

“COMPLEMENTARY SOLAR AND WIND RESOURCES IN SPAIN, COMBINED WITH BESS, FACILITATE THE SALE OF ADDITIONAL GENERATION VIA BASELOAD PPAs”



P PAs have played a key role in supporting the expansion of Spanish renewable energy projects in recent years. Emerging trends, such as energy storage and the hybridisation of technologies, are creating new opportunities for investors. In this interview, energy market analyst Kim Keats Martínez discusses these opportunities and the benefits of signing PPAs for hybrid projects and energy storage, among other topics.

Kim Keats Martínez
Director

Experience: Kim has supported the completion of 72GW of renewable and conventional energy projects, as well as water desalination projects worth USD44 billion over the past 23 years, including 15GW in Spain.

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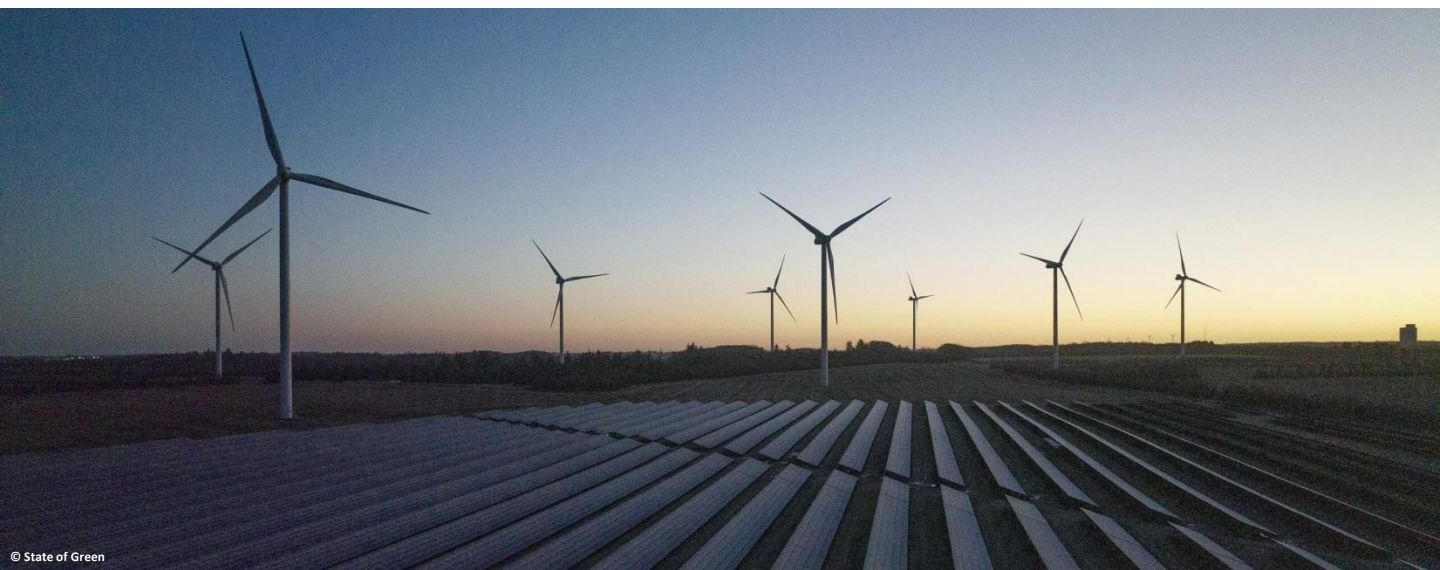
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What are the advantages of signing a PPA in Spain with a hybrid Solar + Wind project?

Owners of renewable projects aim to sell all their generation at the highest possible price. However, there is a technology-specific trade-off between volume coverage and pricing. For instance, while Spanish solar PV projects can secure “pay-as-produced” (PAP) PPAs, **the strike prices are significantly lower than those of baseload PPAs**. This difference arises primarily due to the “duck curve” effect and limited consumer interest in generation profiles that do not align with energy needs.

In contrast, wind projects in Spain, benefiting from more consistent generation, **can often secure baseload PPAs**. However, the inherent intermittency of wind resources means contracted volumes under these agreements are generally low.



Interestingly, location-specific PV and wind resources in Spain complement each other: wind tends to blow when the sun shines less, both across seasons and within daily cycles. **This complementarity creates a combined dispatch curve with a more stable minimum, which facilitates the sale of additional generation via baseload PPAs**. This combination also reduces the need to clear trades at the market price when renewable generation falls short of contracted levels.



And adding BESS?

Adding Battery Energy Storage Systems (BESS) further enhances the volume and price trade-off in the generator's favour. Incremental development of hybridisation projects with BESS can take various forms, but **optimal configurations typically culminate in Wind+PV+BESS setups**. These enable a single baseload PPA contract with higher coverage than standalone wind and a much lower risk profile, as exposure to market purchases is reduced when renewable generation plus BESS injection falls short of the contracted amount. While each site is unique, the overall conclusions are often similar. I made these points in an [earlier article](#).

Is it possible to get better prices?

Compared to standalone PV covered by a PAP PPA or standalone wind with low volume under a baseload PPA, combining the two should enable the generator to **secure higher volumes under the higher baseload PPA price**. Adding BESS further enhances this trade-off. However, it's not only about the captured price. When securing offtake agreements, the generator's aim is to maximise realised prices from their generation while minimising market purchases when renewable generation plus BESS injection falls short of contracted levels. Stored energy can be deployed to reduce purchases during such shortfalls, which should not be underestimated since periods with low wind and PV generation often coincide with the highest spot prices.



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Is it profitable for a developer to opt for BESS by taking advantage of arbitrage opportunities?

Yes, price arbitrage—buying low and selling high—in the day-ahead market is a key opportunity that BESS provides, whether deployed standalone or hybridised with renewables. The volatility of Spanish intraday spot prices is sufficient to secure margins for energy storage solutions, as demonstrated by [EKON's BESS Tracker](#).

I developed this index, starting in January 2014, to track the monthly profitability from arbitrage across hypothetical BESS projects with 1-, 2-, 4-, and 12-hour storage durations. Since October 2021, average monthly net income has been five times higher than previously achieved levels.

While greater storage capacity yields higher arbitrage incomes, it exhibits diminishing returns, meaning the incremental increase in net income decreases as more storage is added. Additionally, **BESS returns can be enhanced by active participation in daily, intraday, and ancillary service markets**. These are critical factors to consider when optimising the size of a BESS facility.

Do you think PPAs will become more common in the coming years if more BESS are developed?

Initially, yes. As described earlier, if BESS in hybrid configurations can demonstrably increase expected cash flows through higher baseload PPA coverage and reduced market purchases, banks will likely show greater interest in lending.

Standalone BESS, however, faces different challenges, as it does not fit well into the energy-only contracting model of existing PPA structures. In other markets, **PPAs for BESS are often structured as tolling agreements**, where the facility's use is effectively rented out to a credit-worthy third party for a fixed fee, with or without a revenue-sharing component. Any guaranteed income stream will be particularly attractive to lenders.

These contractual innovations should facilitate the deployment of additional PV, wind, and BESS. However, as the market penetration of renewables and BESS approaches its economic saturation point—where additional capacity no longer meets the minimum required return for investors—the willingness to lend and sign PPAs will likely decline.

While **PPAs are a valuable tool for managing risk**, they are not a universal solution to achieve overambitious decarbonisation targets, particularly if such targets are not matched by a commensurate increase in demand driven by the decarbonisation of other sectors of the economy.

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