

Negative Power Prices GB Wholesale Energy Market

A Solar Generator's Perspective



Dario Hernandez, Head of Energy Storage,
NextEnergy Capital

The occurrence of periods where power prices drop below zero, a phenomenon referred to as negative prices initially may appear alarming, especially to those unfamiliar with the intricacies of energy markets. However, negative power prices are not as detrimental as they first might seem, in fact they signal very positive trends and opportunities in the energy sector.

This thought leadership piece looks at the fundamentals of why negative power prices occur in the wholesale market, explores the impact of negative power prices for generators, and what this means for the future. Not all generators will be affected by negative power prices in the same way and solar fund strategies with mixed revenues that include subsidies and long term contracted revenue streams at their core will be well insulated from this power price environment.

Throughout 2023 there were 107 one-hour periods where negative prices in the GB occurred, yet only 34 of these one-hour periods (or 0.38% of the annual hours) occurred while solar was generating. Considering the solar generation profile and price, the impact on a fully unhedged solar project would have been below 0.2% of its annual revenue (excluding all other revenues for example subsidies or ancillary services). Therefore, the effect of negative power prices on revenues has been minimal to date.

“In 2023 the impact of negative power prices on a fully unhedged solar project would have been below 0.2%”⁽¹⁾

Market analysts anticipate an increase in the occurrence of negative power price hours in the future, However, the rapid growth in flexible power demand has the ability to counteract this. This includes things such as Battery Energy Storage Systems (“BESS”), need for data centres for AI, adoption of electric vehicles, heat pumps, or green hydrogen. Additionally, from a solar perspective, the majority of negative power prices are primarily driven by wind generation, which traditionally operates countercyclically with solar, and the pool of projects incentivised to generate at negative power prices is reducing over time driven by changes in regulation.

We are in the midst of the biggest transformation in the energy industry in history, displacing polluting fossil fuels from the system. The market signals and demand that follows it, are a natural part of the UK driving towards a net zero energy system while attracting demand, investment, new industries, and jobs with innovative business models whilst delivering energy security, affordability, stability, and sustainability. As an investment manager that focuses on solar and storage systems we see opportunity set as being far above “threat” for our strategies through this evolution.

[1] Based on 2023 annual wholesale market revenue



Why do negative power prices occur?

Negative power prices appear during periods of low demand such as bank holidays or weekends, coupled with periods of very high wind and solar generation and in energy systems with inflexible thermal generation capacity such as coal and gas.

During these “negative” periods, a generator may choose to sell at negative prices due to three main reasons:

- 1 Generators may receive alternative revenues:**
For example subsidies such as Renewable Obligation Certificates (“ROCs”), Renewable Energy Guarantees of Origin (“REGOs”), Feed in Tariffs (“FiTs”) or ancillary services. If the price of the alternative revenue is high enough, a generator can sell energy at a negative price to ensure being dispatched and still make a profit.
- 2 Opportunity cost:**
Some thermal generators have long ramp up rates or higher costs when starting from cold. If they sell electricity at peak times (higher price), they need to ensure they are operating and available by the time committed. This means that they might need to start generating ahead of time even if at a loss.
- 3 Lack of flexibility:**
Some generators simply do not have the capability to reduce generation fast enough or the cost of stop/start is higher than the loss derived from running at negative price.

What is the impact on renewable generators?

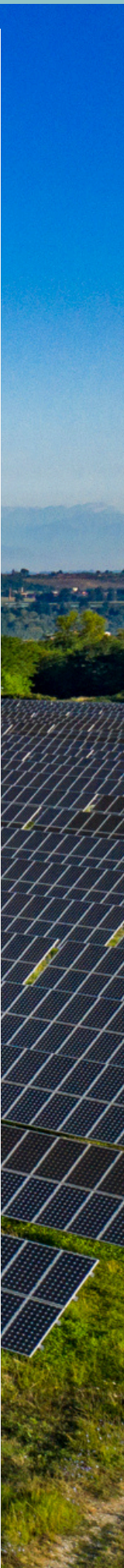
Not all generators will be impacted in the same way. It depends mostly on the technology, revenue structure, and their strategy for sale of power. Projects with a long-term contract via a fixed priced PPA would not be affected at all by negative pricing. Likewise, those earning alternative revenues such as subsidies would likely still make a profit during negative prices. Therefore, it is only pure merchant assets (those that have not forward sold/contracted their power) or Contract for Difference (“CFD”) projects (from Allocation Round 4 (“AR4”) in 2022 onwards) that have some exposure to negative prices.

In the case of CfD, generators get the difference between the strike price (which is the price agreed in the contract) and the Market Reference Price (“MRP”) (fundamentally what is considered the day ahead power price).

However, if the MRP is negative, generators would not receive the difference payment and therefore, they are exposed to negative prices. There is an important distinction to be made: a project that secured a CfD contract in Allocation Rounds AR2 in 2017 and AR3 in 2019 would not receive any payment if the reference price is negative for six or more consecutive hours.

From AR4 and subsequent tenders, the generator will not receive a payment when the Market Reference Price is negative for any length of time. This change is intended to incentivize generators to have the flexibility to turn off, thereby limiting the pool of generators that would potentially bid at zero prices to those with early contracts.

Furthermore, the frequency of negative power prices in the GB market has been low. Figure 1 shows the number of hours per month that recorded negative prices, both in total and during periods when solar PV was generating.



Number of hours with negative price in day ahead market

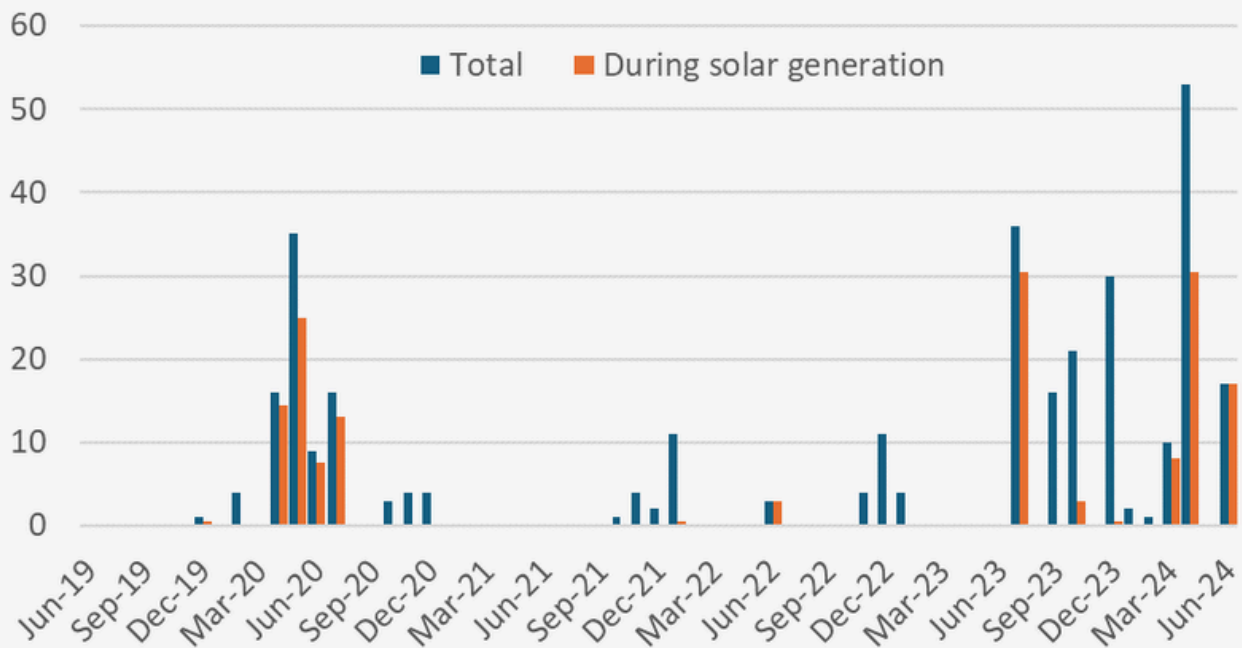


Figure 1: Number of hours with negative price in day ahead market per month. Source: N2EX day-ahead GB power price and internal analysis.

In 2023 there were 107 one-hour periods with negative power prices. However, only 34 of these one-hour periods (or 0.38% of the annual hours) occurred while solar was generating (and almost all of them happened during the weekends in July).

To evaluate the impact, let's assume a fully merchant solar PV plant (GB average) indexed to day-ahead price. The revenue from the wholesale market (excluding any other services or subsidies) would have been £72/kW during 2023 and the negative prices would have represented a loss of £0.15/kW (or 0.2% of the wholesale revenue). This not only is negligible, it is many orders of magnitude below other variables involved in solar generation, and therefore, not a cause for concern.

Negative power prices are relatively shallow, there is a limit to what generators are willing to accept. Figure 2 shows the minimum price recorded in the day-ahead market and also the negative price adjusted by solar PV production or "captured negative power price during solar generation". This shows again how the frequency and magnitude of negative pricing periods in solar generation is much lower than during wind generation in the GB market.

Minimum price and negative price adjusted by solar PV load factor

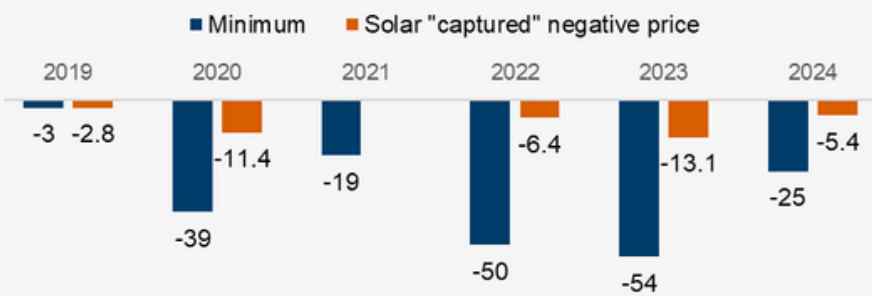
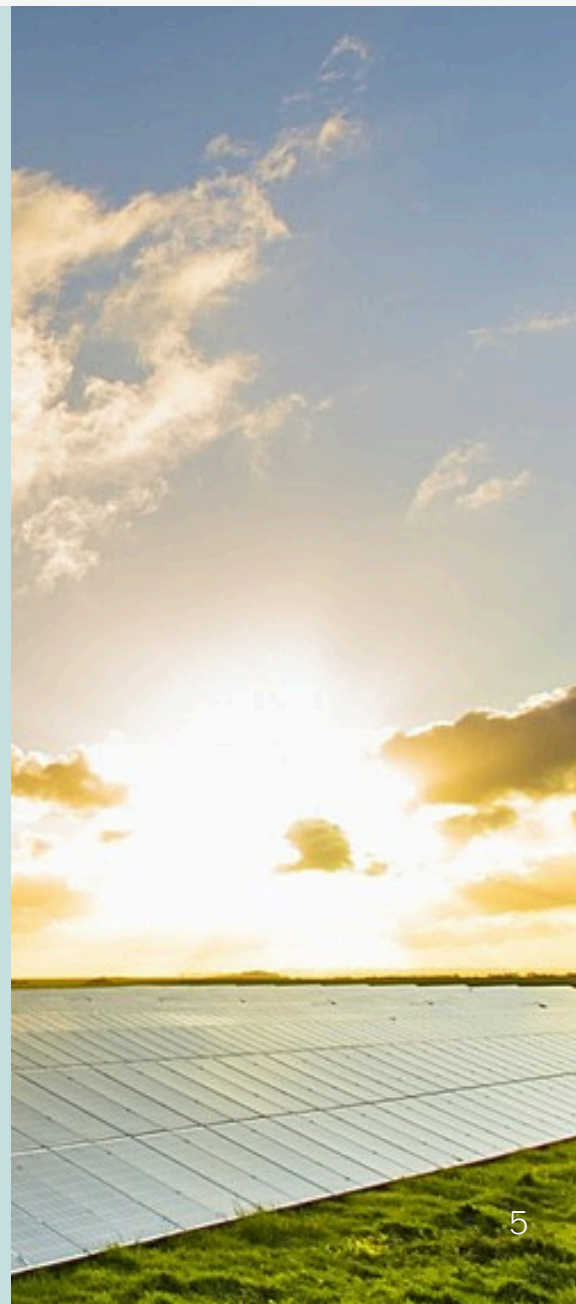


Figure 2: Minimum day-ahead wholesale price and solar PV captured negative price. Source N2EX day-ahead GB power price and internal analysis

There is a limit to where negative prices can go. This is theoretically driven by the alternative revenue streams which is mostly ROCs, CfD (prior to AR4) and REGOs. In theory, ROCs and CfDs could lead to negative prices normally in the range of £50/MWh and £80/MWh (in reality we have seen how prices stay above these levels). In the case of REGOs, its price peaked last year at £25/MWh returning now to lower levels.

What does this mean for the future?

If we look again at the fundamentals of when negative prices occur, these tend to happen during low demand days. National Grid has just released their updated set of Future Energy Scenarios [2] and in all of them electricity demand increases significantly. Figure 3 shows the electricity demand forecasted by National Grid and the range of scenarios. All the scenarios show an increase which by 2050 is at least double compared to 2023 and in some cases it nearly triples. This shows that even with significant additional generation planned, there is a counterbalance emerging on the demand side to reduce the likelihood and impact of negative pricing.



[2]<https://www.nationalgrideso.com/future-energy/future-energy-scenarios-fes>

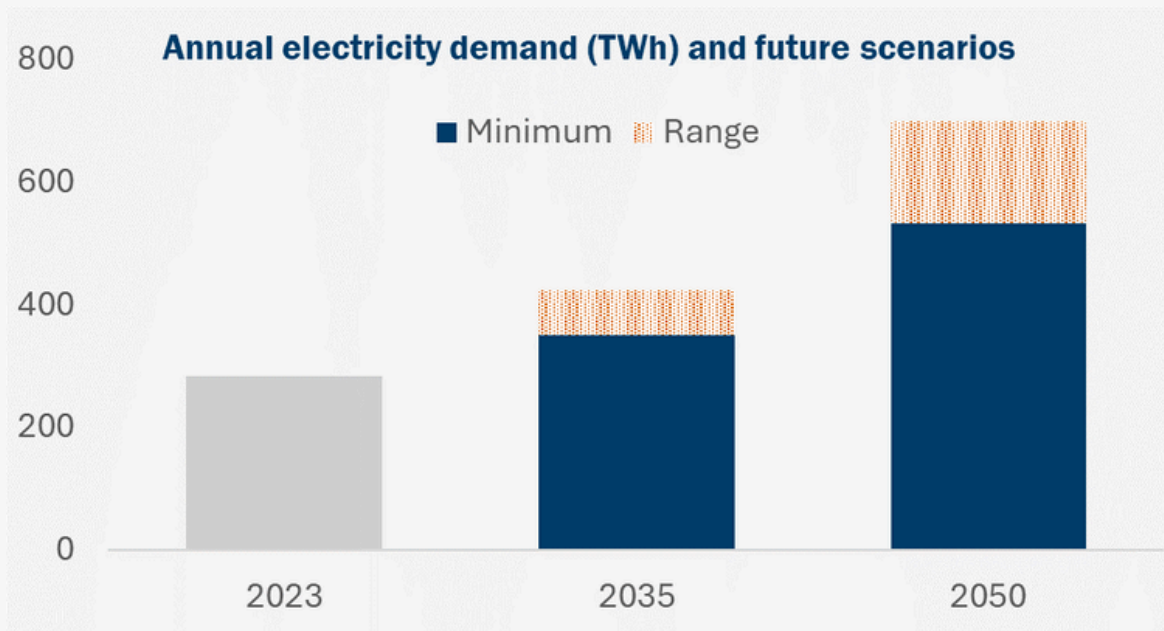


Figure 3: GB annual demand Future Scenarios. Size of the bar represents the range of scenarios. Source: National Grid

The type of demand that is growing the fastest is the flexible demand. This type of applications can target specific periods when prices are low to take power from the grid and therefore, prevents prices from going lower. We have already seen the emergence of increasing flexible demand that provides a consistent counter pressure to negative pricing, these include:

Battery storage capacity in the GB market has increased fivefold since Q1 2020.

Research from Modo Energy[3] indicated that during negative prices on 2nd July 2023 batteries in the GB market charged at 400MW (see Figure 4). Today BESS capacity is over 4GW and it is forecasted to increase to 12GW through 2026 according to the most recent National Grid scenarios forecast.

[3]<https://modoenergy.com/research/battery-energy-storage-operational-profile>



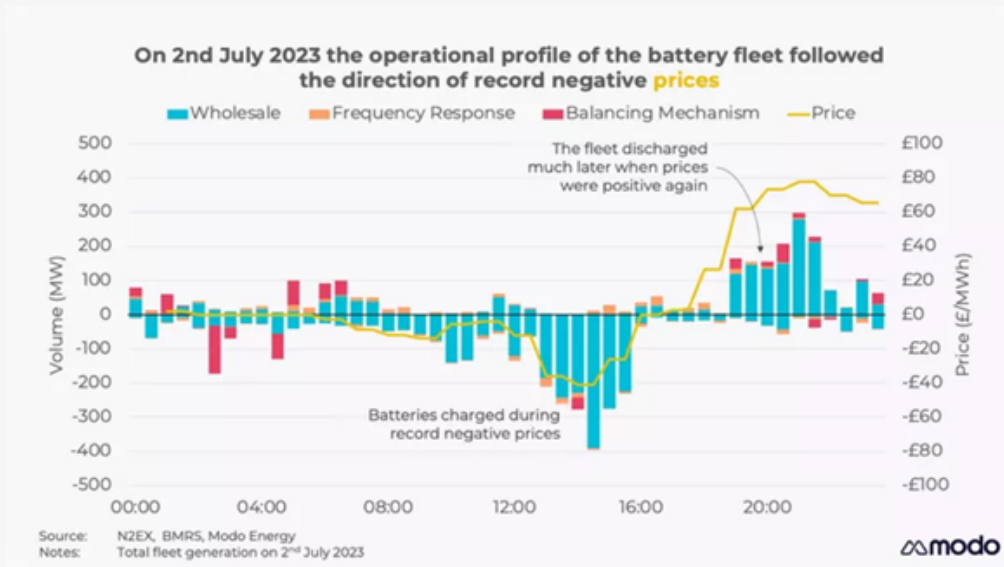


Figure 4: Battery charging during 2nd July 2023. Source: Mod0 Energy. Additional capacity will increase the price during the central hours of the day, reducing the number of negative prices.

Other notable examples are intensive energy users such as data centres.

National Grid indicated that demand from commercial data centres will increase sixfold in the UK ^[5]

fuelled by technologies like artificial intelligence and quantum computing. In Ireland, Data Centres accounted for almost a fifth of the electricity consumed by the entire country^[5] and therefore, concerns about their sustainability are piling up. To tackle this problem Google tested the possibility of running tasks that can be shifted to times of high renewable generation. ^[6] Therefore, not only will demand increase, but it can also be shifted to times of renewable generation.

Other forms of demand flexibility are on the rise too. To date there are 1.1million battery electric vehicles in the UK out of 33.5 million cars on the road. Electricity demand associated with road transport has increased by 5 times since 2020 and it is forecasted by National Grid to increase 10-fold by 2035, from current levels. With electric vehicle flexible tariffs already offered by most suppliers, the demand from these uses alone could outweigh the production of the entire solar fleet in the market.

4 [Transforming the supergrid of the 1950s to a network built on an electrified future for generations to come | LinkedIn](#)

[5] [Data centres use almost a fifth of electricity in Republic of Ireland in 2022 \(bbc.com\)](#)

[6] [Using demand response to reduce data center power consumption | Google Cloud Blog](#)

Additionally, new energy carriers such as green hydrogen (which require large amounts of power to be consumed by electrolyzers) have the potential to add to the mix of price support during renewable periods. Ultimately, higher efficiency in the generation (in this case solar is the lowest cost energy source) drives additional demand. In simple terms, higher level of output (goods, services etc) per same unit spent.

We are in the midst of the biggest transformation in the energy industry in history, displacing greenhouse gas emitting fossil fuels from the system. These market signals, and the demand that follows it, are a natural side effect of the UK driving towards net zero energy system while attracting demand, new industries and jobs with innovative business models whilst delivering energy security, stability and sustainability.

[For more information on BESS systems please follow the link here to NEC/NESF's BESS interactive thought leadership piece](#)

ir@nextenergycapital.com

Phone: +44 (0) 203 746 0700

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