FLASC
Renewable Energy Storage

SIEMENS energy

Clean Energy when the Wind is Not Blowing

Evaluating Business Cases for Co-located Offshore Energy Storage Across 26 UK Offshore Wind Farms

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Co-Founder & CEO, FLASC B.V.

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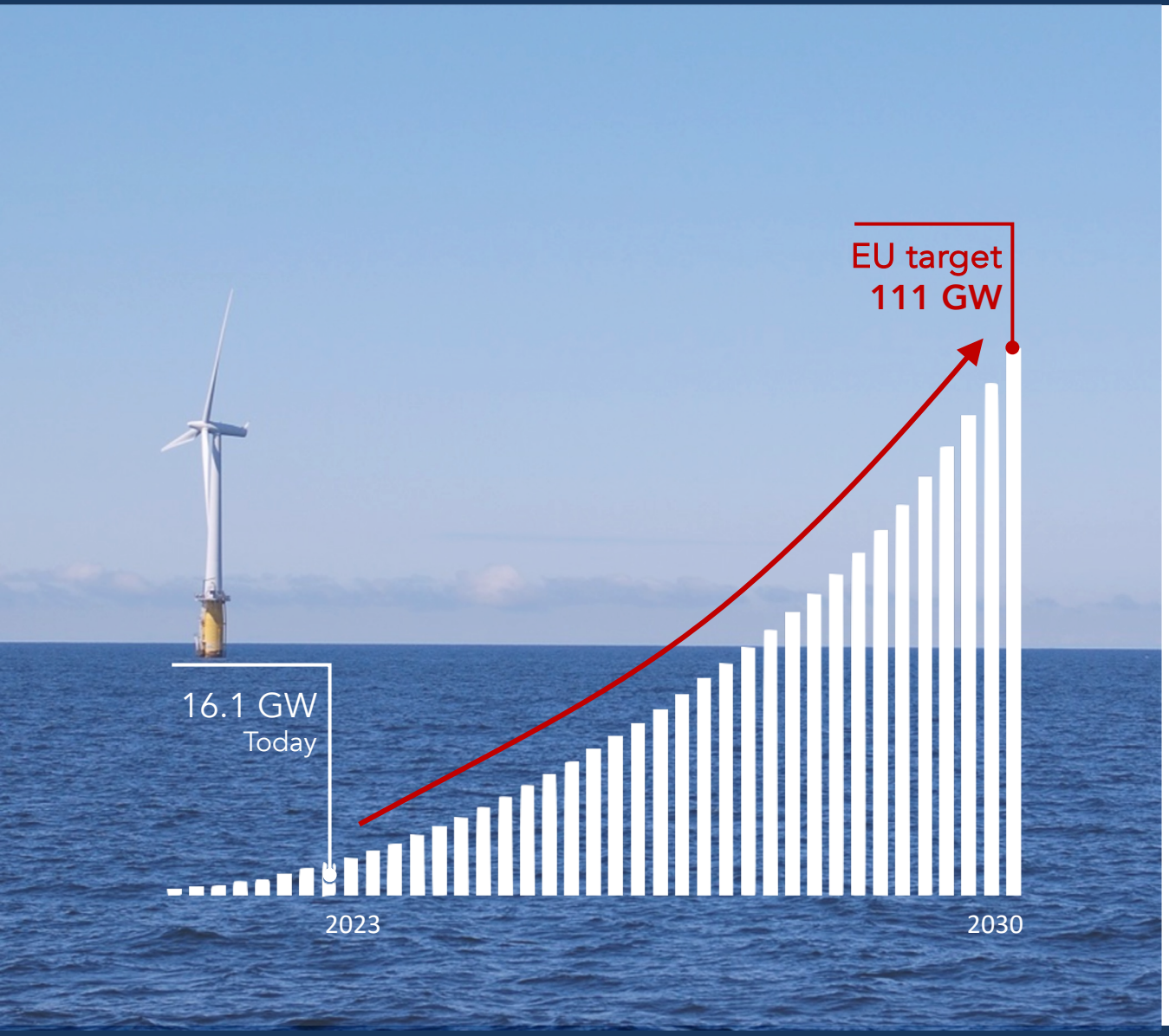
Bilbao 2024

Why *Offshore?*



Temporal Mismatch

- Offshore wind generation is intermittent and can only be used when there is immediate demand.

Spatial Mismatch

- When the onshore grid is constrained, offshore power cannot be delivered where needed and ends up being wasted.

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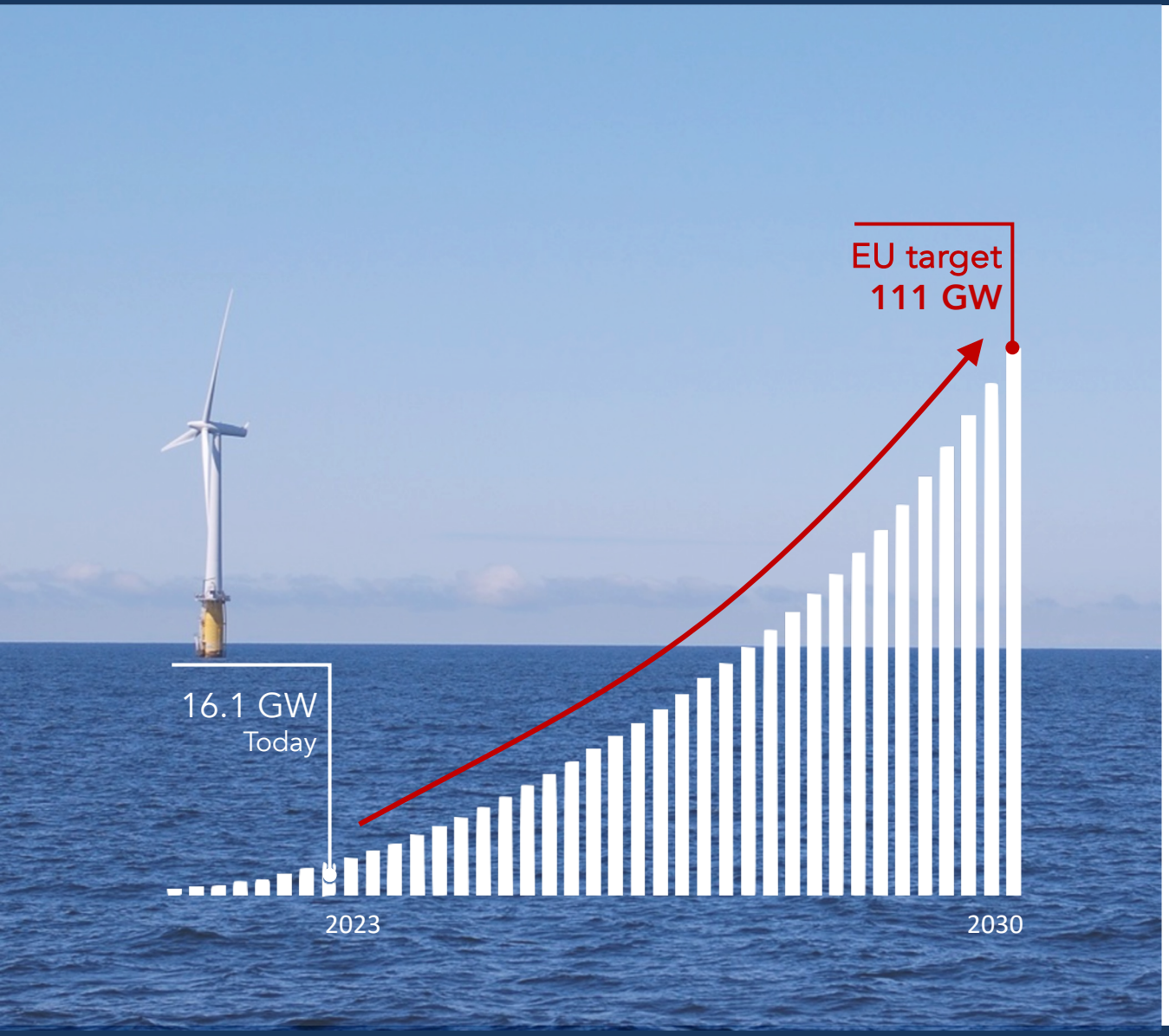
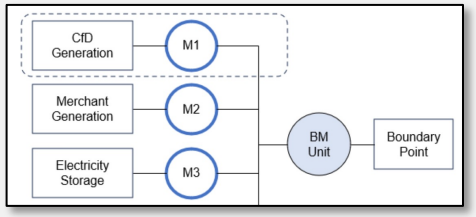
Why *Offshore?*



CfD: proposed amendments for AR7 and future rounds

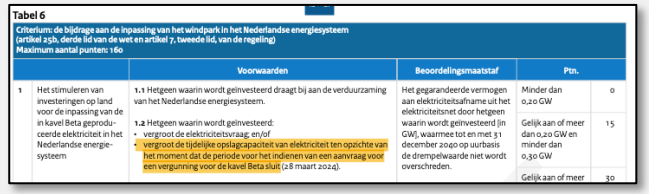
Low Carbon Contracts Company (LCCC Ltd.)
January-2024 [LINK]



*"The aim is that this new metering approach **would make it easier for CfD generators to co-locate** with other assets, including merchant capacity and **storage**.*

Regulations for granting permits for the Beta site in the IJmuiden Ver wind energy area

Rijksdienst voor Ondernemend Nederland
21-07-2023 [LINK]



Tabel 6

Criterium: de bijdrage aan de inpassing van het windpark in het Nederlandse energiesysteem (artikel 25b, derde lid van de wet en artikel 7, tweede lid, van de regeling)
Maximum aantal punten: 160

		Voorwaarden	Beoordelingsmaatstaf	Ptn.	
1	Het stimuleren van investeringen op land voor de inpassing van de in kavel Beta geproduceerde elektriciteit in het Nederlandse energiesysteem	**1.1** Hetgeen waarin wordt geïnvesteerd draagt bij aan de verduurzaming van het Nederlandse energiesysteem. **1.2** Hetgeen waarin wordt geïnvesteerd: • vergroot de elektriciteitsvraag; en/of • vergroot de tijdelijke opslagcapaciteit van elektriciteit ten opzichte van het moment dat de periode voor het indienen van een aanvraag voor een vergunning voor de kavel Beta sluit (28 maart 2024).	Het gegarandeerde vermogen aan elektriciteitsafname uit het elektriciteitsnet door hetgeen waarin wordt geïnvesteerd [in GW], waarmee tot en met 31 december 2040 op uurbasis de drempelwaarde niet wordt overschreden.	Minder dan 0,20 GW	0
				Gelijk aan of meer dan 0,20 GW en minder dan 0,30 GW	15
				Gelijk aan of meer	30

*"1.2 What is invested in…**increases the storage capacity of electricity** compared to the moment the period for submitting an application…"*

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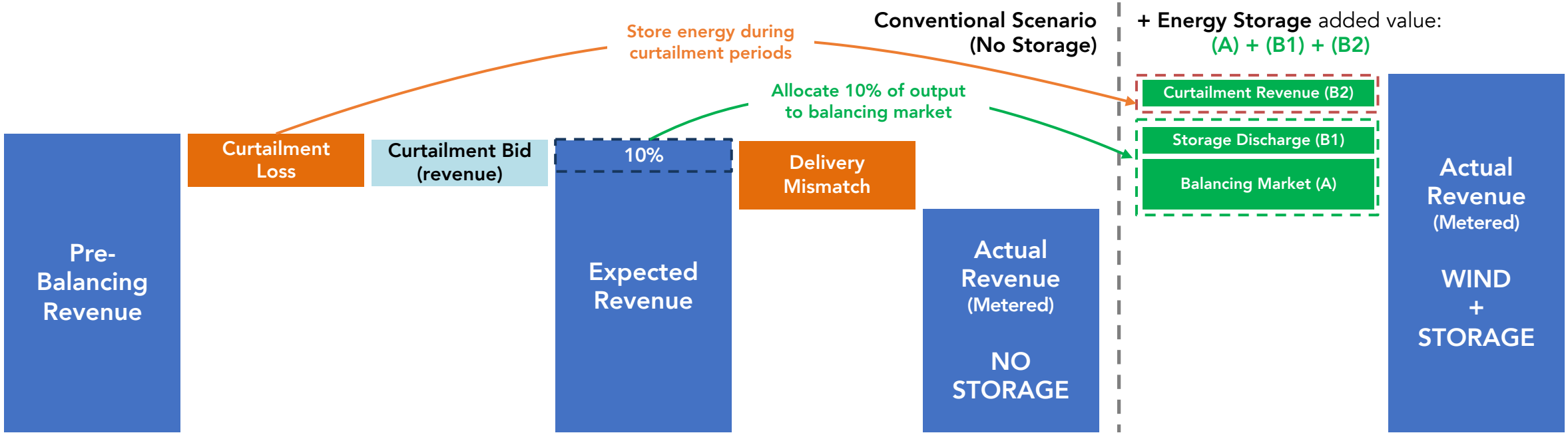
Balancing Market Participation: Adding Storage to Improve Offshore Wind Revenues

- Co-located Wind + Storage treated as a single Primary BMU is allowed under the latest AR5 CfD round[1]
- This allows energy storage to unlock additional revenues from offshore wind:
  - A – Balancing Market Participation: allocating a portion of wind farm power to balancing market participation
  - B1 – Discharging Revenue: When balancing prices are less feasible energy is stored and later discharged at better prices.
  - B2 – Discharging Revenue: Curtailment bids[2] can still be monetized but this otherwise lost power can be stored and sold.



BMU: Balancing Mechanism Unit
CfD: Contract for Difference

[1] *CfD Co-Location Guidance – UK Low Carbon Contracts Company – May 2023* [LINK]
[2] *A bid for downward flexibility, which translates into a payment for reducing the net power output at the BMU.*

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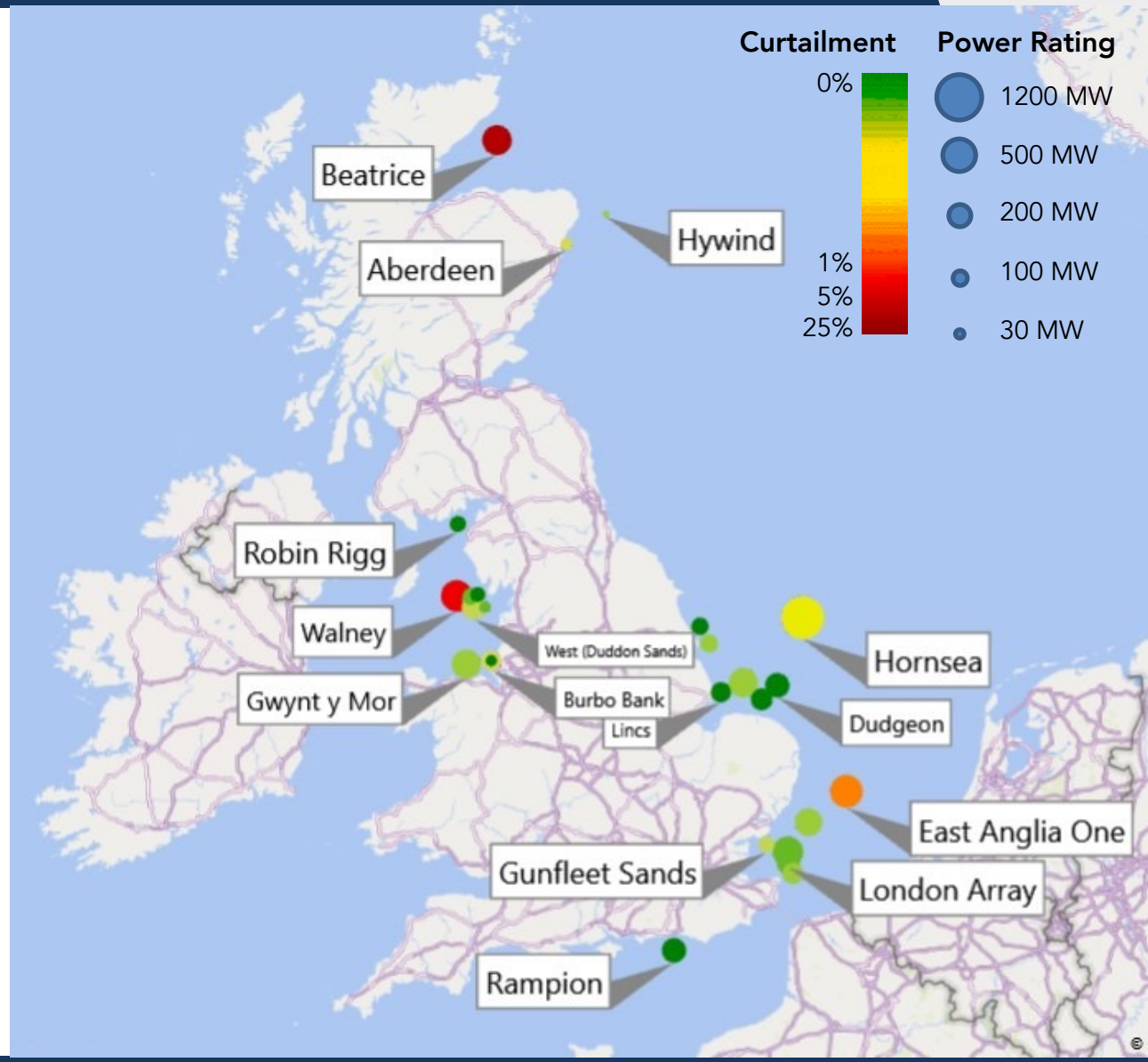
Wind Farm Locations & Input Data

- Total of **26 Wind Farms**
- **Data sources:**
  - 4C Offshore (wind farm sizes, power measurements, curtailment rates, bids, and locations).
  - Elexon Portal (balancing prices)
  - Power dataset includes both predicted and actual values during operation, allowing for the calculation of the delivery mismatch.
- **Period:** 365 days (March 2021 – July 2022)
- **Time Resolution:** 30-min settlement periods
- **Observations on curtailment rates:**
  - Some outliers show significant curtailment (25%)
  - One third of windfarms have no curtailment 0%
  - One third of windfarms have curtailment <0.2%



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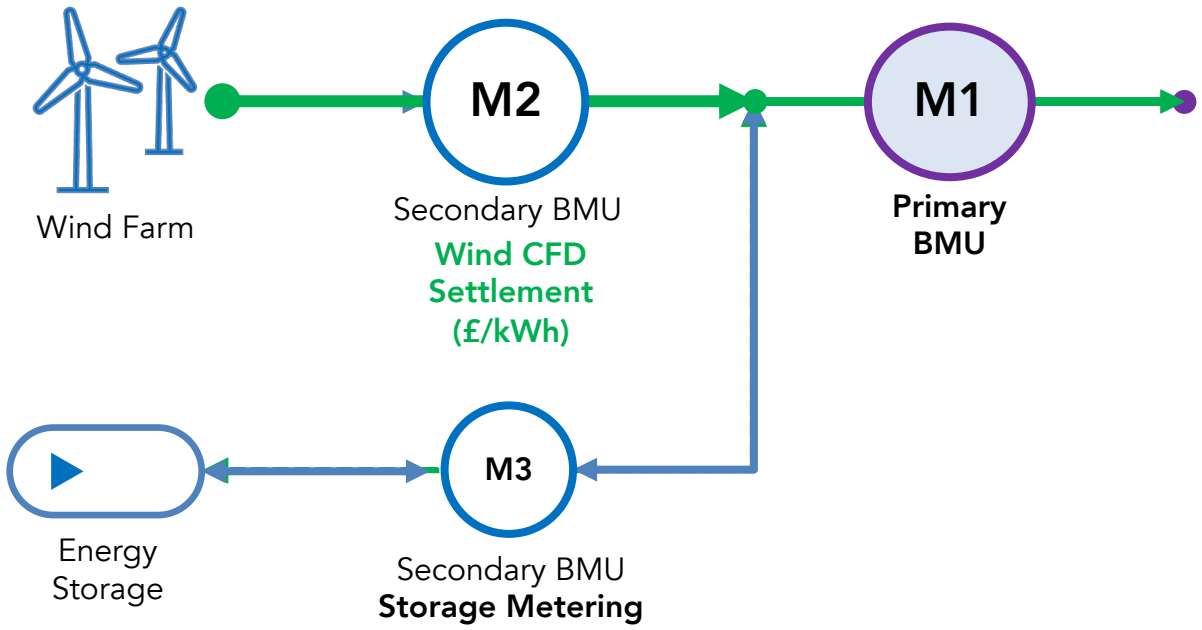
IRR Calculation – Input Parameters

- **Power levels / Duration :**
  - Storage power level (e.g. 5%)
  - Balancing power level (e.g. 10%)
  - Duration storage (e.g. 4 hours)
- **Storage Cost :**
  - Power CAPEX: 1,720 £/kW (= 2000 €/kWh)
  - Storage CAPEX: 194 £/kWh (= 225 €/kWh)
  - OPEX: 2% of CAPEX /yr
- **Project Timeline:** 30 years
- **Key Assumptions:**
  - Selected data is representative for yearly analysis
  - Representative cost for CAPEX and OPEX
  - Revenues estimated using publicly available CfD prices

- **Storage can be co-located within the same BM Unit as long as it only charges from the co-located Wind Farm**



- **CfD settles at M2: storage charges with electricity on which CfD would still be paid.**
- **Will then discharge to address imbalance at the primary BMU**

Based on: CfD Co-Location Generator Guidance (v1, May 2023) (LCCC Ltd.) [LINK]

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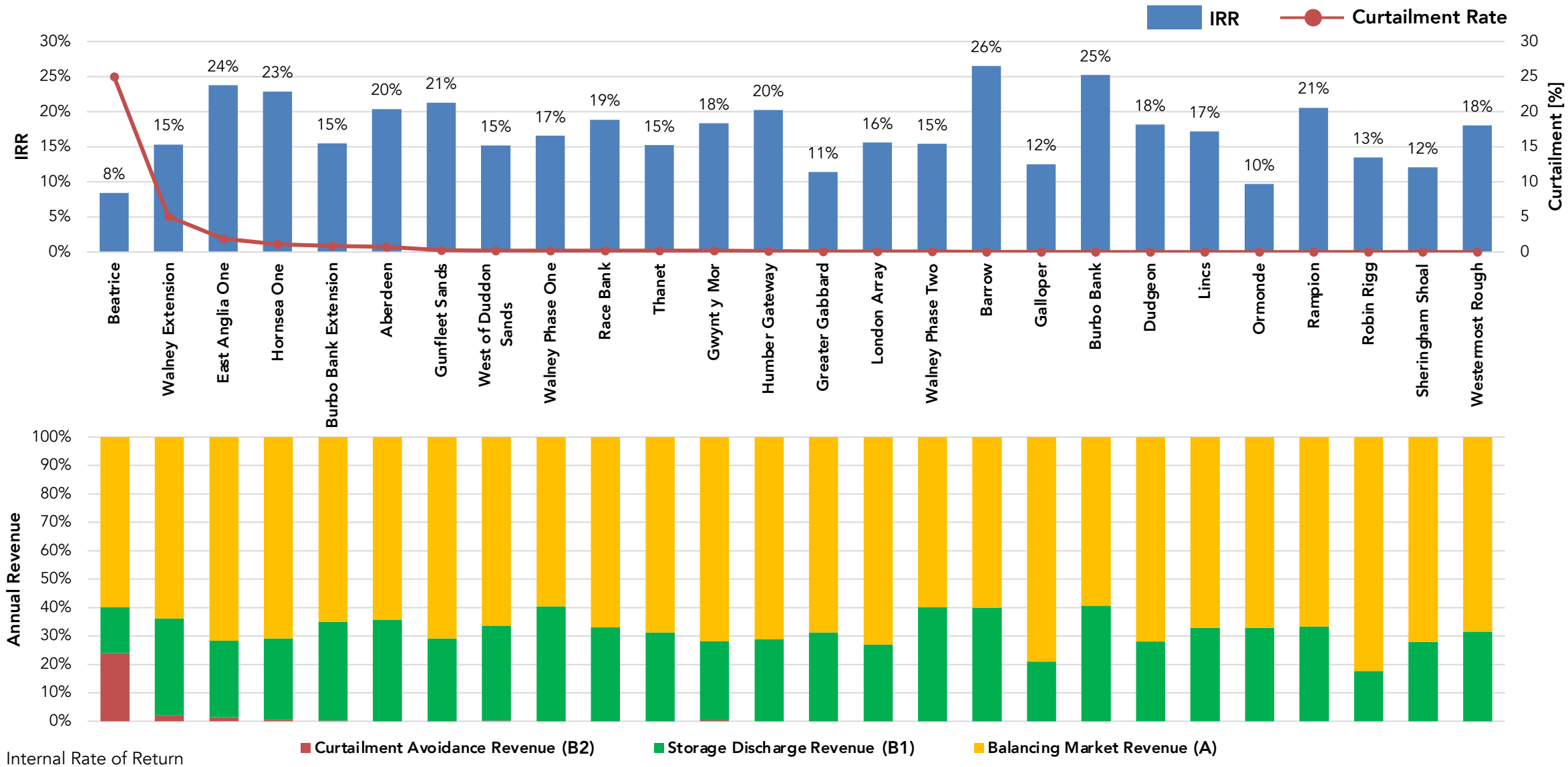
IRR & Curtailment Rates at 26 UK offshore wind farms



IRR: Internal Rate of Return

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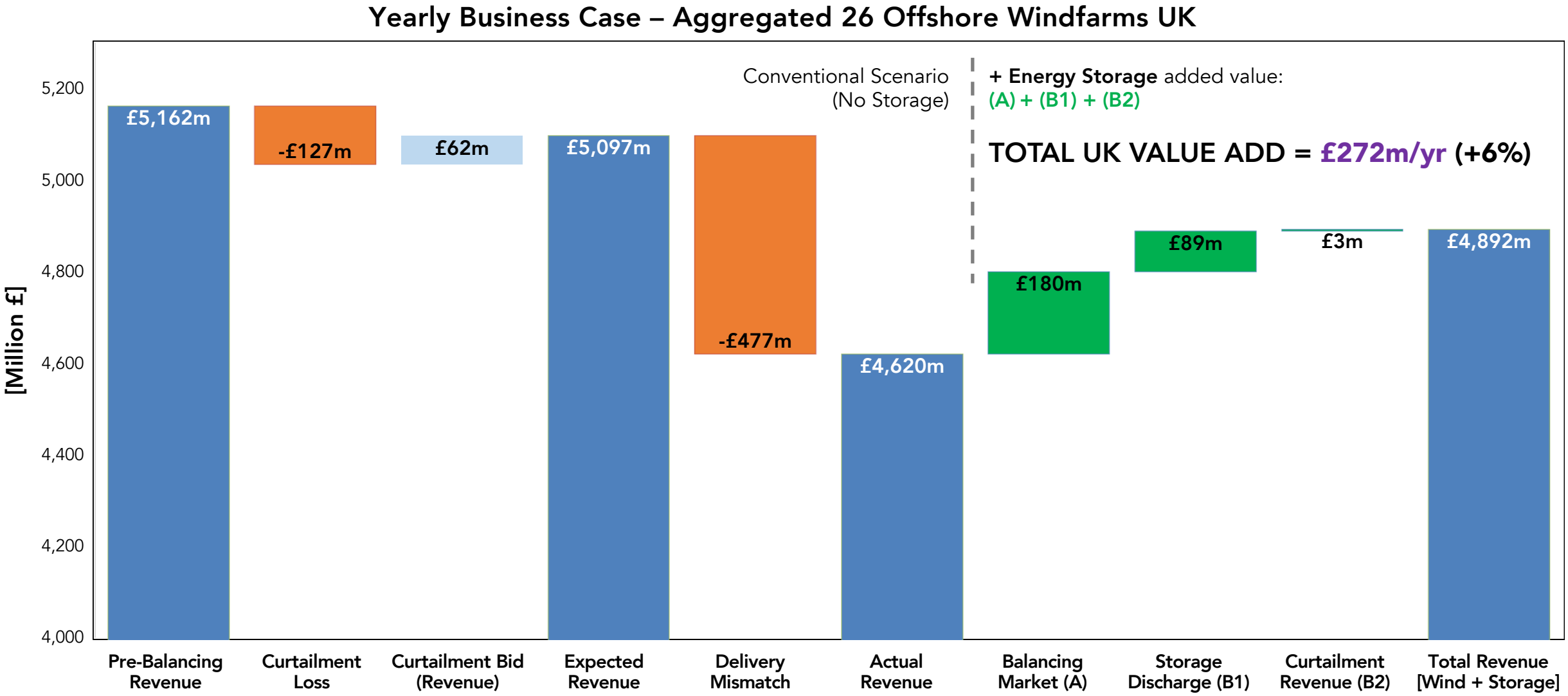
Aggregated Result for all UK Offshore Wind: Overall IRR = 18%



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Enabling Offshore Energy Storage

The FLASC Technology

TRL 6

- **FLASC HPES** (Hydro-Pneumatic Energy Storage) is the first solution tailored for co-location of large-scale energy storage with offshore wind.

- It enables wind developers to store energy **where** it is produced and deliver it **when** needed.

Pneumatic Pre-Charging
→ Shallow-Water Energy Density (10-18 kWh/m^3)

The Ocean as a Natural Heatsink
→ High Thermal Efficiency (>96%)

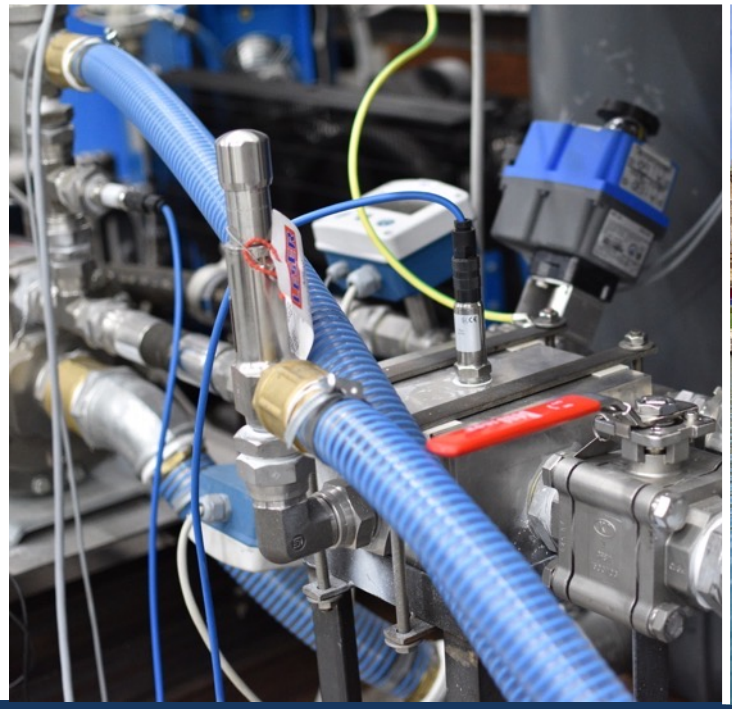
Scalability: **>100 MWh**

Power Rating: **+10MW**

Roundtrip Efficiency Target: **70%**

Storage Duration: **4-12 hours**

Operational Lifetime: **+30 years**



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Co-located Offshore Energy Storage: Conclusions and Next Steps

Adds up to **10% more value** to UK offshore wind farms

Enables participation in **balancing markets** by hedging against volatility

Offshore wind can become an **active provider** of grid flexibility

- Total value-add to existing UK projects estimated to be **£272m/yr (+6%)**. Based on FLASC system cost this corresponds to an overall IRR of **18%**.
- Maximum IRR was obtained with a **4-hour duration**, and a power level corresponding to **5-10%** of the wind farm power rating.
- Optimum balancing market participation was **10%** of the wind farm output.

We are eager to collaborate on offshore energy storage projects, business case evaluation and pilots. **Get in touch!**

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