# **PV and BESS co-location:** sizing the battery for the best investment case

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**As solar revenues come under pressure from lower capture prices, negative pricing, curtailment and grid congestion, hybridising PV assets with BESS is becoming a concrete way to defend and improve project economics. The value case depends on choosing a battery configuration that fits the site, the grid connection and the revenues the asset can realistically capture.**

## 1. Introduction

Across the UK and Europe, renewable generators are increasingly exposed to grid constraints, curtailment and periods of negative pricing. As solar penetration rises, a larger share of generation is produced during the same daylight hours, when market prices are more likely to be low or negative. In parallel, local grid constraints and curtailment are becoming more visible in several markets. Annual production remains important, but project economics increasingly depend on the value captured from each MWh and the asset owner's ability to manage exposure to low-price or constrained periods.

Co-locating battery energy storage systems (BESS) with existing solar PV and wind farms has emerged as a critical strategy to manage these risks and unlock additional value. A battery can shift part of the asset's output into higher-value hours, reduce the economic impact of curtailment where the site configuration allows it, and create access to additional revenue streams such as intraday optimisation and ancillary services. This is particularly relevant for operating assets, late-stage development projects and repowering situations, where land, grid access and an existing renewable production profile may already be available.

This white paper outlines how Natural Power and Forsyt Energy assessed BESS co-location for a 9 MWp solar PV asset in France. The work combined Natural Power's site-level technical advisory with Forsyt Energy's market modelling and investment valuation capabilities. The objective was to identify which technically feasible battery configuration created the strongest market-facing investment case for this asset under the assumptions tested.

## 2. Why co-location matters now

Battery sizing is the central investment question in a co-location project. The value of a BESS depends on the relationship between power capacity, energy duration, operating strategy and cost. A smaller battery can be capital-efficient but may leave flexibility value uncaptured, whereas a larger battery can access deeper revenue opportunities but may dilute returns if the additional revenue does not justify the additional CAPEX.

Trade-offs are highly asset-specific. The optimal configuration depends on the shape of the PV generation profile, timing of curtailment, export capacity at the grid connection, available land, battery performance, degradation, and the market products available to the asset. Operating strategy also matters: a battery operated mainly to support renewable generation can produce a very different financial outcome from one allowed to optimise across wholesale, intraday and ancillary service opportunities.

A robust sizing assessment therefore needs to compare credible configurations on a consistent basis. The technical work defines the options that can be built and the constraints they must respect. The commercial modelling tests how each option performs once dispatch behaviour, market revenues, CAPEX, OPEX and degradation are considered. This analysis gives the asset owner a practical basis for moving from a broad co-location opportunity to a specific investment decision.

## 3. We assessed three BESS+PV sizing configurations in France

The study compared three BESS size configurations to quantify the duration trade-off: how much extra value is created by a longer battery, and whether that additional value is sufficient to justify the cost and operating implications.

| | BESS Installed Capacity | BESS Power Output | PV Installed Output | Grid Access Power |
|---|---|---|---|---|
| Scenario 2h | 10 MWh (2h) | 5 MW | 9 MWp | 5 MW |
| Scenario 3h | 15 MWh (3h) | | | |
| Scenario 4h | 20 MWh (4h) | | | |

This way, the same project opportunity is assessed under different battery sizes and operating rules, with outputs expressed in annual revenues by product, simplified EBITDA IRR, NPV and payback. The comparison identifies the configuration that is most coherent for this asset under the modelled assumptions

## 4. Natural Power expertise

Natural Power assessed the project from the technical and site perspective. This included reviewing the solar PV asset, its energy yield, the observed curtailment context and the technical constraints that determine whether a BESS can be added to the project area. The work established the technical envelope within which commercial modelling could be carried out.

Natural Power then defined the feasible BESS configurations and the key assumptions required for valuation, including sizing, performance parameters, CAPEX, OPEX and relevant site constraints. This step is essential because BESS value cannot be separated from the physical asset. The market model needs a realistic representation of what can be installed and how the battery would interact with the existing PV plant and grid connection.

This provided the technical foundation of the case study: a set of credible configurations, grounded in the site and suitable for comparison. It allowed the analysis to focus on investable options rather than theoretical battery sizes.

## 5. Forsyt Energy expertise

Forsyt Energy provided the market modelling, dispatch optimisation and investment valuation layer of the assessment using its ValuationPro platform. Forsyt built a project-specific model of the co-located PV and BESS asset and assessed how each configuration could operate across relevant revenue streams, including Day-Ahead, Intraday and ancillary services.

The modelling translated battery operation into financial performance. It accounted for battery limits, state of charge, efficiency losses, degradation, availability, cycling, curtailment and grid constraints. This allowed revenues to be assessed based on feasible operation rather than theoretical market spreads. It also made the trade-offs visible: using the battery for one purpose can reduce its availability for another, and the highest-value strategy may not always be the one that absorbs the most curtailed PV.

Forsyt then converted the modelled dispatch and revenues into investor-ready outputs, including annual revenues by product, revenue-stack evolution, full-life cashflows, IRR, NPV and payback. ValuationPro can be used directly by clients as a subscription-based platform to assess their own BESS, co-location and hybrid projects, or deployed by Forsyt within assignment-level advisory work where Forsyt delivers the modelling, interpretation and investment outputs.

## 6. Results

### 6a. Results of the comparative analysis

The three technically feasible configurations produced EBITDA IRR estimates between 13.7% and 14.6%. The range is narrow enough to show that all three options remain commercially relevant, but wide enough to influence the sizing decision. Scenario 3h ranked first in this assessment, although the margin versus Scenario 4h is limited and should be tested through sensitivity analysis before being treated as a final investment.

| Configuration | Simplified market-facing IRR estimate* |
|---|---|
| Scenario 2h | 13.7% |
| Scenario 3h | 14.6% |
| Scenario 4h | 14.3% |

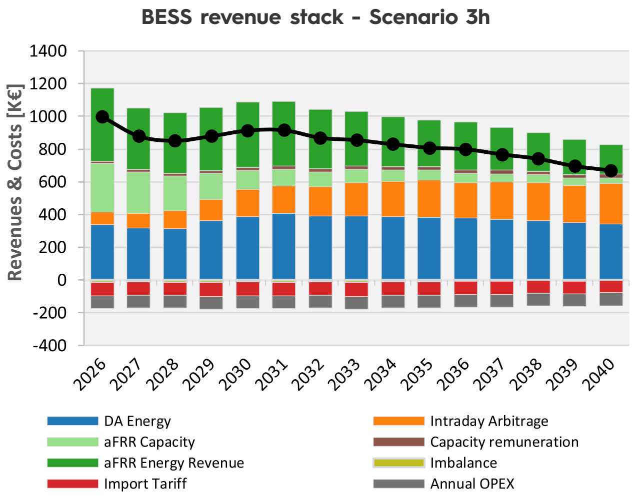
The comparison shows the sizing trade-off clearly. Additional battery capacity or duration only improves the investment case when the incremental revenue capture is sufficient to compensate for the additional cost. In this study, Scenario 3h delivered the strongest balance between revenue capture and capital intensity under the assumptions tested.

The result should be read as asset-specific. The preferred configuration may change with the PV generation profile, export limit, curtailment pattern, battery cost, degradation assumptions, ancillary service access and long-term price outlook.

### 6b. Representative view of the central market-driven case

The scenario table shows the ranking of configurations; the annual revenue stack explains the value behind that ranking. The figure below presents the **3h RES+BESS market-driven configuration** as a representative case, showing annual revenues by product, market-facing costs and resulting cash flow over the modelled period.

The revenue mix changes materially over time. aFRR capacity revenues are high at the beginning of the horizon, but decline as market depth increases and cannibalization reduces both pricing and achievable capture. Intraday arbitrage moves in the opposite direction, becoming more important over time as price dispersion and short-term flexibility increase.




This evolution is important for the investment case. The asset is not relying on one static revenue pool: value gradually shifts across products. Net cash flow remains positive throughout the period, but declines toward 2040, showing why a co-location assessment needs to model both the initial revenue stack and how that stack evolves over the asset's life.

**6c. From model result to investment decision**

The IRR and NPV figures are simplified market-facing investment metrics. They include modelled market revenues, market-related costs, CAPEX and OPEX. They exclude financing structure, tax, accounting treatment, working capital, transaction costs, shareholder-level items, and final project-specific contractual terms.

This level of analysis is useful for sizing because each configuration is assessed on the same basis. It helps identify which option deserves further development, which revenue pools drive value, and which assumptions need validation before detailed financing, procurement, legal structuring and contracting.

Battery sizing remains asset-specific. The preferred configuration depends on the PV generation profile, curtailment pattern, export limit, market access, degradation assumptions, cost base, and price scenario. A robust co-location study makes those dependencies explicit and gives the project team a clearer basis for the investment decision.

*Simplified pre-tax, unlevered market-facing IRR estimate based on modelled market revenues, market-related costs, CAPEX, OPEX and degradation assumptions. Excludes financing structure, tax, accounting treatment, working capital, transaction costs and final project-specific contractual terms.

## 7. Conclusions

Co-location is becoming a practical response to the pressure on solar capture value. For asset owners, the question is no longer only whether a battery can be added to a PV site, but which configuration improves the project's economics after costs, operations and market access are considered.

The case study shows why sizing needs to be treated as an investment decision. Under the assumptions evaluated, the scenarios produced different returns and a different revenue mix over time. That difference is large enough to matter: battery duration, dispatch strategy, and cost assumptions can change which option deserves further development.

Natural Power and Forsyt Energy bring the two sides of that decision together. Natural Power defines credible site options and technical constraints. Forsyt Energy quantifies dispatch, revenue capture, and market-facing economics through ValuationPro. The result is a clearer basis for deciding which co-location configuration should be taken forward.

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