Fit4Finance

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Portfolio Bridge

Solar PV and Battery Energy Storage System (BESS)

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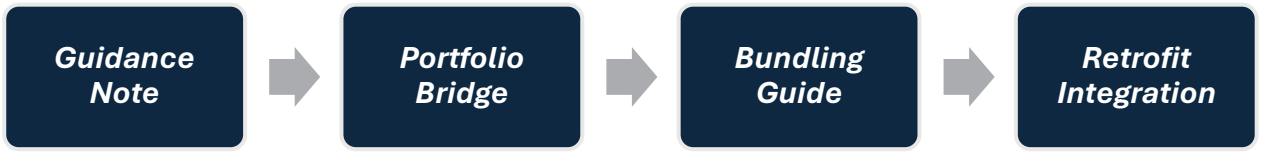
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Purpose of Portfolio Bridge

What is this document for?

The Portfolio Bridge is designed to connect single-technology project guidance with a portfolio-based approach to investment and delivery. Its purpose is to translate individual asset types into a form that allows them to be commercially and financially assessed, combined, compared, and structured as part of multi-asset bundles.

The Portfolio Bridge is designed to be used in the following sequence:



Most forms of external investment and finance are deployed at a portfolio level rather than on small standalone projects. The Portfolio Bridge addresses this gap by explaining how each technology functions within a bundle, which other assets it complements, and how its data, risks, and commercial characteristics should be interpreted at a portfolio level.

Why this document is important?

The Portfolio Bridge is important because it enables consistency and interoperability across different technologies. Without it, projects developed using separate playbooks cannot easily be aggregated, modelled together, or presented to funders in a standardised and credible way. By establishing common portfolio-facing logic, the Portfolio Bridge supports scale, reduces transaction friction, and strengthens the credibility of Local Authority portfolios in the eyes of funders and investors.

What this document does (and does not)

The Portfolio Bridge:

- defines the typical role of each asset type within a bundle (e.g. anchor, support stabilising, enabling)
- sets out which other technologies it naturally complements and why
- explains how the asset bundle contributes to asset development, construction and operation and portfolio economics and risk

The Portfolio Bridge does **not**:

- replace or duplicate the technical and commercial guidance in the single-technology playbooks
- provide specific project designs or engineering solutions
- determine which projects should or should not proceed on a standalone basis
- act as a financing manual or substitute for legal, financial, or technical advice

Instead, it provides the essential connective layer that allows single-asset guidance to be applied coherently within a portfolio and bundling context.

Using this Guidance in Practice

The Portfolio Bridge for Solar PV and BESS should be used as the link between early project identification and the Bundling Guide. It translates individual Solar PV and BESS opportunities into a consistent, portfolio-ready format.

At this stage, projects are often:

- defined inconsistently across teams or technologies
- lacking comparable technical, financial, and commercial assumptions
- unclear in their role within a wider bundle
- not yet ready for investor or funder review

The Portfolio Bridge resolves this by setting out each asset's role, complementary pairings, key risks, revenue pathways and the standard project data required to assess and integrate it within a portfolio. These outputs are then used in the Bundling Guide to group, assess, and progress projects through the finance stage gates.

Asset Pairing

I. ANCHOR/SUPPORT ASSET

Solar is currently the anchor asset in UK co-located solar and Battery Energy Storage Systems (BESS) projects. However, projects currently in planning or construction phases indicate a clear trend toward larger battery storage capacities to optimise revenue streams and grid services indicating that battery storage may in future become the anchor asset in some co-located projects.

The sizing of the solar and storage assets is dependent on:

- Revenue: the relative value of the forecast solar and battery storage revenue streams
- Capital costs: the relative value of the solar and battery storage capital costs
- Regulatory and market drivers: Subsidies, wholesale electricity market prices and volatility, government intervention, grid requirements and market perception of the relative risk of the technologies will all impact the future development of each technology as an anchor or support asset
- Technical constraints: The export / import capacity on the grid

II. SUMMARY

Co-locating solar and battery storage (Bundling) can have significant Financial, Investment, Development, Construction and Operational implications and should be carefully considered on an ongoing basis at each stage of a project's assessment and development.

Bundling solar and battery storage is considered advantageous by many developers, asset owners and investors in the UK due to revenue optimisation and cost reduction opportunities as well as development, construction and operational synergies however the benefits of doing so may be project specific and will also be impacted on an ongoing basis by many factors including:

- Electricity prices and volatility

- Market developments
- Flexibility revenues
- Regulation and market contracts
- Relative capex and opex costs
- Planning and grid
- Investor confidence and market forecasts

Implications	Pros	Cons	When to bundle
Financial	**Development** Double project premiums Shared costs **Revenue** Larger revenue stack Energy arbitrage Uncorrelated revenues Reduced curtailment losses **Capex** Shared grid, inverter and infrastructure costs **Opex** Shared opex costs	**Revenue** More complex revenue stack Increased variable revenue stack (less opportunity to fix) **Capex** Higher upfront cost	**IRR** Forecast IRR exceeds increase in required rate of return **NPV** NPV of bundled project exceeds non bundled; discount rate expected to be higher for bundled asset. Reference listed battery and solar fund discount rates. **Budgeted Expense** Bundled asset is within budgetary constraints
Investment	**Revenue optimisation** Generation optimisation Long term flexibility **Capex & Opex** Cost savings **Pipeline** Project optimisation	**Risk** Enhanced investment risk **Financing** Enhanced financing risk	**IRR & NPVs** When bundled IRRs and NPVs exceed required hurdle rates (Reference listed battery and solar fund hurdle rates) **Risks** When revenue risk can be commercially managed (i.e. long-term contracts at appropriate prices) **Financing**

			Commercial finance is available and affordable **Investment** Bundled assets are acceptable asset class or expected to become acceptable asset class for target investors
Development	**Design** Optimised system design **Planning** Streamlined planning process Integrated planning documentation Enhanced justification **Grid** Shared grid connection	**Design** Increased design complexity **Planning** Increased complexity	**Design** System optimisation outweighs increased complexity **Planning process** streamlined / planning dates not delayed/brought forward **Grid applications** Streamlined / grid dates not delayed/ brought forward
Construction	**Management & Works** Shared infrastructure & civils works and installation **Capex** Cost savings **Environmental** Reduced environmental impact	**Management & Works** Increased build complexity and management **Capex** Higher overall project cost	**Management & Works** Timelines reduced **Capex** Economies of scale Project cost within budgetary constraint
Operation	**Export** Export smoothing Reduced Curtailment Enhanced flexibility **Management & Operations** Single asset manager Operational synergies (combined site	**Management & Operations** Enhanced asset management required Higher qualification/skill requirements	**Export** Co-location alleviates demand on National Grid **Management & Operations** Qualified asset managers are available

	visits/reporting for bundled assets)		Operational synergies
Trends	**Intermittency** Increased forecast intermittency	**Large Battery Pipeline** Increased battery pipelines make forecasting difficult	**Intermittency** Forecasts expect intermittency and battery revenues to increase / support IRRs **Pipeline** Forecasts expect pipeline to undermine standalone project revenue streams and IRRs

III. FINANCIAL

Development Pros:

Double Project Premium: The potential for double project premiums for solar and battery storage co-located sites coupled with development, operational and financial benefits has led to a significant proportion of the UK's solar pipeline being co-located with storage.

Shared Planning / Environmental and Technical Studies: Planning application and required assessments may apply to both assets and can be combined

- Planning (statement, design and access, EIA, screening/scoping) (one set of professional fees)
- Ecology surveys
- Landscape and visual impact assessment (LVIA)
- Flood risk assessment
- Cultural heritage and archaeology
- Transport and construction traffic assessment
- Noise assessment

Revenue Pros:

Larger revenues compared with single technology site.

Energy arbitrage low value energy generation can be stored and sold during high price periods.

Uncorrelated revenues acting as a natural "hedge". Energy price volatility and negative pricing is a benefit to BESS asset revenue streams and risk profile and a negative to solar asset revenue streams and vice versa.

Reduced curtailment losses excess solar generation can be stored instead of curtailed during congestion or negative price periods.

Revenue Cons:

Complex Revenue Stack: More difficult to forecast.

Higher Variable Revenue Stack: 100% of the solar revenue can be fixed for periods of between up to 30 years either, often at a limited discount to merchant forecasts (particularly for shorter term fixes). For battery storage fixed tolling agreements and floors exist for battery revenue streams but they are often at a significant discount to unfixed revenue stacks and for relatively short periods.1

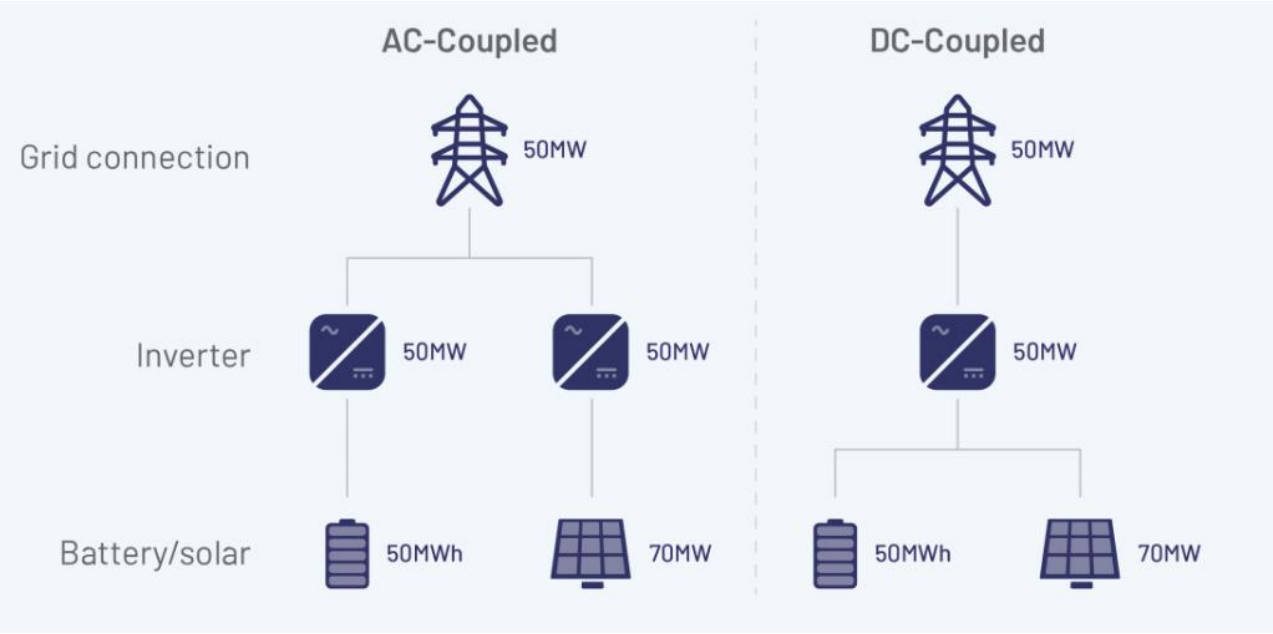
Capex Pros:

Grid: Payments to secure grid connection, and later to install physical grid related equipment can be shared between the two technologies. These costs are based on a project's required grid capacity, not how much power travels through it. Combining two technologies to more thoroughly utilise a grid connection is therefore an efficient way of achieving economies of scale.

Inverters: The number of inverters can be reduced if the solar and BESS elements can be 'DC-coupled' (i.e. they are connected "behind the meter" and before the inverter, without the Direct Current being converted into Alternating Current).

Shared Infrastructure: Fencing, roads, transformers, substation and SCADA (Supervisory Control and Data Acquisition) systems can be shared between projects.

Figure 1[2]



[1] **Pexapark: What is a PPA/Guide to PPAs**

[2] **https://greshamhouse.com/news-media/collocation-a-smart-solution-for-the-uk-energy-transition/**

Capex Cons:

Higher Upfront Capital Requirements: Solar ~£600k/MW; Solar + Battery ~£1,100/MW3

Operational Cost Benefits:

General: Co-located projects will typically be able to achieve operational cost efficiencies from two technologies co-habiting the same site.

Lease Costs: Relative to separate standalone projects reduced lease costs per project

O&M Costs: Relative to separate standalone projects reduced costs per project, contractors should be able to combine site visits across technologies and monitoring should be achievable under a single contract.

IV. INVESTMENT

Co-locating solar and battery storage can maximise investors' returns by increasing revenue potential, lowering costs and enhancing long term asset value.

Overall investment risk however is higher with a co-located installation which is why listed solar funds typically cap their battery storage allocation at between 10-25% of Gross Asset Value.4 5

Investment Pros:

Revenue optimisation: Price arbitrage, curtailment and negative price management.

Generation optimisation: Surplus generation can be stored rather than curtailed.

Cost Savings

Shared development costs: Development savings

Shared infrastructure, grid and inverters: Capex savings

Shared operating costs: Opex Savings

Long term flexibility: As solar penetration increases long term margins may decline due to electricity price cannibalisation, conversely as renewable penetration increases battery storage margins may increase as increased flexibility services are required and price volatility increases. Co-located solar and battery storage projects will be better placed to mitigate the impact of price cannibalisation and adapt to evolving market rules and pricing structures than standalone projects.

Investment Cons:

[3] **Modo Energy Research Round Up August 2024**

[4] **Nest Energy Solar Fund Annual Report 2025**

[5] **Foresight Solar Annual Report 2024**

Investor Preference

Many investors prefer to keep technologies unbundled to facilitate risk assessment and fund allocation. Bundling technologies together may therefore complicate funding.

Enhanced Risk

The key drivers of solar investment return are capex, yield and electricity price and all of these can be significantly derisked.

Capex and construction risk can be largely passed onto the EPC contractor

Yields at a project level should be within ~5% of forecast.

Electricity price the electricity price can be fixed under long term Contracts for Difference (20 years in Allocation Round 7)6 or up to 30 years in corporate power purchase agreements (although more typically at between 5-15 years). The cost of fixing the electricity price is not necessarily at a significant discount to merchant prices as the other side of the contract is also benefitting from reducing their risk to electricity price volatility and potentially a reducing their exposure to non-commodity costs.

The key drivers of battery investment return are capex, operating performance of the battery and the price for services.

The operating performance of batteries and their ability to enter different revenue stacks some of which do not yet exist is still relatively untested.

Battery revenue stacks are varied and should increase renewable energy deployment and an increase in intermittent electricity supply. However, they are also highly uncertain and will be sensitive to the level of battery storage deployment.

Risk Mitigation:

Revenue Smoothing: Batteries can mitigate solar price cannibalisation by shifting power output to higher-value hours. Batteries can also reduce exposure to negative prices which are expected to be increasingly frequent with renewable energy penetration.

Increased revenue streams (with various durations and predictability)

Uncorrelated revenues acting as a natural "hedge". Energy price volatility and negative pricing is a benefit to BESS asset revenue streams and risk profile and a negative to Solar asset revenue streams and vice versa.

Reduced curtailment losses excess solar generation can be stored instead of curtailed during congestion or negative price periods.

Long Term Contracts: Both solar and battery storage projects can be de-risked by introducing long term contracts to guarantee a proportion of their revenues. This can be achieved in the following ways.

PPA: can offer (10 year plus) security of income by fixing a guaranteed price per MWh of power generated by the solar project (with potential for inflation-linkage)

[6] **PV Magazine**

Contract for Difference (CfD): 20 year (Allocation Round 7) government backed contracted revenues for renewable energy projects.[7] [8] [9]

BESS optimisation floor: long-term (up to 10-year) minimum profit floor guaranteed by the optimiser trading the BESS.

Capacity market: 15 year contracted revenues for the BESS element available from National Grid (subject to auction).[10]

Tolling Agreements: Battery storage asset owners can receive a fixed long term fee for operational control of the batteries to an optimiser, effectively turning variable cashflows into fixed cashflows.[11]

However it should be noted that battery storage contracted revenues are generally at a higher discount to the prevailing market price and for a shorter duration reflecting the perception of increased risk associated with battery storage revenue streams.

V. DEVELOPMENT (Design/Planning/Grid/Build)

Design Pros:

Optimised System Design: Co-locating solar and battery storage allows the design to maximise the energy capture, storage and dispatch efficiency.

Design Cons:

Increased Complexity: Co-locating solar and batteries increases complexity with regard to inverter selection and sizing, avoid shading and maintain safe distances for fire and safety.

Planning Pros:

Streamlined Planning Process: Submitting a single planning application for both solar and battery storage reduces duplication of effort and administrative costs.

National Significant Infrastructure Project (NSIP) Removal: Projects exceeding 100MW are deemed NSIP projects with applications made to the Secretary of State rather than the Local Planning Authority. NSIP

[7] **Smartest Energy: CfD AR7 results**

[8] **Catapult: (AR7) Results and Analysis**

[9] **Osborne Clarke: The Energy Transition**

[10] **Service.gov.uk: Capacity Market frequently asked questions: 2025**

[11] **Gresham House Media**

applications are typically slower and more expensive. From 2020 battery storage and co-located storage was removed from the NSIP regime removing this legislative impediment to co-location.12 13 14

Integrated Planning Documentation: Impacts such as visual, noise and ecological effects can be assessed collectively reducing overall mitigation requirements.

Enhanced Justification: Demonstrating that storage complements the solar installation can strengthen the planning application due to:

- Alignment with UK government energy policy (supporting renewable integration and grid flexibility)
- Efficient land use
- Visual impact is incremental, not new

Planning Cons

Fire and Safety Concerns: Battery systems have stricter fire safety requirements than solar panels

Consent Complexity: Environmental consents may become more complex with increased visual, heat and chemical risk considerations.

Grid Pros:

Shared Grid Connections: Solar and battery storage can use the same grid connection point, simplifying grid applications and may improve connection capacity utilisation.

VI. CONSTRUCTION

Build Pros:

Shared infrastructure and reduced civil work: Fencing, access roads, internal roads, civils works and security can be shared between solar and battery components.

Simplified electrical integration: AC/DC cabling, switchgear, transformers can be installed together.

Cost savings: See Financial Benefits.

Accelerated commissioning and testing: Co-location alongside sufficient onsite demand may negate the need for an export connection and avoid potential lengthy grid connection queues. Solar output can be tested immediately, allowing early detection of design or performance issues.

Reduced environmental and regulatory impact: Combined projects reduce soil disturbance, vegetation clearing and dust generation over separate builds.

Build Cons:

[12] **Solar Power Portal: Revised Planning Guidance**

[13] **Solar Power Portal: Battery Storage Legislation**

[14] **Osborne Clark: Changes to Planning System**

Increased Complexity: More complex electrical design and protection, larger substations and protection equipment required.

VII. OPERATION

Export Smoothing: Solar and battery storage have complementary export profiles and would typically expect to export power to the grid at different times of the day, meaning that co-locating the two technologies smooths export to the grid and efficiently uses a single grid connection point, whilst allowing each technology to commercially operate optimally.

Figure 2 [15]



1. BESS dispatches to the grid at a high-power price period before solar generation is available (not yet daylight)
2. Solar dispatches to the grid during the day, contributing to low power prices (linked to increased supply on the system). BESS charges during this low power period. This could be from the grid, or (depending on the design) by using any solar generation which exceeds the grid capacity and would otherwise be wasted (or "spilled")
3. BESS dispatches at a period of peak power price and high demand, as solar generation falls in the evening.16

Reduced Curtailment: Most UK solar projects are oversized vs their grid connection because they will rarely be exporting at full capacity. This means that when they are generating at full capacity, particularly during daytime in summer months potentially export has to be capped. Solar projects co-located with storage allow the excess generation to be stored and released to the grid later when generation from the solar project is lower. Co-locating solar and storage also allows a solar project to avoid negative price periods where the generating unit

[15] **Gresham House: Collocation-a-smart-solution-for-the-uk-energy-transition**

[16] **Gresham House: Collocation-a-smart-solution-for-the-uk-energy-transition**

would either have to pay to generate or shut off its export. Negative pricing is expected to become increasing significant in the UK as the electricity grid is decarbonised.17

Operational Flexibility: Co-located solar and battery storage projects can dynamically switch operating models, increasing commercial resilience to short and long term market and regulatory changes.

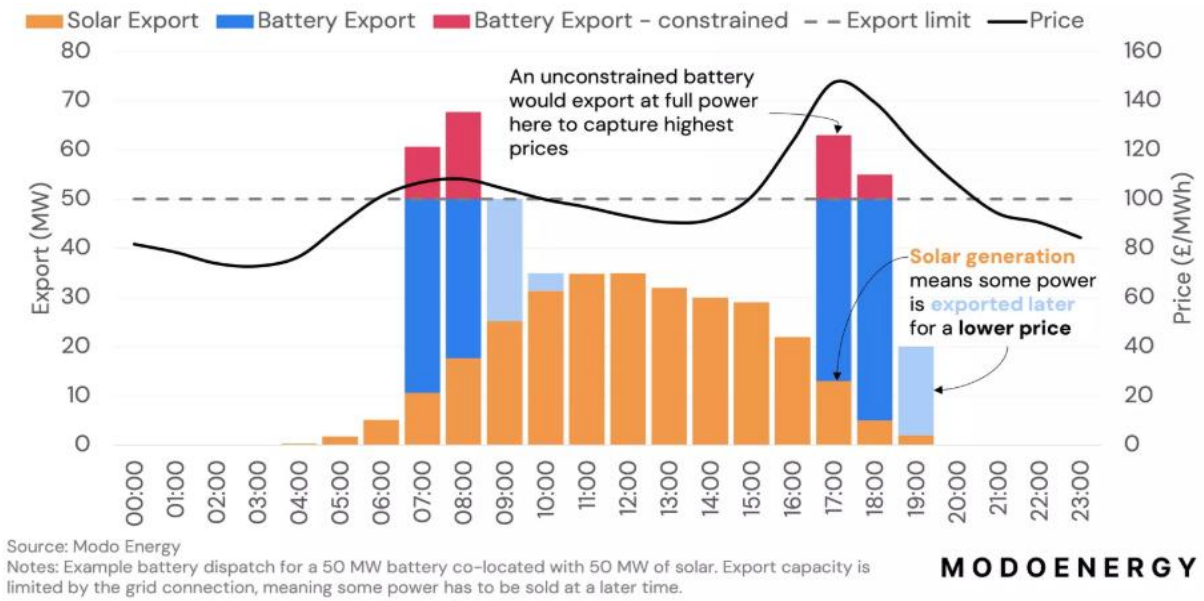
- Energy Markets: charge from solar (or grid) when prices are low and discharge when high and reduce exposure to negative prices.
- Ancillary Services: switch to prioritisation of ancillary services where prices dictate prioritisation.

Asset and Operation Management: Co-located solar and battery storage systems can be managed by a single asset and technical manager reducing costs and increasing scale and co-ordination.

- Single site control room and monitoring
- Combined financial, technical and regulatory reporting
- Combined capacity site providing economies of scale
- Co-ordinated site and O&M management

Limits of Co-location: While co-location can smooth export, reduce curtailment and improve operational flexibility, it is not a perfect solution to the challenges of intermittent generation and a constrained grid and depending on the sizing configuration of the solar and battery storage there will still be peaks and troughs in export, a degree of curtailment, potential exposure to negative prices and a limit to the operational flexibility of the installation.

Figure 3



Source: Modo Energy
Notes: Example battery dispatch for a 50 MW battery co-located with 50 MW of solar. Export capacity is limited by the grid connection, meaning some power has to be sold at a later time.

[17] **Solar Power Portal: aurora-bess-successful-as-negative-price-periods-increase**

VIII. TRENDS

There is currently 6.8GW of battery storage in the UK, the government's Clean Power 2030 Action Plan estimates that between 23-27GW of battery storage will be required by 2030 and National Grid ESO forecast that over 50GW of energy storage will be necessary to reach net zero by 2050.18 19 20

This would indicate that at current rates there will be an increase in intermittency and potential battery revenue streams.

However, there is currently 60GW of consented battery storage capacity and a total pipeline of 127GW indicating that the current pipeline of projects exceeds the actual battery storage requirement and while there are significant hurdles in increasing deployment in the form of grid connection delays, insufficient manufacturing capacity, high upfront capital costs and uncertain revenue streams any oversupply of battery storage projects is likely to have a significant negative impact on battery storage revenues and the benefits of bundling.

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0.1	15-JAN-26	Draft	Ed Goldsworthy and Nicholas Sia Han Ming	Justin Olosunde	07-AUG-26
1.0	**30-SEP-26**	**Version 1.0**	**Nicholas Sia Han Ming**	**Dora Hargitai**	**30-SEP-26**

[18] **Renewables UK: Energy Pulse: Where the UK battery market stands in 2025**

[19] **www.gov.uk: clean power 2030 action plan**

[20] **Renewablers UK: why-battery-energy-storage-systems-are-crucial-to-the-uk-s-clean-power-future/**