Creating Opportunities

Weekly Summary

Economics of Climate Change

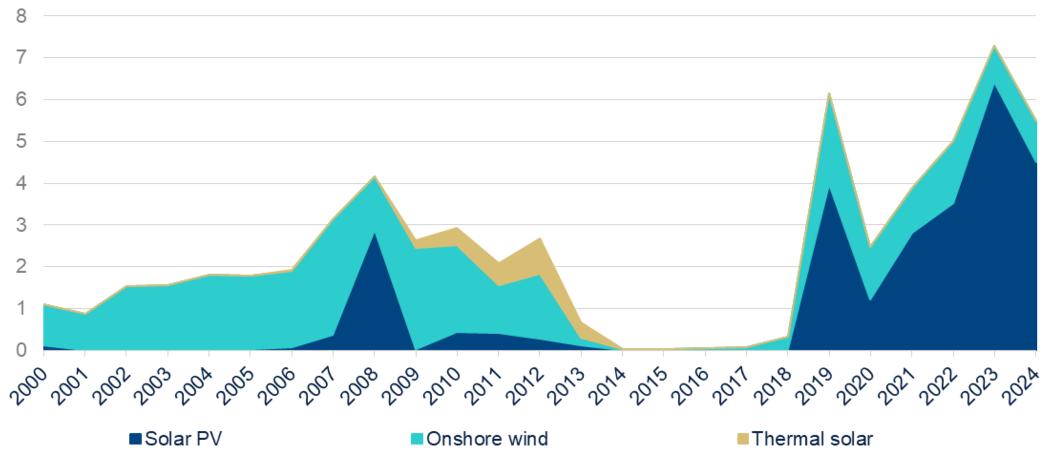
March 7, 2025

The renewable landscape in Spain: wind in the north, solar in the mid-south -strong growth yet falling short of targets

Location selection for renewables has been primarily driven by technical and geographic criteria, with minimal influence from local socioeconomic factors. Although Spain has experienced two significant waves of renewable expansion, it still falls short of the targets set by the government, especially in wind energy.

This week's summary aims to **review the state of renewables in Spain, examining where they are located, why they are there, and how far are we from meeting the** "Plan Nacional Integrado de Energía y Clima" (**PNIEC**) **targets.** Next week, we will extend our analysis by exploring the geographic disparities between electricity supply and demand, as well as the potential challenges that could arise from electrical grid constraints.

Figure 1. **Additional installed capacity of renewable, cogeneration and residual sources in Spain. 2000-2024. GW**



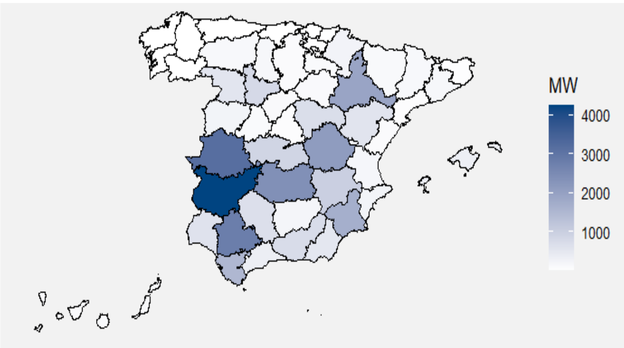
Source: BBVA Research from PRETOR[1] data.

Spain, recognized as one of the leading countries in the transition to renewable energy, **has experienced two distinct cycles of investment in the sector (Fig 1)**. As noted by Fabra et al. (2023), the **first wave, spanning from 2008 to 2014**, **emerged from public incentive policies**, such as targeted subsidies. During this period, **solar plants were typically small-scale**, averaging just 0.5 MW, and were widely dispersed geographically, with two-thirds located in rural areas. In contrast, **wind farms, averaging 21 MW, were predominantly situated in northern and eastern regions** like Galicia and Aragon, where abundant wind resources and available transmission capacity provided a strategic advantage. This phase, however, ended abruptly in 2014 due to a moratorium[2] on the subsidies of renewables installations imposed by the Spanish authorities in order to reduce the electricity sector's tariff deficit.

1: PRETOR is the national registry for facilities generating power from renewable energy, cogeneration, and waste, managing their operational and compliance data.
2: Real Decreto-ley 1/2012.

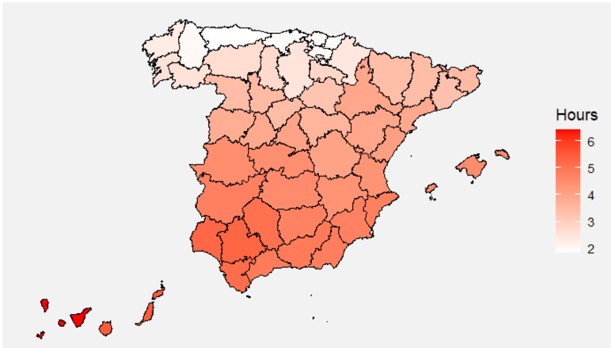
The second wave, which began in 2019 and continues today, reflects a different economic and technological landscape. Factors such as post-crisis economic recovery, **historically low interest rates, and further cost reductions, most notably an 84% drop in solar energy costs between 2010 and 2020, spurred a renewed boom**. Additionally, the Government introduced public auction mechanisms to allocate renewable capacity. This period is characterized by **large-scale solar projects, averaging 30 MW, primarily located in southern regions like Andalusia, Extremadura and Castilla-La Mancha**, where optimal solar radiation and land availability prevail **(Fig 2 & 3)**. Wind farms have also increased in size, now averaging 35 MW, yet remain concentrated in the north and along coastal areas, underscoring a continued reliance on natural resources and existing infrastructure **(Fig 4 & 5)**.

Figure 2. **Solar installed capacity in Spain by province. Feb-25.** MW



Source: BBVA Research from PRETOR data.

Figure 3. **Mean effective solar hours per day in Spain by province. 2000-2024 mean.** Hours



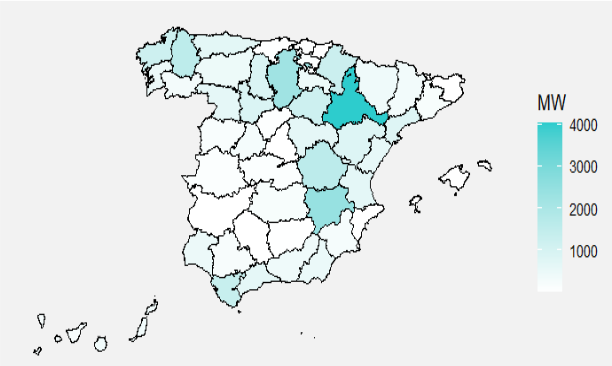
Source: BBVA Research from AEMET and Copernicus data.

Location selection for renewable projects is driven mainly by technical and geographical criteria, with little influence from local socioeconomic factors. For solar energy, municipalities chosen for installations typically feature high annual solar radiation, low precipitation, and flat terrain, as detailed by Fabra et al. (2023). These conditions are especially common in the southern half of the Iberian Peninsula (**Fig 3**), where the combination of an arid climate and vast non-urbanized areas favors the development of photovoltaic plants. In February 2025 the province with the highest installed solar capacity was Badajoz, with more than 4,200 MW, followed by Caceres (3,170), Sevilla (2,796), Ciudad Real (2,392) and Cuenca (2,118). These **five provinces account for 48.5% of the total installed capacity of solar energy in Spain**, with their average effective hours of sun[3] per day being 25% higher than in the rest of the provinces.

Conversely, wind farms are generally sited in areas with consistent winds, often in elevated regions or near the coast (**Fig 5**). Currently, Zaragoza is the province with the most wind installed capacity, more than 4,000 MW, followed by Albacete (2,428), Burgos (2,228), Cuenca (1,606) and Lugo (1,588). All these **5 provinces account for 39.2% of the total installed wind in Spain**, showing a lower degree of concentration than the one observed for solar plants. The aforementioned provinces have a mean wind speed 6% higher than the one observed for the other provinces. Note that the mean effective hours of sun per day and wind speed are important variables to explain where the renewables are being installed, even though there are other characteristics of the land or the grid system that also influence the amount of renewable installed capacity in each province.

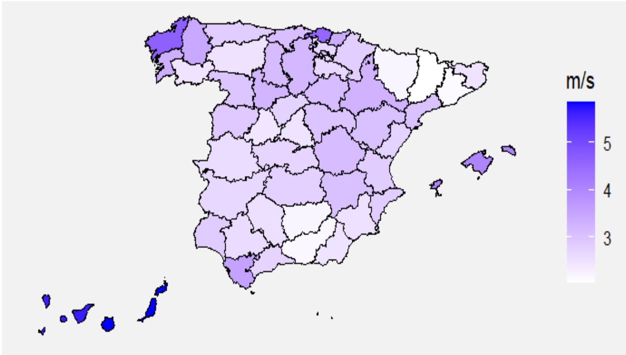
3: The effective solar hours is the average sun hours per day multiplied by the average cloud cover of the province.

Figure 4. **Wind installed capacity in Spain by province. Feb-25.** MW



Source: BBVA Research from PRETOR data.

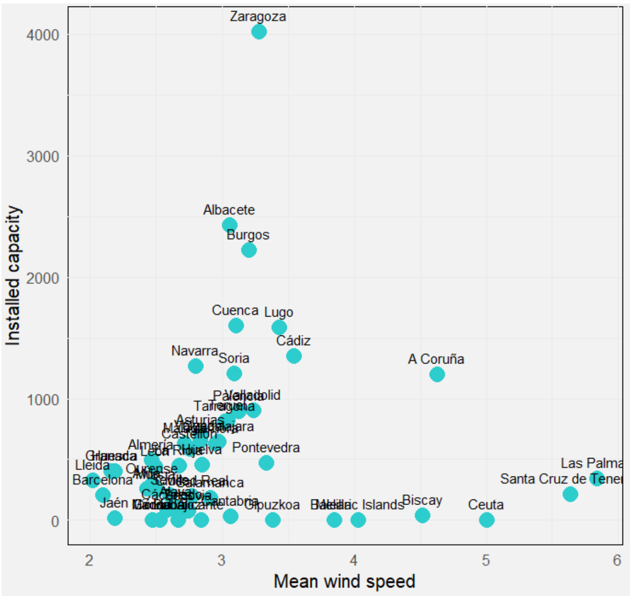
Figure 5. **Mean wind speed in Spain by province. 2000-2024 mean.** m/s



Source: BBVA Research from AEMET data.

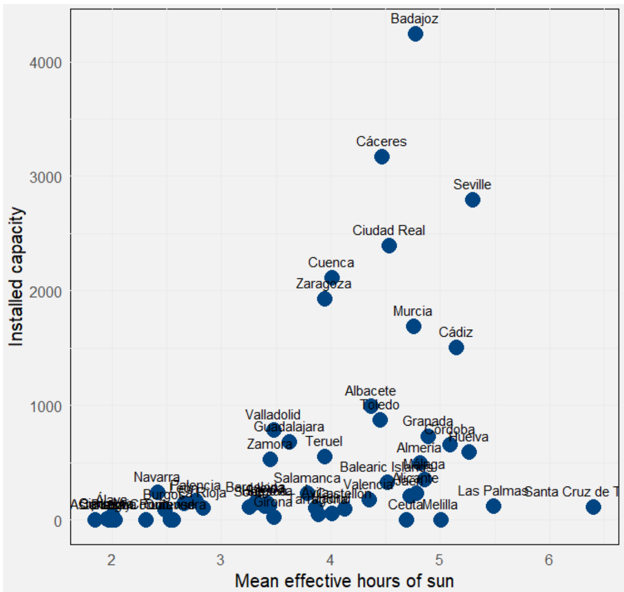
A noteworthy aspect is the link between project location and population dynamics. **Wind plants tend to be established in rural municipalities that have experienced depopulation over recent decades, while solar installations, though also prevalent in rural settings, are typically found in areas with more stable demographics.** It is important to note that, according to Fabra et al. (2023), labor variables such as unemployment rates or wage levels do not significantly influence location decisions. This suggests that **investment choices are primarily driven by technical considerations, maximizing resource efficiency and minimizing connection costs**, rather than by local development strategies.

Figure 6. **Wind installed capacity and mean wind speed by province. Feb-2025.** MW over m/s.



Source: BBVA Research from PRETOR data.

Figure 7. **Solar installed capacity and mean effective hours of sun by province. Feb-2025.** MW over effective sun hours.



Source: BBVA Research from AEMET data.

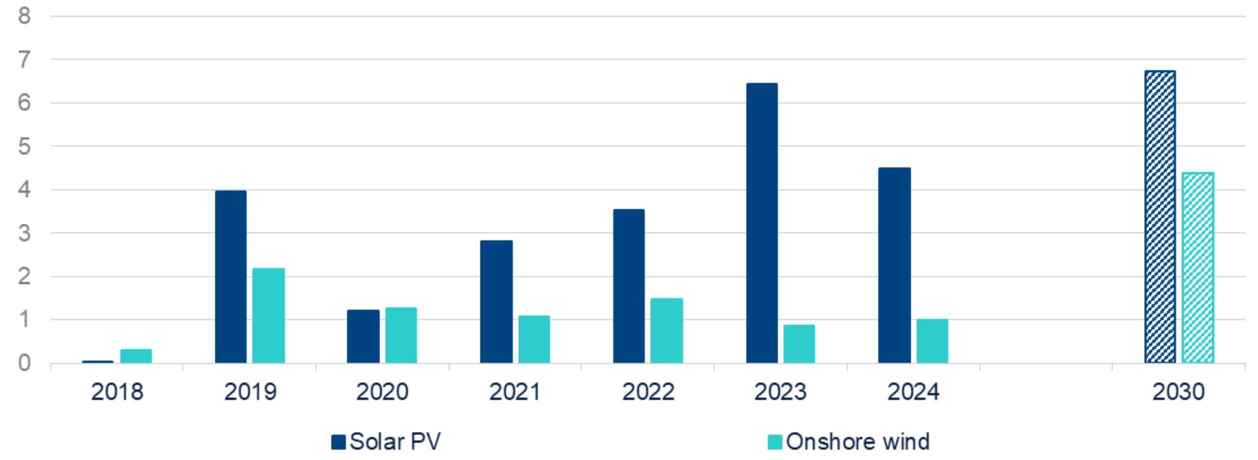
Figures 6 and **7** provide further insight into the evolution of MW capacity by province and the natural resources present within them. These figures highlight both the provinces that excel and those that, due to factors such as connectivity with other regions, topography, or land costs, do not fully utilize their physical potential.

Building on Spain's renewable energy evolution, **a comprehensive review of its energy transition objectives reveals that the targets set by the PNIEC[4] seems difficult to achieve, even within the renewable sector.[5]**

The primary aim of the PNIEC is to reduce greenhouse gas emissions so that Spain can reach climate neutrality by 2050. For that, the plan establishes the following ambitious targets for 2030: a 32% reduction in GHG emissions relative to 1990; a 48% share of renewables in final energy consumption; a 43% improvement in energy efficiency; 81% renewable energy in electricity generation; and a reduction in energy dependency to 50%. **However, when these goals are compared with historical renewable deployment, the magnitude of the challenge is clear.**

The photovoltaic target might be within the achievable range. To accomplish the PNIEC Target (72,130 MW), Spain would have to install 6,735 MW annually in the 6 following years, which is 25% more than what has been installed on average in the last two years (5,464 MW). **Difficult, but not impossible. In contrast, the wind energy target is much more daunting,** demanding an average annual increase of 4,381 MW in order to achieve the target of 57,740 MW (**Fig 8**). This annual growth is four times the average growth of the last biennium. This comparison allows us to understand the difficulties to achieve the PNIEC targets in such a short term.

Figure 8. **Growth of installed capacity in Spain (2018-2024) and annual mean growth needed to achieve the PNIEC's target (2025-2030).** GW.



Source: BBVA Research from PRETOR and REE data.

In short, Spain's renewable energy landscape, defined by strategically located wind and solar installations, highlights a dual narrative of progress and persistent challenges in its transition to a decarbonized economy. While the country has capitalized on its natural strengths (abundant solar resources in the south and wind-rich northern regions) to drive substantial capacity growth, this journey remains far from complete. Despite two phases of expansion fueled by policy evolution and plummeting technology costs, Spain's current pace falls short of the ambitious targets outlined in its National Energy and Climate Plan.

4: The PNIEC serves as a long-term strategic framework whose planning horizon far outlasts typical political cycles. Its ultimate goal is decarbonization, with all other targets, such as increasing renewable energy shares and reducing consumption, serving merely as instruments to achieve that end.
5: It becomes even more **daunting when considering objectives related to storage deployment or reductions in non-energy industrial emissions**, though we will leave that discussion for another time.

This gap is most pronounced in wind energy, where required annual installations vastly outstrip recent deployment rates. The solar sector, though better aligned with goals, still faces steep challenges to meet escalating targets. As Spain navigates this decisive decade, aligning resource-driven growth with systemic priorities, such as modernizing grids, integrating storage solutions, and ensuring equitable regional development, will be critical to converting technical potential into successful outcomes.

Next week, we delve deeper into the geographic mismatches between supply and demand, and the looming risks of grid constraints.

Highlights of the Week

- **Global | The battery industry has entered a new phase – Analysis - IEA.** Battery deployment continues to break records as prices fall.
- **Europe | Transatlantic clean investment monitor 3: battery manufacturing. Bruegel.** Battery manufacturing investment is rising fast on both sides of the Atlantic with the US outstripping Europe – for now.
- **US | Judge blocks Trump administration from freezing federal funding without congressional approval. ABC.** A federal judge on Thursday issued a nationwide injunction blocking the Trump administration from freezing federal funding without going through Congress.
- **China | China se desmarca de Trump y refuerza su compromiso con la transición ecológica | Clima y Medio Ambiente | EL PAÍS.** Mientras la Casa Blanca da aire a los combustibles fósiles, el Gobierno de Pekín anuncia para 2025 nuevas iniciativas y más inversión para combatir la crisis climática.

DISCLAIMER

The present document does not constitute an "Investment Recommendation", as defined in Regulation (EU) No 596/2014 of the European Parliament and of the Council of 16 April 2014 on market abuse ("MAR"). In particular, this document does not constitute "Investment Research" nor "Marketing Material", for the purposes of article 36 of the Regulation (EU) 2017/565 of 25 April 2016 supplementing Directive 2014/65/EU of the European Parliament and of the Council as regards organisational requirements and operating conditions for investment firms and defined terms for the purposes of that Directive (MIFID II).

Readers should be aware that under no circumstances should they base their investment decisions on the information contained in this document. Those persons or entities offering investment products to these potential investors are legally required to provide the information needed for them to take an appropriate investment decision.

This document has been prepared by BBVA Research Department. It is provided for information purposes only and expresses data or opinions regarding the date of issue of the report, prepared by BBVA or obtained from or based on sources we consider to be reliable, and have not been independently verified by BBVA. Therefore, BBVA offers no warranty, either express or implicit, regarding its accuracy, integrity or correctness.

This document and its contents are subject to changes without prior notice depending on variables such as the economic context or market fluctuations. BBVA is not responsible for updating these contents or for giving notice of such changes.

BBVA accepts no liability for any loss, direct or indirect, that may result from the use of this document or its contents.

This document and its contents do not constitute an offer, invitation or solicitation to purchase, divest or enter into any interest in financial assets or instruments. Neither shall this document nor its contents form the basis of any contract, commitment or decision of any kind.

ENQUIRIES TO:
BBVA Research: Azul Street, 4. La Vela Building – 4th and 5th floor. 28050 Madrid (Spain).
Tel. +34 91 374 60 00 y +34 91 537 70 00 / Fax (+34) 91 374 25
www.bbvaresearch.com