

MARKET INSIGHTS

The sector calls for faster permitting of hybridized storage as a counterbalance to negative prices

In recent weeks, representatives of the energy sector have urged the Administration to speed up procedures for the development of energy storage, which is considered a key component for the massive integration of renewables such as photovoltaics (PV) into the power system.

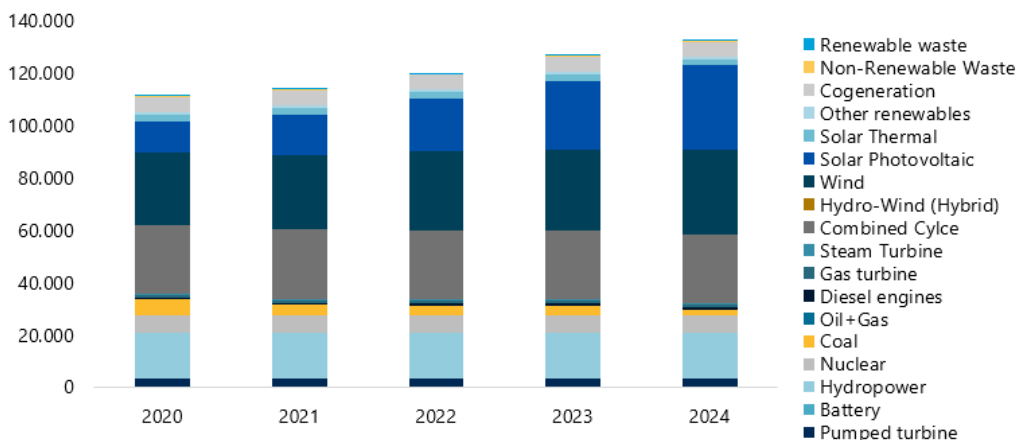
During various industry events and sectoral meetings, it has been made clear that the current administrative pace represents a bottleneck for the rollout of storage projects. The sector is calling for urgent measures to enable the deployment of such infrastructure in parallel with the progress of renewable energy generation.

In the words of the president of the Business Association of Batteries, Cells, and Energy Storage (AEPiBAL): "You can't talk about energy transition without storage. We need to accelerate permitting if we want to ensure supply security, harness solar energy when the sun isn't shining, and move toward a more flexible and resilient electricity system."

Analysis of the Fundación Valenciaport

Photovoltaic energy has taken a leading role in Spain's **energy transition**, being one of the European countries with the greatest potential to harness solar power. The installed capacity of solar panels has experienced exponential growth in recent years, contributing significantly to the **decarbonization of the electricity sector**. However, this boom in photovoltaics has also brought certain challenges and changes to the electricity market, particularly with regard to **electricity prices**. As shown in Graph 1, during the year **2024**, **solar photovoltaic** energy became, for the first time in history, the technology with the highest **installed capacity** on the Spanish mainland, reaching 31,719 MW, surpassing wind power with **25.1% of the total installed mainland** capacity (compared to 21.3% in 2023).

Graph 1. Installed electrical power in Spain by technology (MW)



Source: Red Eléctrica Española

In Spain, **photovoltaic energy** is being deployed through three main types of installations, reflecting the sector's diversity and maturity. On one hand, there is **residential self-consumption**, where individuals and households use solar energy for their own consumption. On the other hand, **industrial self-consumption** involves companies and large consumers installing photovoltaic systems to reduce costs and improve sustainability. Finally, **commercial solar farms** represent large-scale generation aimed at selling renewable energy in the electricity market.

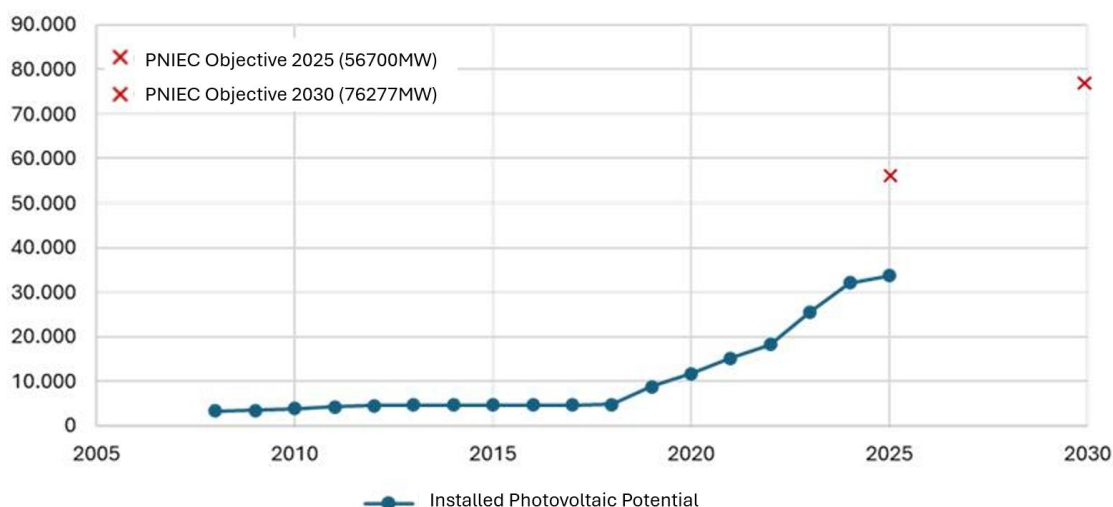
- **Residential installations:** According to estimates from the Spanish Photovoltaic Union (UNEF), the trade association for the PV sector in Spain, 1,182 MW of photovoltaic self-consumption capacity was installed in 2024, continuing the growth of these solutions, which now total 8,137 MW.
- **Industrial installations:** According to UNEF, industrial self-consumption was the segment with the highest newly installed capacity in 2024, with 674 MW, of which 578 MW came from industrial projects over 100 kW and 96 MW from projects under 100 kW.

Regarding overall self-consumption installations, the Renewable Energy Companies Association (APPA) reports that 1,431 MW of photovoltaic self-consumption capacity was installed in 2024, with approximately 76% corresponding to the industrial sector—equivalent to 1,085 MW.

- **Commercial solar farms:** The installed capacity of PV plants dedicated to selling renewable energy is approximately 31,000 MW. This includes grid-connected photovoltaic generation plants not intended for direct self-consumption.

Although PV energy generation has experienced drastic growth over the past decade, the Integrated National Energy and Climate Plan (PNIEC) 2023–2030 sets even more ambitious renewable generation targets. According to the PNIEC, total installed capacity is expected to reach 214 GW by 2030, of which 160 GW will be from renewable generation and 22.5 GW from storage. The Self-Consumption Roadmap forecasts an installed self-consumption capacity of 19 GW by 2030, which is expected to cover 11% of electricity demand.

Graph 2. Evolution of Installed Photovoltaic Power in Spain and PNIEC Objectives



Source: Own elaboration based on data from Red Eléctrica Española and PNIEC.

Table 1. Generation park of the PNIEC 2023-2030 Scenario. Gross capacity (MW)

Year	2019	2020	2025	2030
Wind	25.583	26.754	36.149	62.054
Solar Photovoltaic	8.306	11.004	46.501	76.277
Solar Thermal	2.300	2.300	2.304	4.804
Hydropower	14.006	14.011	14.261	14.511
Biogas	203	210	240	440
Other Renewables	0	0	25	80
Biomass	413	609	1.009	1.409
Coal	10.159	10.159	0**	0
Combined Cycle	26.612	26.612	26.612	26.612
Cogeneration	5.446	5.276	4.068	3.784
Oil and Oil/Gas (Non-Mainland Territories)	3.660	3.660	2.847	1.830
Waste and Others	600	609	470	342
Nuclear	7.399	7.399	7.399	3.181
Storage*	6.413	6.413	9.289	18.913
Total	111.100	115.015	151.173	214.236

** The closure of coal-fired generation will be subject to the System Operator's assessment of compliance with the system's supply-security criteria, as established in Article 137 of Royal Decree 1995/2000.

Source: Ministry for the Ecological Transition and the Demographic Challenge

Although the **PNIEC** forecasts suggest that the installed capacity of **photovoltaic energy** in Spain will continue to grow at the current pace—or even accelerate—in the coming years, as shown in Graph 2 and Table 1, the reality of the **electricity market** presents signs that call for **critical reflection**.

Electricity **prices in the wholesale market** during **peak solar generation** hours have frequently reached values close to **zero** or even **negative**.

The strong growth of installed renewable capacity in Spain in recent years is occurring in a context of **stagnant electricity demand**, which exacerbates the structural imbalances of the system. Mainland demand has remained virtually unchanged for more than a decade, without significant increases to accompany the deployment of new renewable generation. At the same time, the phase-out of conventional fossil technologies—such as coal—has been relatively limited, with a much smaller impact compared to the added renewable capacity. As a result, the electricity system increasingly faces situations of overcapacity during solar hours, leading to zero or negative marginal prices, difficulties in managing non-dispatchable generation, and growing pressure on the profitability of generation assets.

Graph 3. Annual evolution of electricity demand (GWh)



Source: Own elaboration based on data obtained from Red Eléctrica in Spain.

Spain's traditional electricity market model, historically based on **fossil fuels and nuclear power generation**, has been disrupted by the growing share of renewable energy sources. At certain times, this has caused wholesale market prices to fall to €0/kWh or even into negative territory. In 2024, more than 10% of the hours in the year recorded electricity prices at zero or negative levels. In total, approximately 1,100 hours saw zero or negative prices, with around 830 hours at zero euros and about 270 hours with negative prices.

One of the key solutions to overcome the saturation of the photovoltaic generation market is the implementation of **energy storage systems**, particularly **grid-connected batteries**. These technologies allow excess energy generated during peak solar hours—which currently leads to very low or negative prices—to be stored and later released during periods of high demand, when **renewable generation** is insufficient or unavailable. Battery storage provides **essential flexibility** to the power system by decoupling energy production from immediate consumption. This not only helps stabilize prices by preventing extreme drops, but also enhances **supply security**, reduces reliance on fossil backup sources, and optimizes the use of renewable energy.

Beyond managing energy surpluses, battery storage can offer a critical benefit in terms of **grid stability** through the deployment of inertia-capable systems. Inertia in a power grid refers to the system's natural resistance to abrupt frequency changes, traditionally provided by the rotating mass of conventional generators.

Grid-forming batteries replicate this physical property using power electronics. This enables batteries to respond quickly and effectively to sudden frequency fluctuations, **stabilizing the grid** and preventing blackouts or damage to infrastructure.

In addition to battery storage, other complementary solutions exist to manage excess PV generation and avoid market saturation. One key option is to increase electrical **interconnections between Spain and the rest of Europe**, especially with France. These interconnections would allow surplus renewable energy produced in Spain to be exported to European markets with higher demand during peak solar production hours. This would position Spain as a **key exporter of clean, low-cost energy**, contributing to the decarbonization of the entire continent and optimizing the use of its renewable resources.

In this context, the development of a **capacity market** in Spain represents a **decisive boost** for the expansion of energy storage. The Ministry for the Ecological Transition and the Demographic Challenge has already published a draft of this new regulatory framework, which aims to remunerate not only generated energy but also **available capacity** to ensure supply security. This structural change will enable storage technologies—especially grid-connected batteries—to earn **additional revenue** for their ability to deliver energy during critical system moments, beyond their participation in the spot market.

Thus, the capacity market becomes an essential tool for making new storage investments economically viable, which are crucial for absorbing photovoltaic surpluses during low-demand periods and releasing them later when needed. This market signal will significantly **accelerate the deployment of batteries** and other flexible solutions, facilitating greater integration of solar energy into the national energy mix.

Another important avenue is to promote the installation of **large energy consumers** that can be strategically located to absorb renewable energy during high production periods. For example, the deployment of **data centers or server farms**, which require a stable and high-power energy supply, can act as a sink for renewable electricity, encouraging the installation of new photovoltaic plants.

Similarly, **industrial energy communities** represent another key tool to efficiently channel renewable generation, particularly in productive environments with high energy demand. By grouping various companies within the same industrial park or zone, these communities enable shared photovoltaic infrastructure and optimized collective self-consumption, acting as a **coordinated sink** for clean energy.

In addition to improving **energy efficiency** and reducing operational costs, this model promotes local and participatory energy management, and can be integrated with storage or demand management solutions.

The development of industrial energy communities is supported by regulatory instruments and public funding programs, and is emerging as a strategic solution to absorb surplus solar production in areas with strong industrial activity.

Photovoltaic energy has experienced significant growth in Spain, becoming one of the country's main renewable energy sources. However, this rapid expansion has introduced **challenges** in the electricity market, especially with negative prices during peak solar generation hours. Future projections based on the **PNIEC** indicate that PV installed capacity will continue to grow rapidly, with ambitious targets set for 2030. However, to fully realize this potential, it is essential to address the challenges related to PV generation market saturation. One key solution is the implementation of energy storage systems, such as batteries, to manage energy surpluses and stabilize electricity prices. Additionally, European interconnection offers an opportunity to export excess renewable energy to other countries, positioning Spain as a **major exporter of clean and affordable energy**.

In summary, while photovoltaic energy holds great promise for Spain's energy future, it is crucial to implement **strategies and solutions** that enable efficient management of energy generation and consumption, ensuring the **stability and sustainability** of the electricity system.