Battery energy storage trading: who pays the price?

Large-scale solar utilities with co-located battery storage – a brief exploration of the business case

Takeaways

- **Solar-only projects will deliver the lowest price electricity – but at a cost to investors.** Systems without battery back-up will produce the cheapest power, but, crucially, they lack flexibility, face high summer curtailment risk, and create stranded assets during parts of the year, undermining returns.

- **Battery storage is essential to reducing curtailment.** Without storage, projections indicate that summer curtailment across a 45GW solar system could reach 450–550 hours per year by 2030, wasting zero carbon electricity and curbing revenues for solar asset owners.

- **Most new solar projects now include co-located battery storage.** Around 90% of new large-scale solar developments plan to pair generation with battery energy storage systems. Recent connection queue reform will jeopardise a significant proportion of co-located schemes.

- **Curtailment avoidance alone does not pay.** Using batteries solely to limit summer curtailment delivers weak financial returns because of high capital costs, typically exceeding £250,000 per MWh.

- **New analysis reveals that the real money will come from trading and 'grid services'.** Side-by-side analysis of the three main solar business models shows that pairing solar with battery storage for energy arbitrage (store or buy low/sell high) and grid services makes storage highly profitable for investors, effectively offering them a 'backdoor' subsidy.

- **Battery storage can generate substantial additional revenue.** Storage assets can earn £50,000–£90,000 per MW per year, often contributing up to half of total project revenue. Storage-based income sits outside the Contracts for Difference regime.

- **The highest investor returns do not align with lowest power costs.** The arbitrage and grid services model delivers the strongest internal rates of return but will increase the levelised cost of energy, keeping electricity prices high for consumers. Analysis based on current pricing shows that the average cost of grid-scale solar/battery complex-provided electricity could be as much as £130/MWh – higher than offshore wind and substantially higher than the past year's overall average grid price of £78/MWh.

- **This creates a policy tension.** Government goals to reduce consumer energy costs will conflict with solar investors' need for flexible, high-value revenue streams.

- **Key takeaway: Grid-scale solar power paired with battery storage will forfeit its 'cheapest' status – average costs are projected to escalate by more than 75%. It will cost more than offshore wind, and significantly more than the past year's average price across the whole grid.**

Battery storage is becoming the profit engine for solar

UK grid-scale solar will not deliver big profits on a stand-alone basis. Developers behind large solar complexes know that they have to double down on their investment to build expensive battery energy storage assets too. These battery arrays will be used to help minimise power curtailment during summer oversupply. But as set out in this paper, their real commercial value will lie in providing 'grid services' and enabling energy arbitrage, both of which can significantly increase revenues. Batteries can be used to buy or store electricity when prices are low and sell when prices spike, as well as earn income from contracted network services – all outside the Contracts for Difference (CfD) controls. Electricity purchased from the grid, stored, then sold back at a profit, will be from any source on the network, including gas.

Now, the National Energy System Operator's (NESO's) reform to the transmission grid connection queue has introduced new risks for developers that depend on co-located batteries to justify their investments. Many are faced with the prospect of losing connection priority, or even being forced to drop their battery build plan altogether. Understanding the role of battery storage in the solar business model, and the cost implications of excluding it, is therefore critical.

New analysis presented in this paper examines three distinct solar models:

- Solar without batteries
- Solar with batteries used solely to minimise summer curtailment
- Solar with batteries used for grid services and energy arbitrage

The results reveal dramatically different business case scenarios. The highest returns will come from the battery assets deployed for grid services and arbitrage – contributing up to 50% of site revenues – but this model comes with clear consequences for energy consumers.

Grid reform puts solar's battery plans at risk

The government has set ambitious targets for solar PV capacity: 45GW by 2030 and 75GW by 2035. Most new capacity is proposed to be land-based, with a trend to employ very large-scale solar facilities ranging from 100MW to more than 1,000MW.

As of early December 2025, NESO's Transmission Entry Connections (TEC) register showed over 90% of proposed large-scale solar projects include co-located battery energy storage systems (BESS). But following NESO's connections reform of December 2025, many schemes will fail to secure a critical Gate 2 connection agreement, which offers a confirmed connection date, location and queue position.

Even where projects do proceed, battery components may be excluded unless they have 'protected status' through existing contracts or demonstrable progress before specified cut-off dates. This creates a material risk to the dominant solar-plus-storage business model now emerging across the sector.

Why solar needs longer duration, costlier batteries

Battery energy storage tech is very expensive. Systems can cost in the region of £250,000 per MWh of storage capacity and in some cases even more. While many existing systems employ 2-hour durations, solar facilities increasingly require longer durations of 4- to 6-hours. Longer-duration storage allows energy generated during the day to be shifted into the evening peak, where it provides greater system value – and attracts higher prices. These systems are naturally more costly to install and beyond 6-hours, costs become prohibitive.

Electricity prices vary every half hour, and operators must respond dynamically to market signals to maximise returns. Greater storage capacity provides greater flexibility to exploit periods of high network prices.

Avoiding curtailment – and exploiting big ticket investment via arbitrage and grid services

Co-located BESS can be operated in two principal ways:

- Export-only, to reduce curtailment in summer
- Import and export, enabling arbitrage and grid services across the year

Solar facilities without battery back-up will be vulnerable to curtailment when the network becomes saturated, particularly during sunny summer periods when demand drops. Saturation can happen at local or regional level but, as large-scale solar build-out rates increase towards the government's 45GW target, by 2030 it will increasingly be an issue for the entire solar fleet at national level.

The first job of BESS is therefore to reduce summer curtailment risk by storing excess generated solar energy and releasing it as demand rises and solar insolation drops – see Figure 1. Modelling suggests that without BESS, a 45GW national system could experience 450–550 hours of curtailment in a year, with a potential value of around £250–£300 million. Curtailment reduces operator revenues and wastes valuable zero carbon electricity potential for the network, while BESS slightly increases the price of electricity by shifting energy to higher-priced periods on the market.

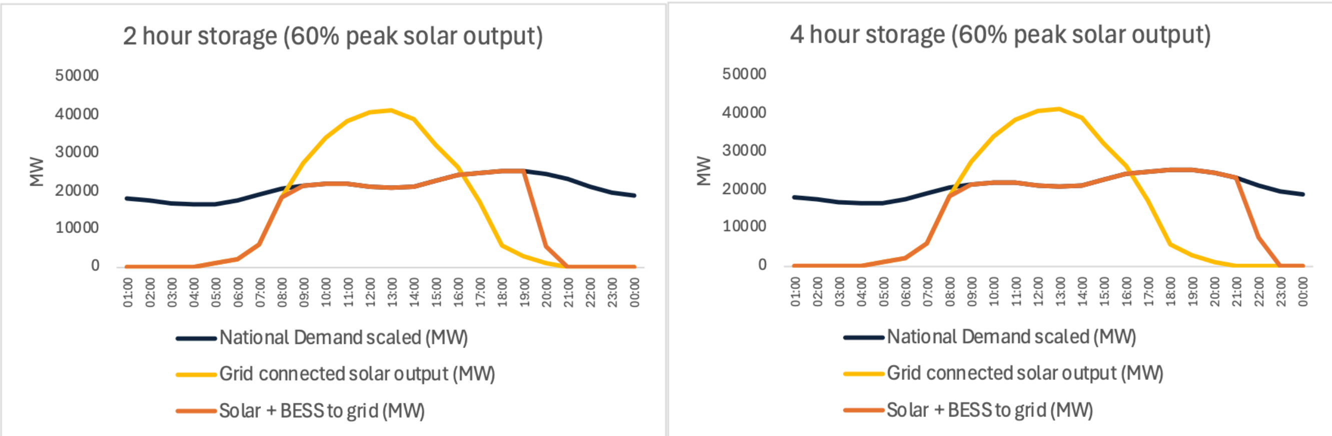

Figure 1 Example of a summer day with peak solar output (for a 2030 target 45GW scenario) exceeding national demand using BESS to mitigate curtailment losses with 2-hour storage (left) and 4-hour storage (right)

But there is a catch. Avoiding curtailment alone does not justify the cost of batteries. Capital costs rise sharply while additional revenue remains limited, resulting in weak returns.

As a result, most developers also plan to use BESS for 'grid services' and energy arbitrage. Crucially, this income stands alone. Under the CfD mechanism, payments are calculated only on eligible electricity generated and metered from a CfD-accredited solar PV-generating asset. Since a co-located battery system stores rather than generating electricity, a whole range of battery-related income is outside the CfD and is not clawed back or adjusted – it is fully retained. This income is derived not just from arbitrage involving electricity stored in batteries charged from the grid during off-peak periods as well as from on-site generation, but from a portfolio of ancillary and flexibility services, such as frequency response, reactive power, wider grid services and Capacity Market payments. Revenues are variable, and asset owners frequently switch between services and arbitrage depending on market conditions. Import and export capability is essential to access these revenue streams.

BESS revenue can range from £50,000 to £90,000 per MW per year in addition to direct solar sales and curtailment avoidance.

New cost-benefit analysis of three solar facility models

An illustrative cost-benefit analysis was conducted for a notional large-scale facility comprising a 500MW solar PV scheme co-located with a 350MW/1,400MWh (4h) BESS system. Generic costs and simplified assumptions were used. Revenue streams are based on the current solar CfD strike price of £75/MWh, with grid services revenue, separate from CfD terms, set at £70,000 per MW as a mid-range estimate. The results are indicative and do not represent a real project. The analysis excludes taxation and mid-life plant replacement costs and is intended solely to show relative differences between operating models.

Figure 2 presents headline results for indicative internal rate of return (IRR), gross (pre-tax) annual profit, and percentage variation in levelised cost of energy (LCOE) relative to the CfD strike price.

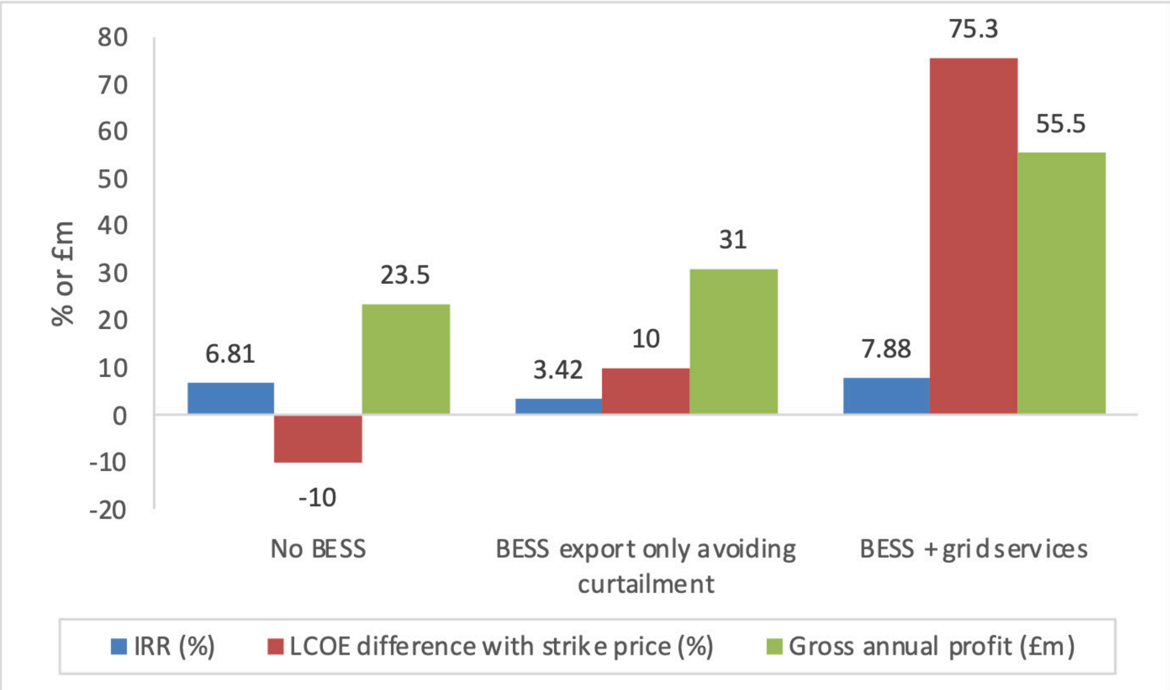

Figure 2 Impact of adding BESS to a large-scale solar PV facility. The example shows assumed curtailment rates of 10%, 4-hour BESS, CfD strike price of £75/MWh, peak sell price of £150/MWh and £70,000/MW grid services income

Profit peaks with batteries – at a price

Analysis of the three models reveals substantial differences in price and profit outcomes:

- Solar with batteries used for grid services and energy arbitrage – will deliver the highest financial returns but pushes the LCOE well above the CfD strike price. It would be more than 75% higher in this analysis, which based on the Allocation Round 7 strike price of £75/MWh could inflate the average cost of grid-scale solar/battery complex-provided electricity to over £130/MWh. This is two-thirds higher than the past year's average grid price of £78/MWh. In this scenario, batteries can contribute up to 50% of total site revenue.

- Solar with batteries used solely to minimise summer curtailment – will increase profit compared with solar-only schemes, but IRR shrinks due to higher capital costs. The LCOE remains above the strike price, though by a smaller margin than with grid services.

- Solar without batteries – will avoid battery installation costs but remains exposed to summer curtailment risks. It achieves the second-highest IRR, yet the lowest profit margin. Its LCOE falls below the strike price, which is how this scheme makes its profit – the cost of generating electricity including operating costs and loan repayments is below what the operator can sell it for. This illustrates that solar PV is cheap relative to other forms of generation, though only as a highly intermittent and inflexible form of supply. Adding BESS improves flexibility – at the expense of higher capital costs and operational price uplift.

Batteries benefit investors – but will raise costs for consumers

This new analysis exposes problematic, conflicting positions.

Solar-only facilities will deliver the lowest-cost electricity to the system yet provide no flexibility and waste zero carbon power during periods of summer oversupply. From a commercial perspective, these assets will effectively be stranded for part of the year, while generating little revenue during the deep winter months. From a policy perspective, they will squander clean energy.

Adding batteries solely to reduce summer curtailment does little to improve this picture, as it offers investors poor returns under current market conditions. By contrast, using BESS for grid services and arbitrage, as well as curtailment control, is highly attractive to investors and can provide genuine value to the network. But this shift fundamentally changes the nature and cost structure of the electricity being supplied. The energy sold from these solar-plus-BESS assets will not necessarily be from a renewable source and it will no longer be the cheapest form of energy on the system – in fact, it will be more expensive than offshore wind, and significantly higher than the average grid price over the past year. As this paper makes clear, storing excess generated solar energy in batteries to trade at peak price on the electricity market serves to decouple it from the CfD strike price. This price decoupling, together with broader energy arbitrage and contract services opportunities, will improve project economics and investor appeal for these large facilities, yet at the same time it ensures that the price of electricity to the consumer remains high. Solar PV systems deployed in this way will not deliver cheap zero carbon electricity, but have a built-in mechanism to ensure the opposite.

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■ Read an important new modelling report revealing the ‘bit part’ grid-scale solar would play in contributing to UK electricity demand and our energy security. In the UK climate, average solar power outputs are much lower than in other countries. A solar site in Spain produces almost double the power of an equivalent complex operating on British soil. In addition, projections expose grid-scale solar’s extreme seasonal supply/demand mismatch ‘trap’. Even with 75GW of installed capacity, grid-scale solar would contribute as little as 13% of annual national electricity demand by 2035 – and during winter months, it would collapse to just 2–3%.

‘Battery energy storage trading: who pays the price?’ is published by Stop Oversized Solar, a coalition of community groups from across the UK countryside. Contact: stop.oversized.solar.uk@gmail.com