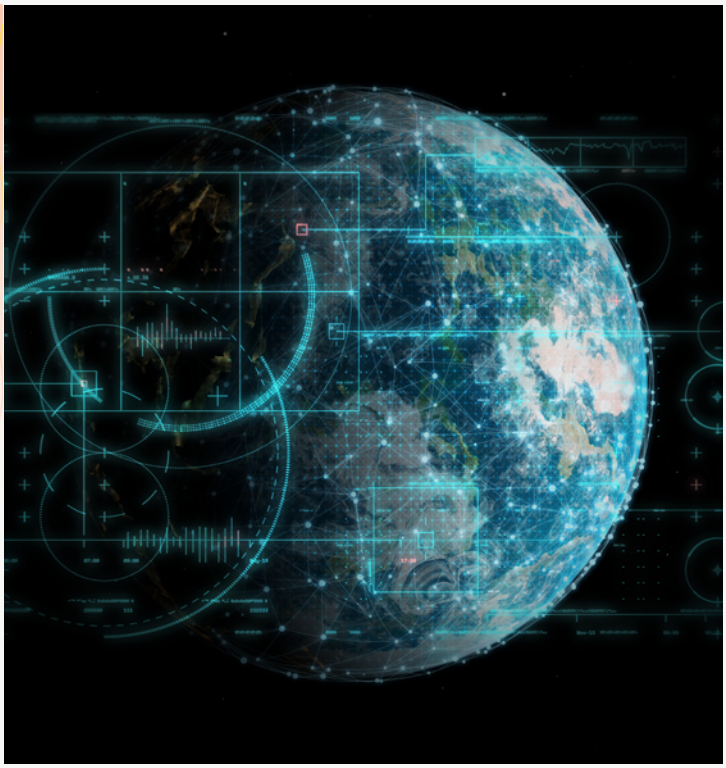
In order to get the most out of distributed generation resources, in recent years we have **been developing new control and protection systems to ensure the stable island operation of medium-voltage distribution grid feeders.** This will improve the quality and continuity of the electricity service in the event of electrical disturbances, taking advantage of distributed generation sources as an alternative source of supply, creating a system that is sustainable over time.

Furthermore, during the transition of the electricity grid from a fully centralised to a highly **decentralised** system, grid operators have to change their operational activity to adapt to faster reactions and adaptive exploitation of flexibility. For this purpose, at Iberdrola we are involved in creating the necessary **conditions for a new generation of grid services** to take advantage of **demand** response, **storage** and **distributed generation**, within a framework of fair, transparent and open conditions for the consumer. As a result, while creating a European grid, it aims to build a customer-centric approach to grid operation. This ambitious vision is achieved by proposing new markets, products and services, creating a unique IT architecture.

Along these lines, together with various actors in the European electricity value chain, we are participating in a coordination project to **adapt, define and promote future standardised grid services and related market platforms** to enable a seamless pan-European electricity market with non-discriminatory access for all market participants.

GEM (Global Energy Management)

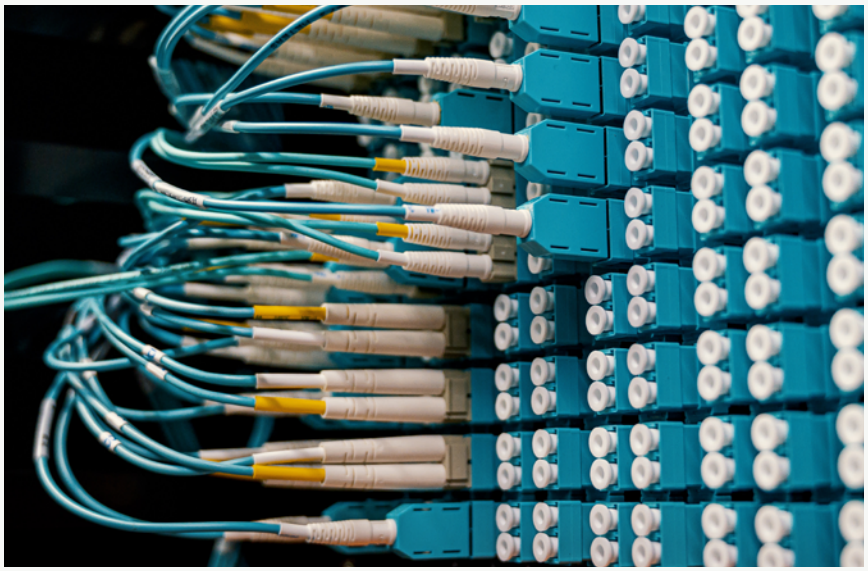
The main challenge of energy management lies in the agile adaptation to the change towards a decarbonised, renewable and distributed electricity system model. The focus is on finding solutions that help provide greater flexibility to the electricity system, as a key element of this transformation.



We are researching new technologies and simulation models that enable a 100% renewable and decarbonised energy mix, effectively integrated into the electricity system of the future. Thanks to the technological change already underway in the field of renewable generation, storage, grids and flexible demand management, it is possible to research new capacities, electrical models, algorithms, concepts and specific technology in areas such as power electronics, interoperability and connectivity of equipment and weather forecasting systems, which facilitate their integration and operational management.

Another pioneering initiative being carried out seeks to connect customers' flexible distributed resources in a VPP that enables their monitoring and distributed control for market management, also generating valuable services for the customer, such as: risk buffering in demand peaks, the possibility of new revenues and greater control over their consumption and processes. It also makes it possible to extract the value of the flexibility of these aggregate resources for their participation in the System Balancing Services, managed by REE.

Along the same lines, with the aim of facilitating the integration of renewable generation and distributed generation resources (DERs), ensuring the quality of supply, we are committed to Virtual Power Plants (VPP) or Virtual Power Plants, aggregators of different distributed energy sources or resources, both generation and consumption, which can be managed from a single control system. The VPP allows energy resources to be redistributed internally in an optimal way in the event of weather and system variations, in order to provide flexibility and reliable energy production, while also providing services to the grid. This will provide transmission system operators (TSOs) and distribution system operators (DSOs) with knowledge, models and tools for the synthesis of VPP controls for both local (production) and grid (ancillary services) objectives.



In another line of action, we are also working on the development of new services for the system, as well as testing emerging markets with the different network operators.

One of the most significant problems facing the operation of transmission grids is the problem of voltage control and the associated cost overruns suffered by the system. We are therefore involved in a project to develop new strategies for decentralised and centralised voltage control. We are developing a system of joint participation at the point of service provision (PPS) for installations with different technologies and different connection requirements. Within the framework of the project, new developments in the field of active power management will also be analysed, consisting of systems for limiting production in real time in order to improve the capacity to respond to incidents occurring in the transmission grid. All of this will enable significant contributions to be made to achieving the objectives set in relation to the decarbonisation of the electricity system, facilitating the penetration of renewable energies, increasing the system's electricity storage capacity, and increasing the security of the electricity supply.

Along the same lines, we also participate in various projects focused on defining and testing new local flexibility markets through demonstrators, to manage congestion or other problems in the distribution grid.

Through these projects, we want to advance in the design of an ecosystem that facilitates the interaction and coordination of all the actors involved (grid operators, TSOs and DSOs, flexibility providers, aggregators, etc.), define the architecture and platforms necessary for the introduction of these new services and markets, which together allow the flexibility of the energy system to be increased.

Digitalisation

At Iberdrola, we are at the forefront in the use of **digital technologies** and we are preparing to face a new era in which disruptive tools will be key in all areas. Thus, we maximise the use of technology in those business areas that add value, either by improving processes and the productivity of its assets or by achieving greater efficiency in its activities. We already digitally **manage our power generation assets and have transformed grids into smart grids** with digital tools and Artificial Intelligence.

PROOF OF CONCEPT

In a changing world, we are committed to **disruptive proofs of concept, using emerging and differentiating technologies** to enhance the immersion in the digital transformation in which the Group finds itself.

- **PoC1 - Energy management with AutoML**

Using ***Machine Learning*** and **Artificial Intelligence**, an automatic prediction system of customer demand and market price has been developed. AutoML compares different models to select the one that improves on current prediction methods.

- **PoC2 - Wind turbine monitoring via IoT**

We have developed the low-cost, IoT-based LoRA solution, which provides additional monitoring capabilities on existing wind turbines at our onshore wind farms at **ScottishPower**. This solution demonstrates that it is possible to add additional sensors to an existing wind turbine without the need for modification by the manufacturer.

- **PoC3 - New EV platform for battery banks**

With this initiative, we are committed to a new line of business, battery banks for e-scooters. For this purpose, a new **SW mobility platform** has been developed in the cloud, through which the live data created by the new type of charging stations is monitored.

In addition, we have designed a **mobile application** to control the new drop&go charging station that will be integrated into the Iberdrola charging point management IT environment.

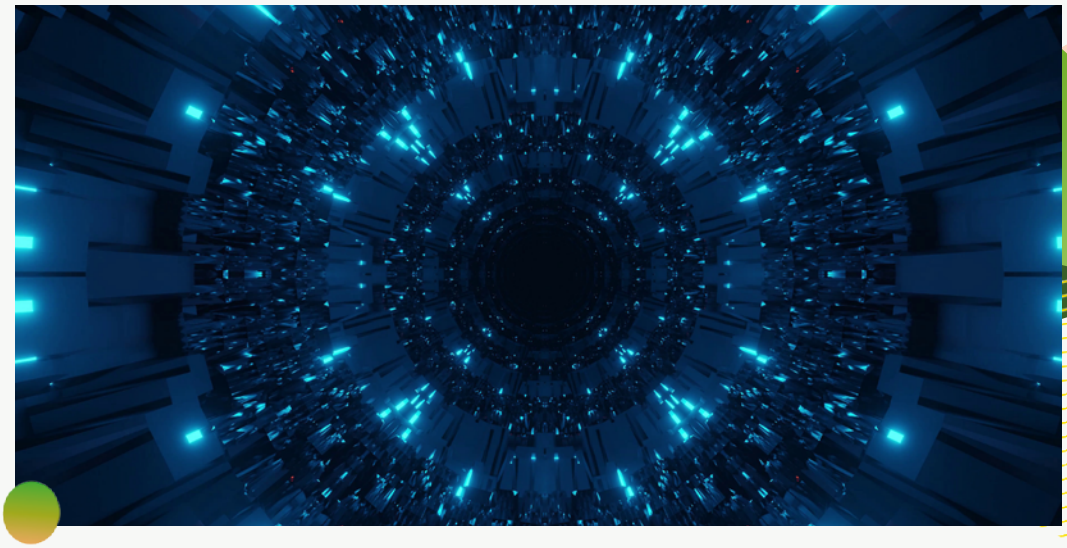
- **PoC4 - Deep Learning for the identification of faults in network assets**

This proof of concept aims to automate grid maintenance programmes using ***Deep Learning techniques.***

Images taken by **Avangrid's** maintenance technicians on the Edge will be used to automate **image recognition** of faults and vegetation surrounding **power lines. *Deep Learning*** techniques will identify the most common faults in the distribution network, and vegetation segmentation will be used to schedule the necessary work to maintain the good condition of the network and anticipate future problems.

- **PoC5 - Voting with Blockchain for the Shareholders' Meeting**

With this PoC we intend to implement ***Blockchain*** as a mechanism to guarantee the security of the shareholders' vote during their annual meeting.



The shareholders' meeting is one of the most important events of the year for Iberdrola due to the importance of the results, as it can impact investment strategies, or growth plans.

Voting is carried out through the **Participation Portal** web application and then encrypted and recorded in an Alastria ***Blockchain*** block (based on Hyperledger Besu) along with an equally encrypted version of the shareholder's ID. The results can be verified and validated by any shareholder to ensure that what resides in the voting system matches the Blockchain results to ensure that the results **are immutable.**

- **PoC6 - Electricity substation 3D model**

With this initiative we have implemented an **interactive 3D model of an Electricity Substation in Virtual Reality with dynamic operation at Neoenergia.** This model can be used by the operation and maintenance teams to optimise the planning of the necessary interventions, both to expand the system and as training and validation of the procedures to be adopted.

R&D PROJECTS

We are carrying out **a modernisation of functionalities in our mainframe,** resulting in a new, more efficient system, which provides more performance and security in our transactions. Among the different lines of work, the following stand out:

- **The use of productivity tools,** leading to a significant reduction in operating costs in multiple areas of the company's work.
- **The conversion of obsolete data storage systems** to relational databases, which allows access to data through SQL queries, facilitating the conversion process.
- **The transformation of our internal system distribution** to advance our technology transition strategy, maintaining our position as a leader in energy trading and ancillary services.
- **A re-engineering of the services** required to review and process information. This new way of working leads us to rethink innovation in processes, improving them through the new emerging technologies.

In addition, **we are leading a tractor project in Artificial Intelligence**, IA4TES (Inteligencia Artificial para la Transición Energética Sostenible), which has been awarded the Next Generation Funds of the European Union. Its aim is to research the **solutions that different Artificial Intelligence technologies can provide to the energy sector**, with the new paradigm of the electricity system in mind. This research is focused on AI enabling technologies, both in new advanced intelligence algorithms and in new paradigms of data governance and distributed data intelligence. The 3 main vectors of the sector's value chain will be covered through cases of use:

- Generation: Smart Sustainable Production.
- Distribution: Smart Grid.
- Smart Consumption.

IA4TES

PARTNERS

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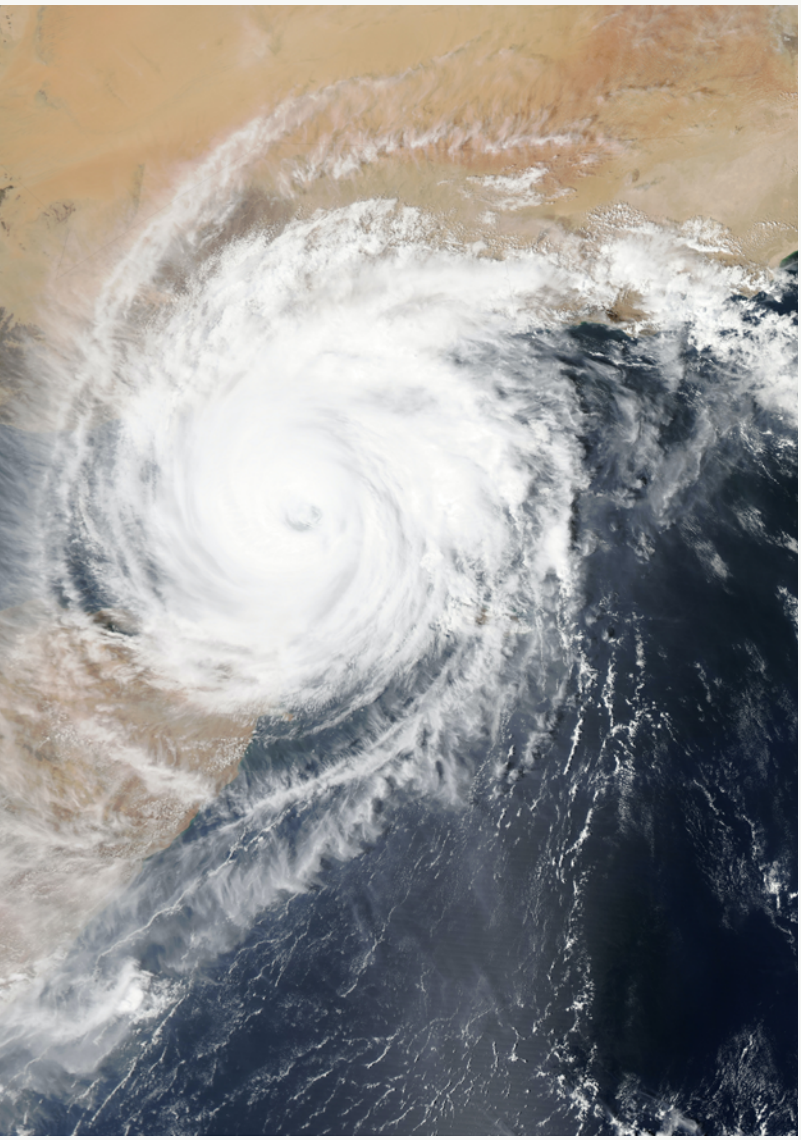
In the framework of the project we will create an **AI Centre of Excellence in the energy sector** that will extend its activity beyond the end of the project, with 4 main missions:

1. **Diffusion, dissemination, generation and attraction** of talent hand in hand with academic institutions.
2. **Alliances, collaboration agreements** and other types of agreements with other similar centres.
3. **Additional foresight** through small proof-of-concepts of highly disruptive technologies in the area of AI in Energy.
4. **Advice for the partners** on the protection possibilities of the new technologies generated in the project.



FORECASTING

The availability and accuracy of renewable resource predictions is key to ensuring electricity supply, developing demand forecasting plans, making projections for different time horizons and planning plant operation and maintenance tasks.

Along these lines, we have designed and developed **a new energy resource prediction** model that increases the degree of accuracy in the prediction of the renewable resource and the power of renewable energy generation facilities. This is an integrated system based on the most modern weather forecasting techniques, as well as *Machine Learning*, **Artificial Intelligence and** *Big Data*. technologies. It provides forecasts for all types of renewable installations, including onshore and offshore wind farms, photovoltaic plants and, more recently, hydroelectric installations.

All these advances have been developed in-house, by our own team, made up of experts in different fields, who are responsible for the maintenance, monitoring and development of the system.

4.3. Demand-Side electrification

The transition to a carbon-neutral economy by 2050 will require significant efforts across all sectors, as well as the use of all available technologies that are either emission-free or carbon-neutral. Through **the electric vehicle and heat pump**, emissions from end-uses such as transport, heating and cooling can be eliminated. In addition, **clean hydrogen** (green hydrogen or green H2) can be produced from renewable electricity and thus carbon-neutral fuels in the form of gas (clean synthetic methane) or liquid (paraffin, gasoline or synthetic diesel).

This changing market also requires energy suppliers to continuously adapt to add new value to customer experiences. New product and service offers for the consumer will need to meet their new role as prosumers through self-consumption **solutions and energy management of household electrical loads**, allowing the customer to minimise cost and environmental impact while optimising comfort, increasing awareness and maintaining control over their energy options and choices.

Transport electrification

We continue to push our stance on transport electrification as part of a strategy for a decarbonised economy, as a key factor in reducing emissions and pollution, as well as for a green recovery in the post-Covid world. Our commitment to the decarbonisation of transport covers all areas of action, including collective transport and micro-mobility. In this regard, electrification in micro-mobility and light vehicles is already a reality worldwide, and we are working on the technological developments necessary for the same to happen with heavy transport.

At Iberdrola, we have already completed more than **60 infrastructure deployment agreements** with administrations, institutions, companies, service stations, dealers and electric vehicle manufacturers, carrying out different initiatives.

SMART MOBILITY

We have a **sustainable mobility plan**, which will intensify the deployment of charging points for electric vehicles in the coming years. The initiative envisages the installation of around **150,000 high-efficiency charging points by 2025**, both on urban roads, in cities and on the first motorways, and in homes and businesses. With a global **investment of €150 million**, Iberdrola's comprehensive sustainable mobility plan has already enabled the installation of 20,000 charging points in Spain.

The commitment to deploying high-efficiency charging points will include the company installing ultra-fast (350 kW) charging points every 200 kilometres, super-fast points (150 kW) every 100 kilometres, and fast (50 kW) points every 50 kilometres.

We already have more than 2,500 public recharging points, of which around 40% are fast or ultra-fast recharging points, and we maintain an expansion rate of more than a hundred new chargers of this type per month. We also have a **unique public charging App** that allows you to check the public charging infrastructure available in Spain, with more than 5,000 chargers for electric vehicles, both our own and those of third parties.

In addition, our mobility electrification plan has the backing of the European Commission, through a €13 million grant awarded by the Innovation and Networks Executive Agency (INEA) under the CEF Transport Blending Facilities call. This grant will help finance the **installation of 2,339 fast, super-fast and ultra-fast recharging points in Spain and Portugal**, at points close to the trans-European transport networks (TEN-T), until 2023.

We have also entered into partnerships with various manufacturers. In this regard, in 2022 we inaugurated in in the Valencian Community **the largest ultrafast charging hub for electric vehicles that currently exists in southern Europe.** The infrastructure, carried out in collaboration with Porsche, has a total of four 400 kW chargers and another 12 200 kW chargers, with the **possibility of charging up to 16 vehicles simultaneously and with the capacity to recharge the battery of an electric car in less than five minutes.**

HEAVY TRANSPORT

We have reached various public-private agreements regarding the electrification of heavy transport.

With regard to **urban transport**, we collaborate with **Madrid's Municipal Transport Company (EMT)** in the electrification of the city's bus network, in the analysis of alternatives for electricity supply to EMT facilities, as well as in the planning of the present and future charging infrastructure network for electric transport. In fact, both companies have already identified optimal locations in the first EMT garages to be electrified, such as those in Fuencarral and Carabanchel.

We are also working with the Town Councils of Ávila and Badajoz and the urban transport concessionaires in both cities to carry out pilot projects with urban electric buses. We have collaborated with more than 20 town councils in the engineering study for the electrification of their fleets.

In addition, we are working together with Irizar to add actions aimed at technological innovation in this field. The alliance starts with our **renewable supply with Guarantees of Origin (GdOs) in Irizar's factories**, in order to contribute to the **decarbonisation of the life cycle of its buses** We will also advise Irizar in all areas that contribute to the group's sustainability, including energy efficiency projects, self-consumption, etc.

With regard to the decarbonisation of **heavy goods transport**, this is one of the great challenges facing the industry due to its high levels of polluting emissions. In this regard, we are going to lead a project to develop t**he first Mediterranean Corridor for 100% electric heavy road transport.** For this, we

will work together with the transport and logistics company Disfrimur and the company specialising in power electronics, Ingeteam. The initiative includes three areas of action: the **acquisition of 100% electric heavy trucks of up to 40 tons; the development of public charging infrastructure**, such as the **deployment of a smart grid to serve these chargers**, ensuring maximum efficiency. **The project would complete the first Mediterranean Corridor for 100 % electric heavy transport**, which would run through the Region of Murcia and the Valencian Community, although the developers intend to extend it to all the other national freight corridors in the coming years.

MICROMOBILITY

The electrification of transport in urban areas also involves the promotion of **Personal Mobility Vehicles (PMVs)** such as bicycles, scooters and electric motorbikes. Mobility using this type of vehicle is not only more efficient and environmentally friendly, but also greatly helps to relieve congestion in cities at times of heavy traffic, thus helping to improve air quality.

For this reason, we are collaborating with Cooltra and Inetum in the implementation of **smart charging stations**, each capable of holding 20 chargers and multi-brand motorbike batteries. These smart charging stations will be automated for around-the-clock service seven days a week, ensuring continuous improvement of the service by harnessing the possibilities of Big Data and artificial intelligence. The first charging stations will be operated entirely by Cooltra, but their design allows them to be used by several operators and electric motorbike users.

In addition, we have launched - through the PERSEO International Start-ups Programme - a challenge **to find parking, custody and recharging solutions for micro-mobility that favour the electrification of urban transport.** The winning company was the Andalusian technology company Solum, which has developed

its proposal for a **parking system for electric vehicles capable of accommodating bicycles and scooters.** The system is installed in synergy with an innovative solar hardstanding, which guarantees that the energy used in the storage and charging stations for the personal mobility vehicles (PMV) is from a renewable source. The company has already put into operation the first charger for electric scooters in Madrid supplied with 100% renewable energy.

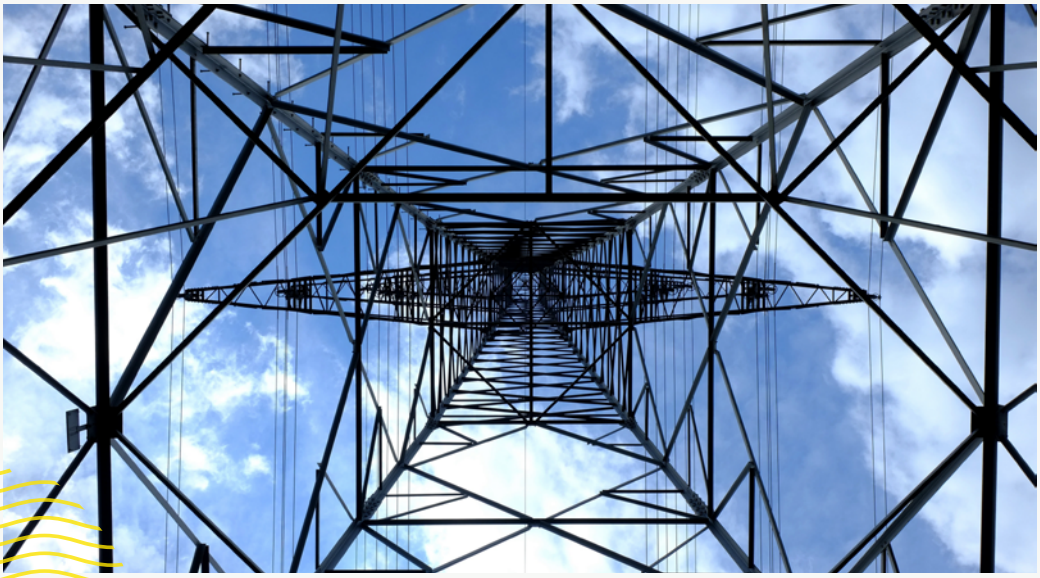
PORTS

In addition to the aforementioned 'Net-Zero MAR Alliance', we offer **port decarbonisation solutions** including on-site renewable generation and deployment of OPS (onshore power supply) technology, among others.

Heat electrification

ELECTRIFICATION OF INDUSTRY

At Iberdrola we are committed to supporting industries in their energy transition through ad hoc solutions so that their production centres improve their energy efficiency and reduce CO2 emissions in a sustainable, cheap manner. Therefore, in 2021 we launched an Emission-free Industrial Heat Challenge **to find innovative solutions to promote the decarbonisation of industrial processes** through design automation and the integration of clean technologies and energy efficiency measures. The Challenge winner, Norway's Olvondo Technology, is collaborating with us to validate the scalability and



competitiveness in industrial processes of its high-temperature heat pump, called HighLift, which is unique in **converting waste heat into up to 200 degree steam.** This reduces industry's fossil fuel consumption, with associated reductions in both CO2 emissions and energy costs.

In addition, **we are part of the Basque Net Zero Industrial Super Cluster initiative** promoted by the World Economic Forum which aims to highlight the achievements of industrial clusters in the transition to net zero emissions and thus motivate and offer experiences and good practices to other clusters to adopt commitments in this transition. The initiative is based on inter-cluster collaboration to advance the transition to net zero emissions by boosting the decarbonisation of energy consumption in industrial activity. The first phase focuses on the sectors with the highest CO2 emissions in the Basque Country (refining, cement, iron and steel, foundry and paper) and will be articulated through the Clusters. Together with Petronor, we will play an important role as a driving force, seeking business opportunities based on new technologies and innovative services that will accelerate the transition.

ENERGY EFFICIENCY IN BUILDINGS

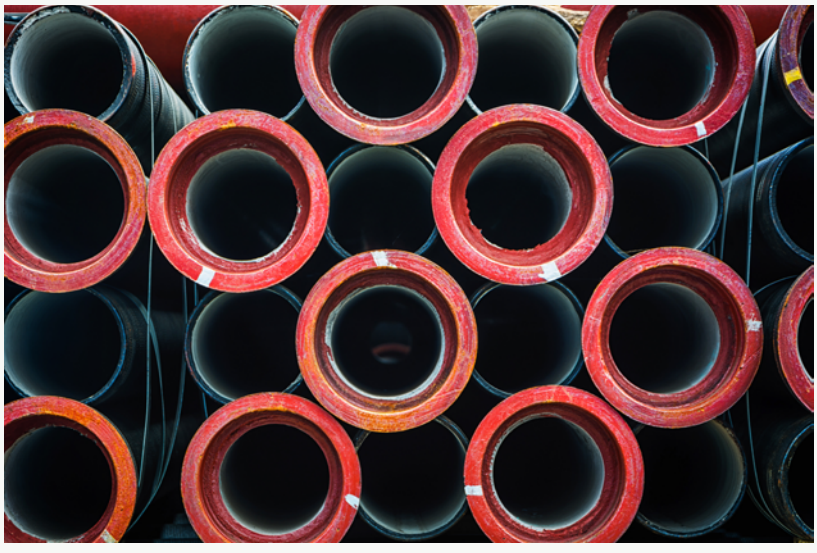
We are committed to the **refurbishment and energy efficiency of buildings,** providing solutions for energy saving and decarbonisation of dwellings, both single-family homes and buildings. The proposal consists of a final turnkey product that brings together different solutions: efficient electric air conditioning with heat pumps, actions on the thermal insulation of the home (façades, roofs, windows), energy supply and optimal maintenance of equipment. In this way, this guarantees simplicity, quality and cost containment to the customer.

With these actions we are committed to the most efficient electric air conditioning technologies (aerothermal/ geothermal), to the detriment of fossil fuels, reducing dependence on gas and promoting the consumption of a renewable energy mix. It also improves the carbon footprint of our customers, in line with our SDG commitments.

HEAT NETWORKS

We also promote the **creation of heat networks** to supply waste heat energy from renewable energy installations to buildings and homes. For this purpose, we have created IR Redes de Calor y Frío S.L. together with the company REBI Recursos de la Biomasa S. L. Through the heat network, an exchange of thermal energy between producers and demanders can be achieved, bringing the energy efficiency values to the maximum.

Among the initiatives planned is **the implementation of a 28-kilometre heat distribution network to supply heating and hot water** throughout the urban area of Puertollano. The heat will come from our green hydrogen production plant at the site. The heat generated by the electrolyser will be used entirely to heat a stream of water up to 40 and 50 degrees that will be distributed to various areas of the city. This electrolyser is powered by Puertollano's PHV and Renewable electricity from our portfolio, so the heat from the heat network will be 100% green.



Self-consumption

With the knowledge and experience of the Smart Solar unit, in addition to the standard self-consumption solutions for residential and business, the PPA On-site products for companies and Solar Communities have been launched.

Through the **On-site PPA**, the customer is provided with 100% renewable energy at a fixed price, producing savings, predictability and long-term stability.

We have launched our **Smart Solar self-consumption solution for neighbourhood communities**, in which the investment can be made by the customer or by Iberdrola, allowing communities **to generate their own 100% renewable energy and save on their bills.**

The energy generated is distributed among the neighbours and the community according to their participation. The customer who joins the plant is a solar self-consumer with all the advantages of self-consumption of energy: savings on their bill, payment for the surplus energy produced that is injected into the grid, and monitoring of the energy produced by the panels from their telephone, as well as enjoying advantageous solar tariffs on their bill during the hours when there is no electricity.

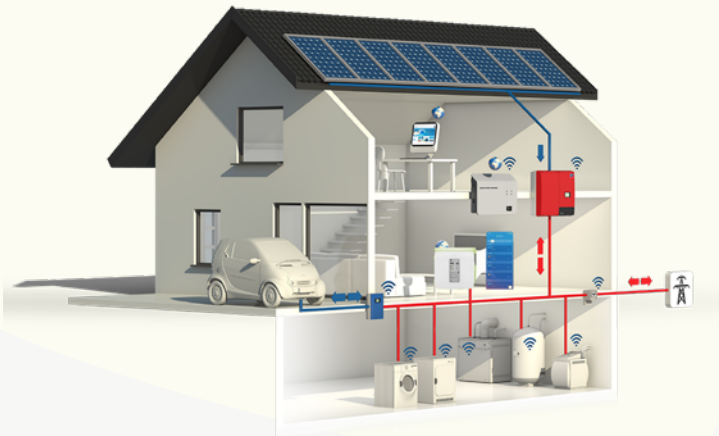
We also offer the possibility of setting up **Solar Communities**, these are communities that prefer to give up their roof for the installation of photovoltaic panels in exchange for clean energy. In this way, self-consumption of energy is treated as a service without the need for installation or investment and the savings can be monitored through the Smart Solar App.

Energy management

Smart grids represent a technological leap forward in responding to the electricity demand needs of today's citizens, enabling them to become prosumers and integrate a greater number of renewable installations.

With this vision, Iberdrola seeks to provide a comprehensive response to the technological and social challenges posed by the needs of citizens by committing to **Smart Cities.** These combine actions in electric mobility with solar self-consumption and climate electrification, and also add the layer of **local energy management and optimisation**, an essential requirement for connecting the solutions and being able to extract their maximum energy potential in an efficient manner.

In addition, at Iberdrola we have developed the **Advanced Smart Assistant**, a comprehensive energy management system which, based on AI, is capable of autonomously managing all the Smart Solutions present in our customers' homes. In this way, it generates additional value on each of the solutions, and a saving on the customer's bill, both through the optimisation carried out by the assistant itself, and through the personalised messages and recommendations that the user will receive. With this, the customer will be able to forget about programming their electric vehicle or switching on the air conditioning, avoid consumption overlaps, decide when to charge their electric car according to the most economical hourly rate, etc. In addition, the user will have access to a breakdown of the electricity consumption of each of the household appliances in their home to improve their efficiency and save on the bill and will be able to consult the consumption history and make a forecast for the current month.



The Smart Assistant is now also available for companies (SMEs). In this case, the service is offered with a monthly report, which the customer can consult in their Customer Area or via email, and which includes a summary of all the functionalities available, which are similar to those for households. Our aim is to export this service to other countries, such as France or Italy, in order to continue contributing to energy savings, in line with the current European regulatory framework.

Green Hydrogen

As part of our commitment to leading the energy transition, we are spearheading the development of **green hydrogen obtained by electrolysis from clean energy sources**, with more than 60 projects in 8 countries (Spain, United Kingdom, Brazil, United States, among others) to meet the **decarbonisation needs of sectors that are difficult to electrify.** This portfolio of projects will require investments of €9 billion by 2030, with the aim of producing 400,000 tons/year of green hydrogen. This would save the 830 million tons of CO2 per year that are generated when this gas is produced using fossil fuels.

And we have already initiated several projects that will enable **the decarbonisation of industry and heavy transport**, as well as the deployment of its value chain.

We have recently inaugurated the largest green hydrogen plant for industrial use in Europe, located in Puertollano (Ciudad Real), with an electrolyser capable of **producing 3,000 tons of renewable H2** per year, thus avoiding the emission of **up to 48,000 tons of CO2/year** into the atmosphere. This pioneering plant will **generate 100% green hydrogen with zero CO2 emissions** thanks to the use of renewable sources.

The electricity needed to produce the hydrogen comes from an innovative **100 MW solar photovoltaic plant** directly connected to the electrolyser. It is our first installation in Spain with bifacial panels and a lithium-ion battery storage system with a capacity of 20 MWh. The green hydrogen produced in our plant will be used in the ammonia factory that the Fertiberia Group has in Puertollano, which, thanks to this technology, will be able to reduce the plant's natural gas needs by up to 10%. In addition, this project is **circular**, as, in the future, the waste heat produced as a result of the electrolysis process could be used to provide hot water and residential heating to the town of Puertollano through a heat network that we are promoting in the town.

Furthermore, in less than a year we have put into service a **green hydrogen plant in the Free Zone of Barcelona to supply TMB (Transports Metropolitans de Barcelona) buses with this clean energy, with a capacity of 2.5MW.** The installation will enable fuel to be supplied to other fleets of heavy vehicles in the industrial estate that adopt this vector as an energy solution. It also aims to generate a tractor effect around this technology and promote the creation of a green hydrogen hub in one of the country's main industrial areas. As of today, the number of hydrogen plants in the world is still scarce, several hundred spread around the world, especially in Japan, Germany, Norway and the United States, while in Spain the number does not reach ten. With this project, **we will contribute to achieving the goal of reaching more than 100 hydrogenerators set by our country by 2030.**

We are also involved in several European research projects. Specifically, in a project focused on improving the storage of this fuel. The **storage of green hydrogen is essential to guarantee the stability of supply** required by industry and to make efficient use of renewable energy production.

The project addresses two different perspectives:

1. Short-term storage: new low-cost, high surface area nanoporous MOFs (Metal Organic Framewoks) will be developed following an original forming process (3D printing). A container will also be developed that can accommodate stacks of MOF bodies in an adapted form.
2. Long-term storage: advanced materials (both catalysts and membranes) and their combination in a 3D printed intensified periodic open cell structured reactor will be developed to enable the storage of hydrogen in the form of ammonia in a more technically and economically efficient process than today with lower temperatures and pressures than conventional systems

Green hydrogen will also be part of the **energy communities** of the future. We are therefore participating in the development of a **technical and commercial ecosystem** to demonstrate the potential for coupling the energy sector by integrating local energy systems across the **federation of communities:** generating economic benefits, improving grid stability and reliability, contributing to the decarbonisation of the energy system and reducing the carbon footprint. In the framework of this project, we will develop both the optimisation models for the operation of the hydrogen plant and the optimal model for supplying electricity to the plant, considering renewable energy, batteries, grid and customer needs. The end result will be a scalable and adaptable cloud-based platform consisting of analysis, modelling and **optimisation services for planning, monitoring and control of integrated local energy systems** (electricity, gas, heating and cooling, industry, electric and hydrogen mobility).

Finally, we are developing and validating **a new innovative liquefier prototype for the cryogenic region**, based on magnetic refrigeration. We will work on increasing energy efficiency for small liquefaction volumes, reducing CAPEX and OPEX and integraton into conventional liquefaction plants **to increase their overall energy efficiency.**

Green hydrogen will be part of the energy communities of the future.

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