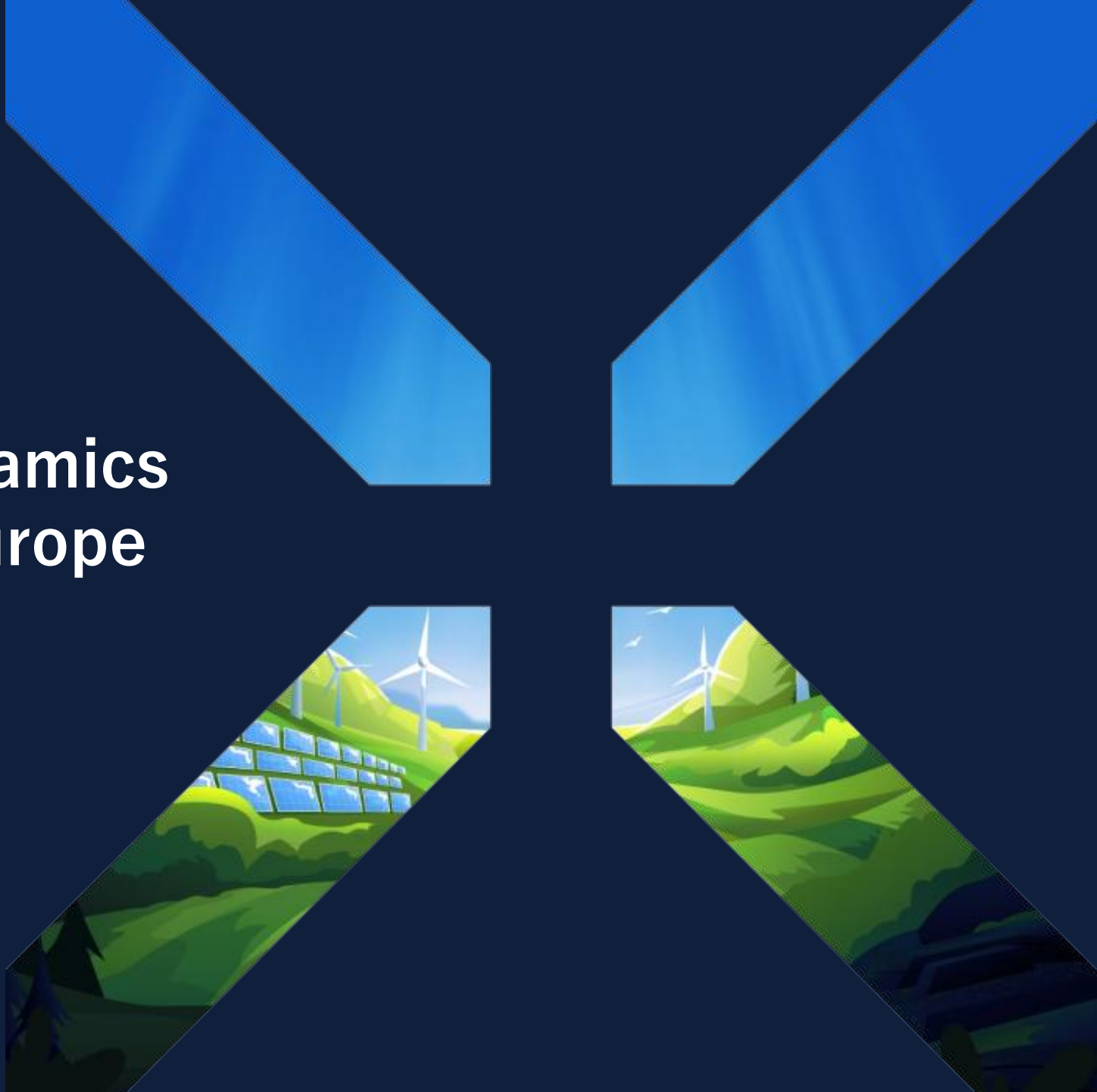


Co-location market dynamics and offtake trends in Europe and Germany

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August 2025



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BESS PPAs supported

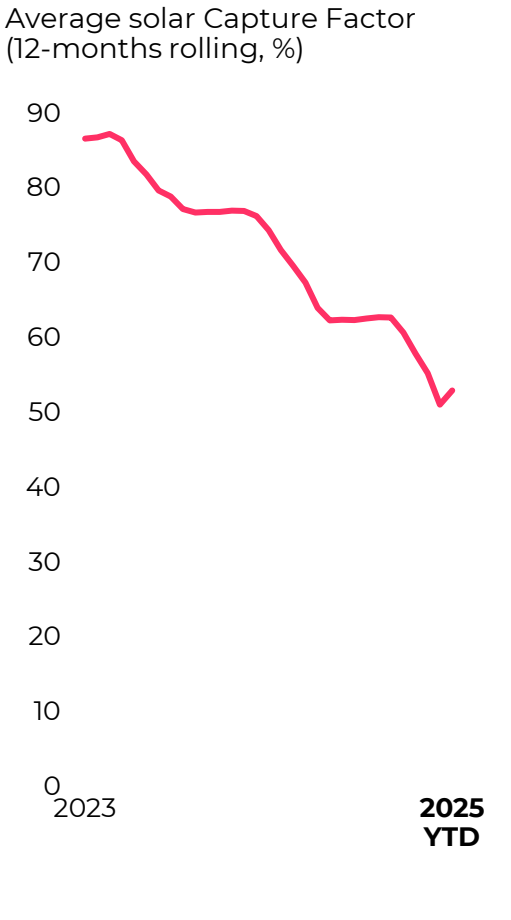
20+
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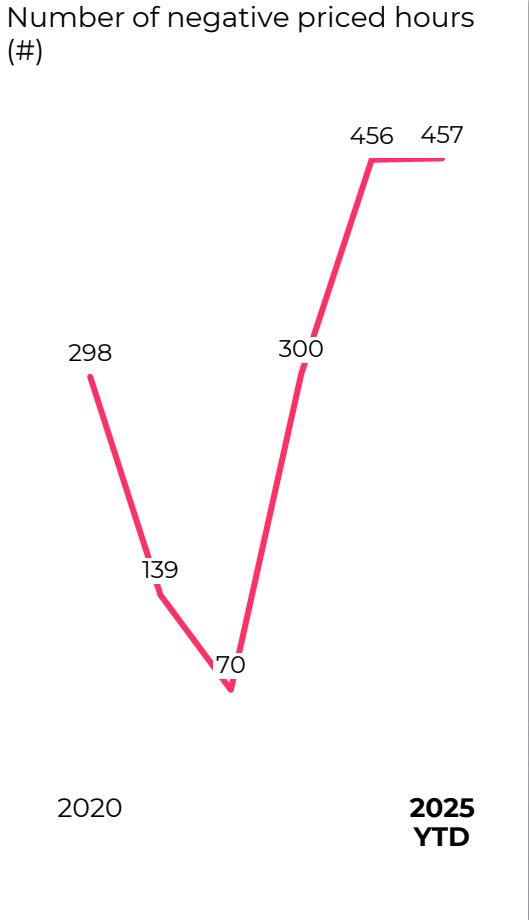
2+
TWh/year portfolio
optimized

Why co-location?

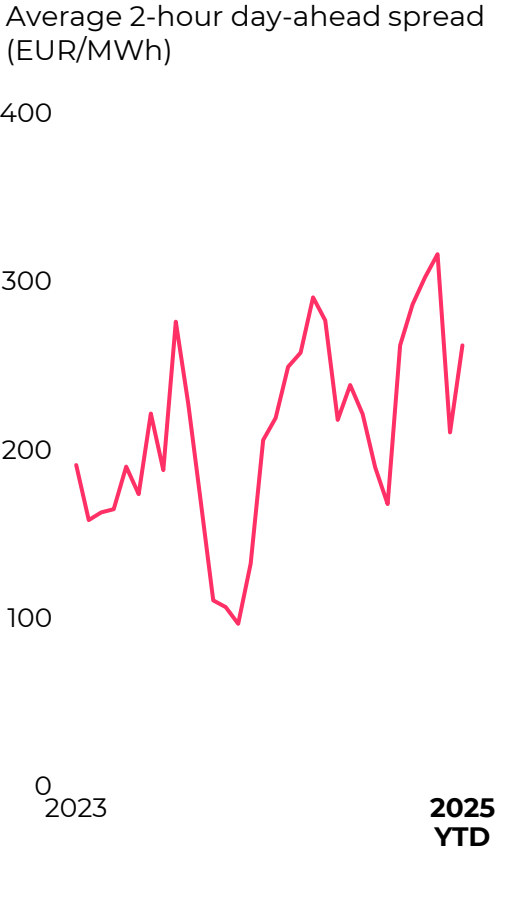
Decreasing value of solar profile



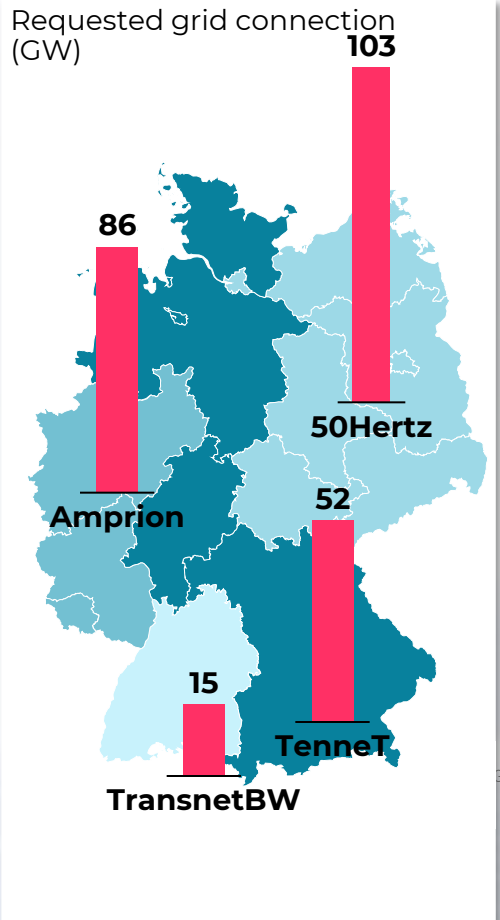
Increasing number of negative priced hours



More volatility

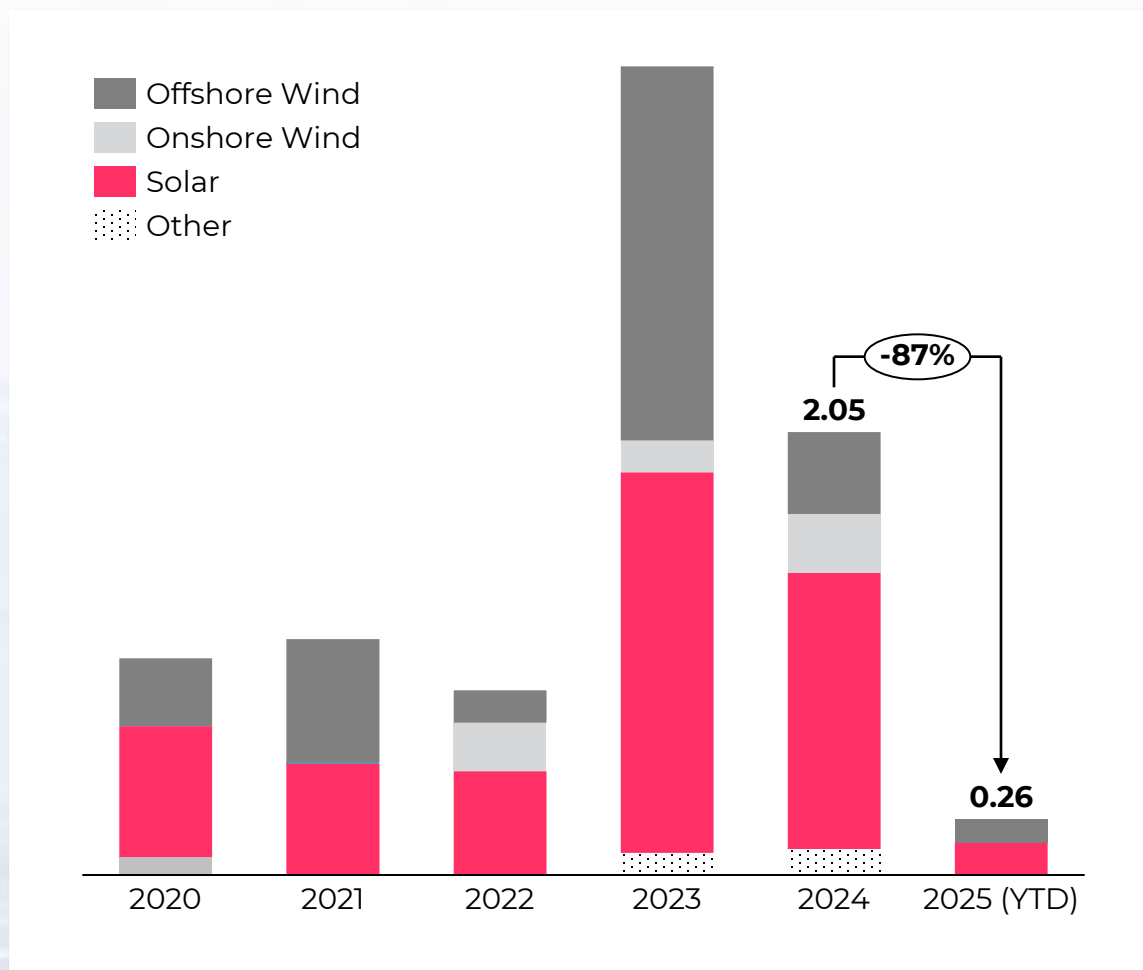


Clogged TSO grid connection queues



The German solar PPA market under distress

Long-term PPA deal volumes in Germany
GW

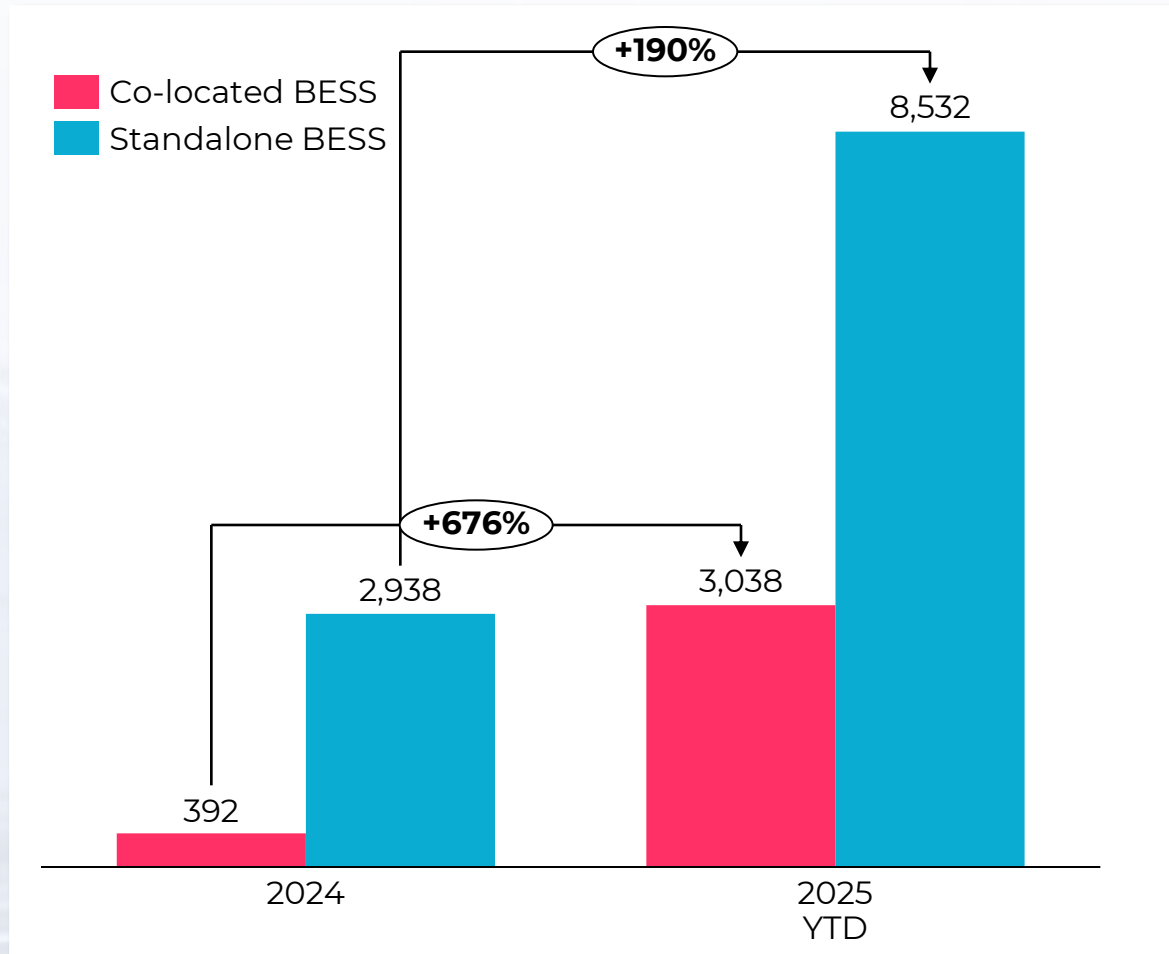


- **Rising solar penetration** depresses the relative value of midday hours while making shoulder hours comparatively more expensive. This widening price spread signals **a structural shift in market dynamics**
- In 2024, **up to 82% of the negative hours occurred during solar generation**. Curtailing during these hours would impact about **18% of their total annual production**³.
- PPA offtakers have difficulties to estimate **how long** it will take for the market to adapt to these phenomena, and therefore **price in the cannibalization and negative price risks** conservatively, depressing PPA price levels, or shy away from taking these risks altogether

Commercial activity centers around standalone, but co-location deals are gaining traction

Disclosed capacity across all BESS offtake and optimisation structures

MWh



- **Co-located BESS dealmaking activity is accelerating** with over 3 GWh of disclosed capacity contracted in 2025 so far (including a mega-deal in Bulgaria) - up sharply from 360 MWh in 2024 and just 80 MWh in 2023.
- However, **standalone projects still dominate** with 8.5 GWh contracted this year compared to roughly 5.5 GWh in 2023 and 2024 combined.
- **BESS offtakers prefer standalone structures** - particularly utilities favour fixed-payment contracts to gain access to flexibility while avoiding the costs and complexity of co-location.
- **Co-located deals remain mostly merchant** as asset owners aim to maximise revenues across the revenue stack with flexible trading strategies. However, we expect appetite for hybrid PPA formats to increase to tackle diminishing demand for solar profiles.

Co-location trends across markets: Different arrangements have emerged



Co-located BESS mostly on merchant terms with solar separately backed by CfD subsidies or PPAs

- PV + BESS co-location has made strides in GB, **almost 70% of solar PV projects** granted planning permission in GB in H1 2025 were co-located with BESS.
- Separate commercialisation + metering common: BESS asset typically optimised separately across the whole revenue stack to maximise value; while the solar asset is often marketed separately under government CfD and a route-to-market PPA.

Example



50 MW BESS optimisation
+ 66 MWp PV PPA



Innovation Auctions driving co-location volumes – new regulatory framework paves way for co-location under EEG

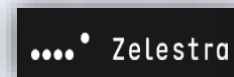
- The Innovation Auctions have supported more than **700 MW of BESS co-located with solar** since 2021, however, no grid charging is allowed in this segment
- A reform on enabling full optimisation of BESS co-located with EEG renewables has been initiated.
- Adoption of co-located projects outside government scheme has been limited so far.



Co-location driven by capex subsidies while first hybrid PPA disclosed

- Spain has already allocated subsidies covering up to 50% of capex for **1.8 GWh** of co-located BESS under the PERTE scheme.
- Following the April blackout, two new subsidy programmes - FEDER and RENOINN - were launched.
- Zelestra and EDPR recently announced a landmark deal (400 MWh hybrid PPA).

Example



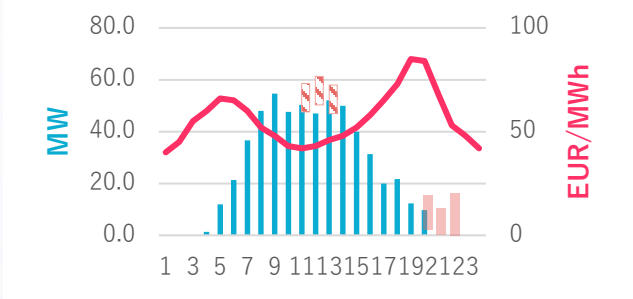
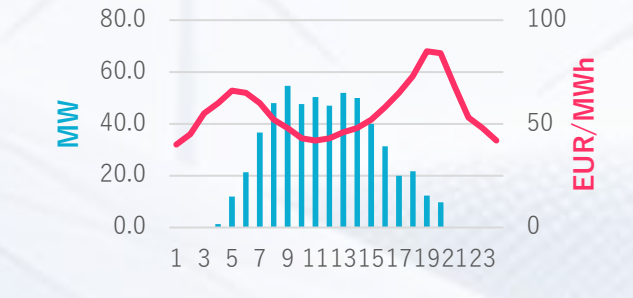
Hybrid PPA
400 MWh

Evolving co-located PPA + BESS structures

++ Market maturity			
Contract Arrangement	Separate Agreements (RES + BESS)	Hybrid PPA – Partial	Hybrid PPA - Combined
Market route	RES buyer + BESS optimizer	PPA & Flex buyer + BESS optimiser	PPA & Flex buyer
Contracts	Separate PPA/CfD + BESS agreement	PPA with flexibility + BESS agreement (for residual flexibility)	One agreement covering RES + BESS
Payment	PPA (€/MWh) + BESS revenues	Premium PPA (€/MWh) + residual BESS revenues	All-in: €/MWh renewable + €/MWh BESS or single fee
Pros	✓ Familiar to market & lenders ✓ Least invasive for retrofits	✓ BESS can mitigate profile risk ✓ Improves PPA bankability ✓ RES output can be shaped to demand (interesting for corporates)	✓ Long-term price certainty ✓ Easier contracting ✓ Offtaker has full flexibility around dispatch and optimisation
Cons	× Doesn't solve lack of appetite for standard PPAs × Coordination between parties	× Harder to price/structure × Needs alignment across multiple parties	× Limited market precedent × Requires advanced pricing/risk models

+ + Contractual Integration

Hybrid PPA structures: Two options for how they could work

PPA Structure	Description
Physical Pay-as-Nominated PPA including load shift (fixed hours)	 - Pay-as-nominated structure (easier to integrate) 3 (or 2) lowest price hours during solar production shifted to 3 (or 2) highest price hours, E.g. load is shifted between hours 12-14 and 18-20. - Reduces impact of negative price hours
Hybrid PPA: Financial DA swap H/L	 - Financial fixed-for-floating swap: Floating spread between the 3 (2) highest priced and 3 (2) lowest priced hours is financially settled against fixed value - BESS dispatched and optimised separately, allowing for full optimisation flexibility

...but hybrid PPA structuring remains complex

Key challenges



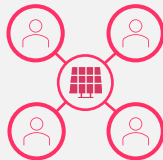
**Sizing of BESS asset
vs. RES asset**



Structuring



Grid constraints



**Operational
interdependencies (e.g. RES
priority) & number of parties
involved**



**Bankability
How to handle tenor gaps
between PPA & OA?**



**BESS Energy
Considered green or
grey?**



Questions?



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