



PV assets with co-located batteries












Ewout Eijkelenboom
London - 1 February 2024



2023 – interesting times

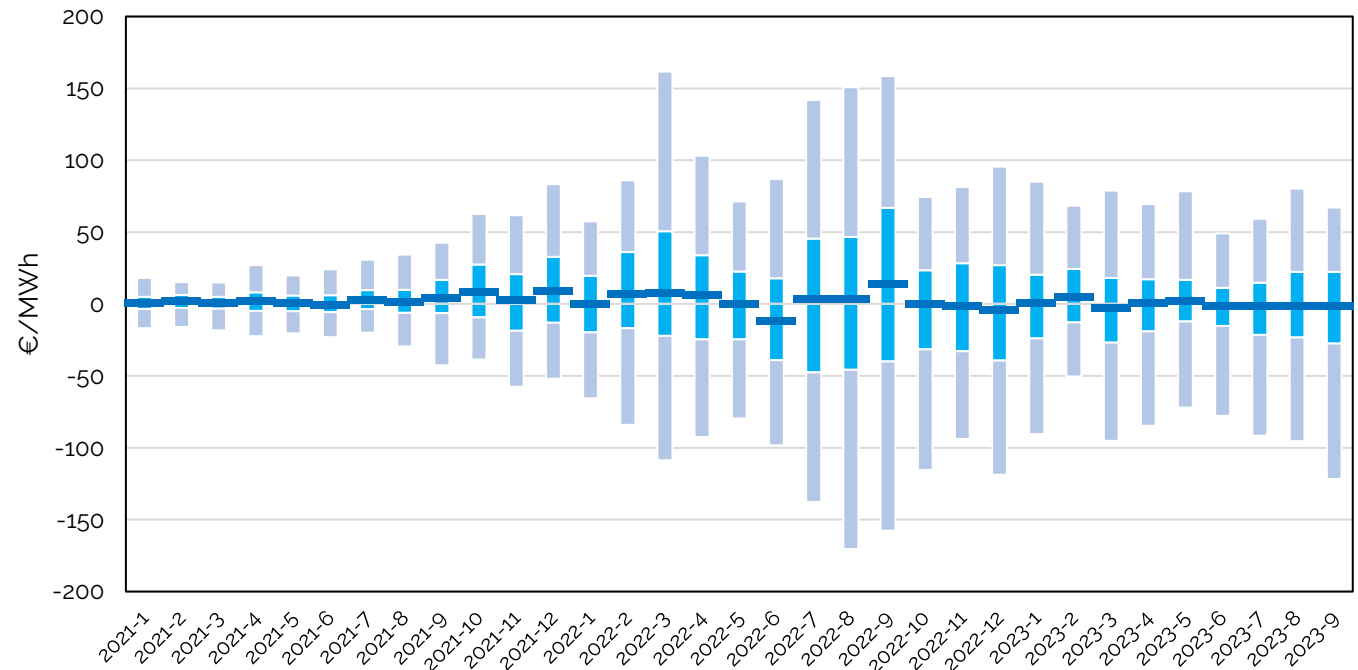


- Capture prices down

	2023 VWAP	YoY change
Spain Wind 	75.56	-53%
Spain Solar 	75.94	-51%
Germany Wind 	78.57	-54%
Germany Solar 	79.04	-66%
France solar 	86.05	-56%
Germany Wind 	86.28	-71%
France Wind 	86.49	-63%
UK Wind* 	97.87	-52%
UK Solar* 	98.54	-59%
UK Wind* 	101.71	-51%
Italy Solar 	115.22	-63%
Italy (onshore) 	126.98	-55%

- Intraday trading gets more attractive
- Spreads show large increase
- ID volumes growing (e.g. EPEX ID showed in 2023 30% growth compared to 2022!*)

Difference between Day-Ahead and Intraday prices in the Netherlands



Source: S&P Global Commodity Insights

*<https://www.epexspot.com/en/news/all-time-high-volumes-growth-spot-markets-illustrate-trust-trading-participants>

KYOS, our analytics, your advantage



Software models for energy

Various models for valuation, optimization and risk management, coupled with advanced forecasting and price simulation tools that will provide you the best basis to take decisions.

All models are developed by the KYOS quant team.



Software models for multi-exposure commodities

The Commodity Portfolio & Risk Management software combines physical commodity management with financial risk reporting and price analytics.



Consultancy

We offer a wide range of top analytical services to companies in the energy and commodity markets.

We are specialists in valuation, optimization and risk management.

Our expert services range e.g. from a one-off deal valuation to a complete solution for the risk management of a portfolio of assets and contracts.



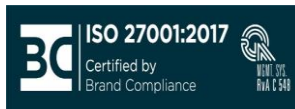
Price data models

Live or End-of-day market price forward curves are essential for trading, structuring and risk management.

In addition, we offer a fundamental model for long-term (>30 year) power prices.

KYOS Energy Analytics

- International client base across Europe, plus Americas and Japan
- 35+ people, headquarter Haarlem, The Netherlands
- More than 100 corporate clients for its software services



KYOS approach to renewable energy assets



- Apply advanced financial models combined with experience of the energy market to value and optimize renewable assets.
 - Models developed by own quant team. All with background in econometrics or similar studies. Combined experience >40 years
 - Many KYOS employees have experience at energy companies and bring real life market knowledge.
- Calculate the market value that an asset can obtain by optimizing it in the market
 - Use realistic scenarios and trading strategies for the valuation of the market value.
 - Use transparent methodologies and scenarios



Energy storage -> strong growth expected



- Strong increase in renewable generation
- Phase out of conventional generation
- European Market Monitor on Energy Storage*
 - > 5-8GW/year growth
 - 57GW installed by 2030
- For reference: TenneT expects 10.3GW installed by 2030 in NL only
- Recent study** shows that 34GW of battery projects have requested grid connection in NL!

* European Association for Storage of Energy

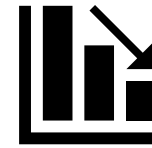
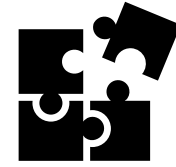
** <https://www.strategy.nl/post/34-gw-aan-batterijprojecten-in-beeld-bij-netbeheerders-per-eind-februari-2023>



But reality is more difficult

- Transport costs
 - Price level, uncertainty
- Grid congestion issue
- Long-term value business case

- And at the same time for PV assets:
 - Decrease in capture rates and absolute price level



➔ A battery co-located with PV assets can be interesting

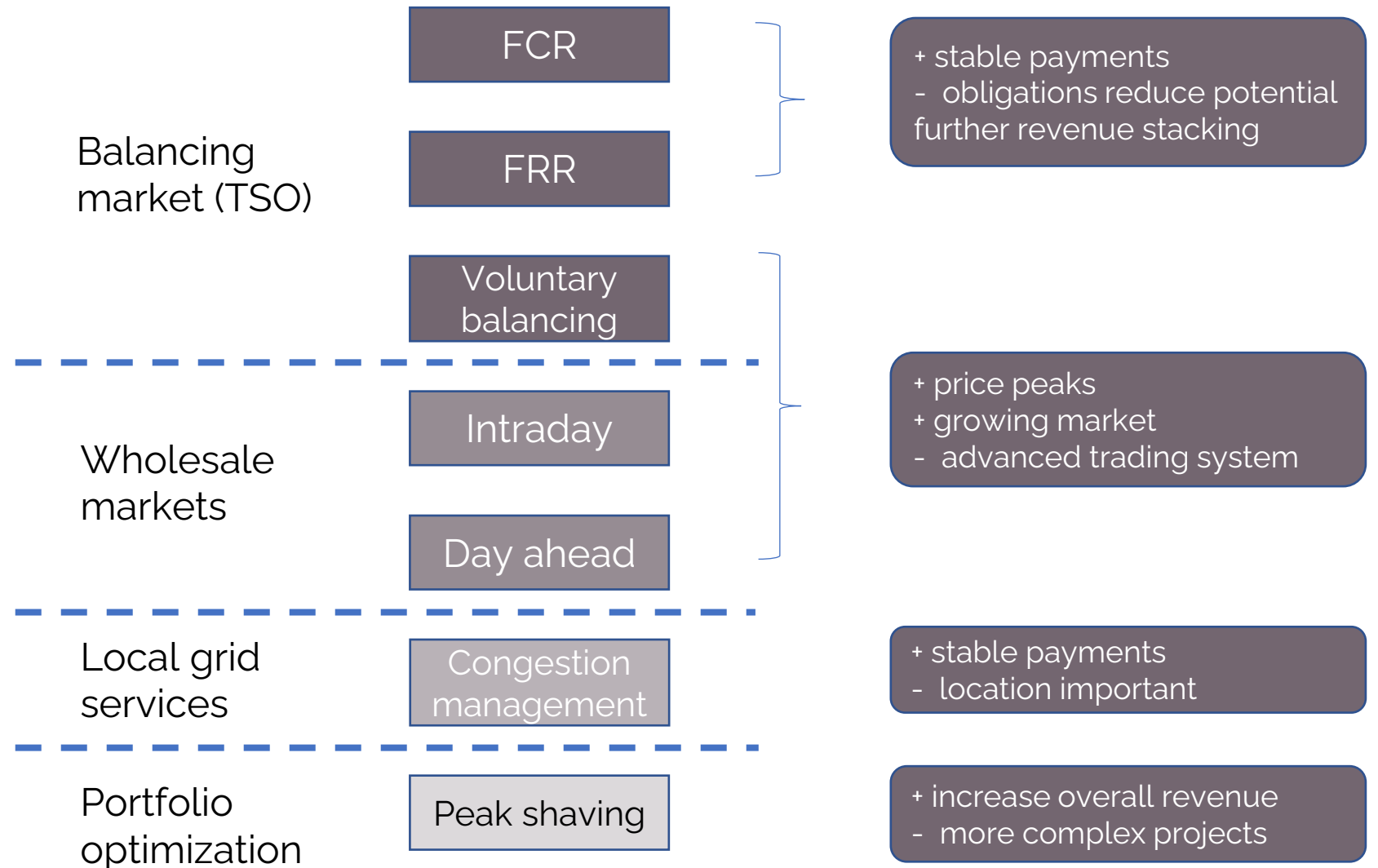
- But how to value this business case?



Energy storage – not as easy as PV



Battery business case typically combination of revenue streams



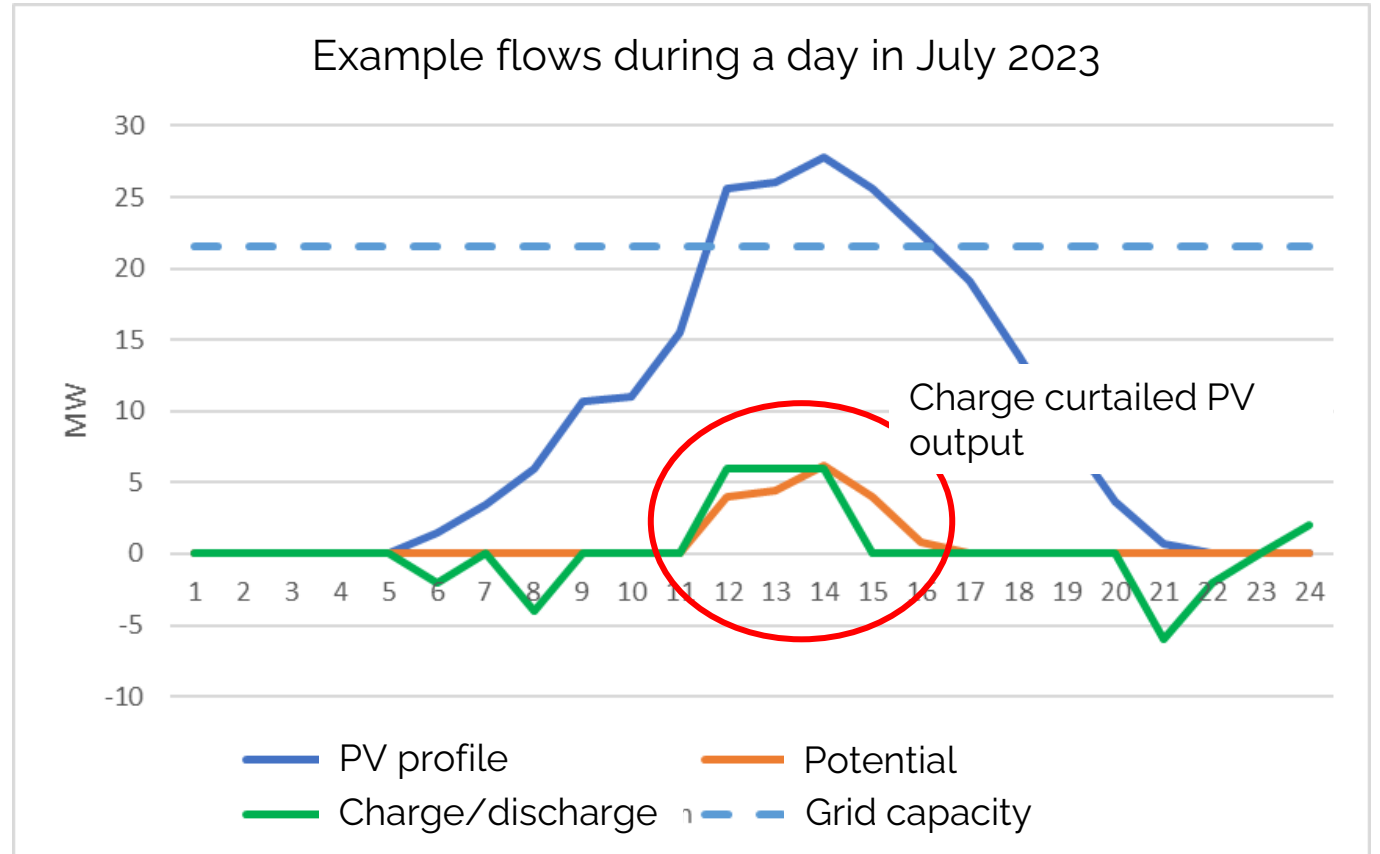
Co-located battery - example



Max PV →
Grid capacity →
Battery capacity →

Co-location is not restricting battery a lot:

- Charge possible
- (full) discharge not during peak PV hours, but typically low prices



Approaches to energy storage valuations



Backtest



Forward looking

Requirement

Realistic trading strategy

Pros

- Actual historical data
- Can take future changes into account
- Probabilities (with simulations!)

Cons

- How to account for future changes?
- Only one reality
- More complex modelling approach



KYOS Approach (KyBattery model)



- Valuation based on price simulations
- Calculates future market value in different energy market:
 - Day-ahead, intraday, imbalance or a combination of these markets
 - Combine with optimizing in FCR market
 - Stand-alone or co-located asset
- Uses advanced trading strategies, avoiding perfect foresight
- Expected value and probability distribution



Example calculation



2 Hour battery, located in NL, revenues for 2025 in €/kWh

- Stand-alone: DA optimization only: 29 €/kWh
- Co-located with PV: DA optimization: 28€/kWh <- limited downside
 - Can even be profitable in case you can charge curtailed volumes
- For reference: stand-alone optimized in DA, ID, imbalance: 175 €/kWh
 - Shows most value is in shorter term optimization. Active optimization required

See also: <https://www.kyos.com/energy-storage-report/>

- KYOS performed various bankable valuations to support client with their battery business case
- Including in-depth discussions with banks about underlying methodology



Summary

- Co-locating battery with PV gets more common
- Typically: limited value destruction of battery business case
- Many upsides: enable project, sharing costs, curtailment, load shifting
- But valuation adds complexity -> rigorous model required



Contact Details



We look forward to supporting you with the right tools and advice in the rapidly changing energy sector!



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KYOS Energy Analytics

- Some useful (free) publications



See: <https://www.kyos.com/knowledge-center/>