

Managing utility-scale batteries in the energy transition

2nd March 2023



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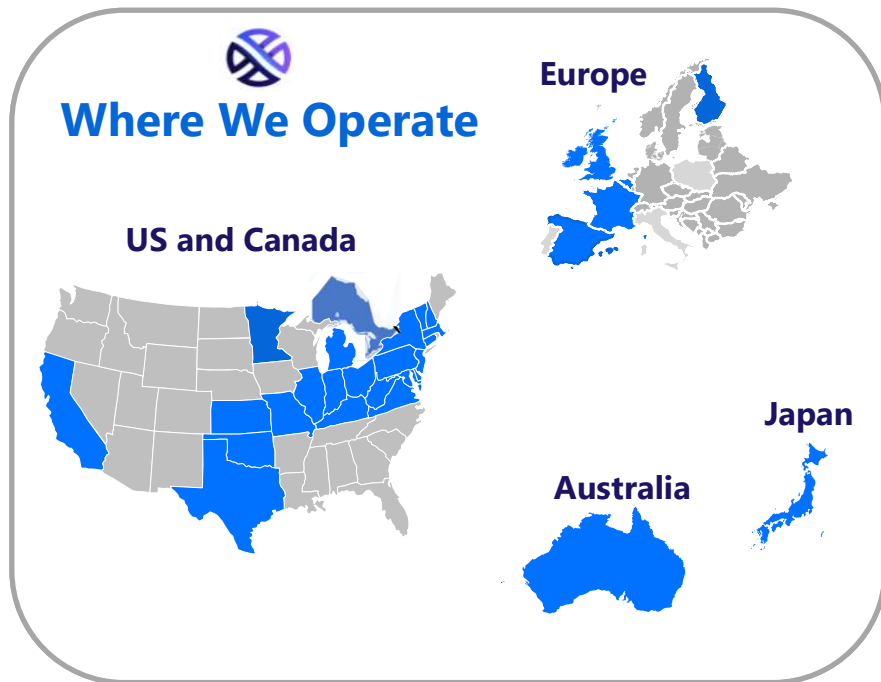
GridBeyond™

**Managing utility-scale
batteries
in the energy transition**



A Global Presence

GridBeyond has built **the leading data-driven intelligent energy platform** to empower large energy users, allowing them to generate additional **revenue** streams, **lower energy cost** and becoming more **sustainable**. Our customers form a virtual power plant that is essential in supporting the decarbonization of electricity networks globally.



Global Locations

USA | Canada | Ireland | UK | Japan | Australia



400+ Customers across **500+** Sites
100 team members across **6** Offices
\$40m turnover and active in **14** Markets
200+ man years in Platform Development



~1,500+ MW DR portfolio (75% growth per annum)
400MW of batteries under management

Some of our Partners/Investors



Extensive Track Record in Battery Asset Optimisation

Key Performance Metrics

~450
Customer sites

1,500+MW
Total customer MW
portfolio

~450MW
Flexible customer MW
portfolio

Grid Beyond Battery Track Record

- Optimizing Batteries since 2017
- Over 30 Individual Assets
- ~400 MW of contracted batteries
- ~48MW hybrid unit (30LF/18HF)(3+ years)

Assets under GridBeyond Management by Service

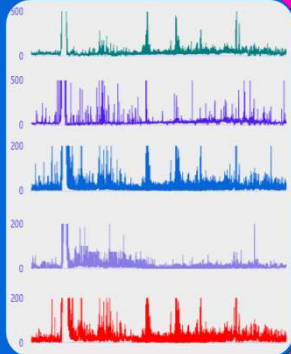
Service	Sites	MW
Regulation/Frequency Response	357	302
Reserve/Capacity Market	385	390



Current GridBeyond High-Level Offering in North America

"GridBeyond provides a suite of services for batteries, with a customized offering depending on individual project need"

Battery Consulting Services



Energy Management System



Trading as a Service



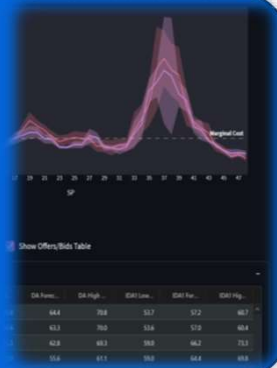
Battery Design & Purchasing Services



Interconnection & EPC
(through Partners)



Trading Software



Forecast / Design

Control

Optimize

Modelling and Asset Valuation of Distributed Energy Assets



Plan, Design and Analyse Prospective Investments

Macro Assumptions

Demand, Installed Capacity (Wind, solar, thermal, battery etc.), Fuel Price

Historic Market Data

Outturn Prices, Fuel Prices, Demand, Plant Availability, Weather, Constraints

Market Rules

Day Ahead, Intraday, RT(BM), Ancillary Services, Capacity

Project Specific

FTM/BTM, Load, Co-located assets, CAPEX, efficiencies cycle constraints, degradation rates

IN



AI/Optimisation Platform



Machine Learning
Pattern Recognition
Price Forecasts
Probabilistic Forecasts



Optimisation Engine
Backcasts/Forecasts
Plant Model (Battery, Solar, Wind, DSR, EVs)
Constraints
Scenario Generator
Cost Functions

OUT



Long Term Energy and Ancillary Price Forecasts

Revenue Maximisation

Optimal Asset Sizing

Financial Analysis

Market Intelligence

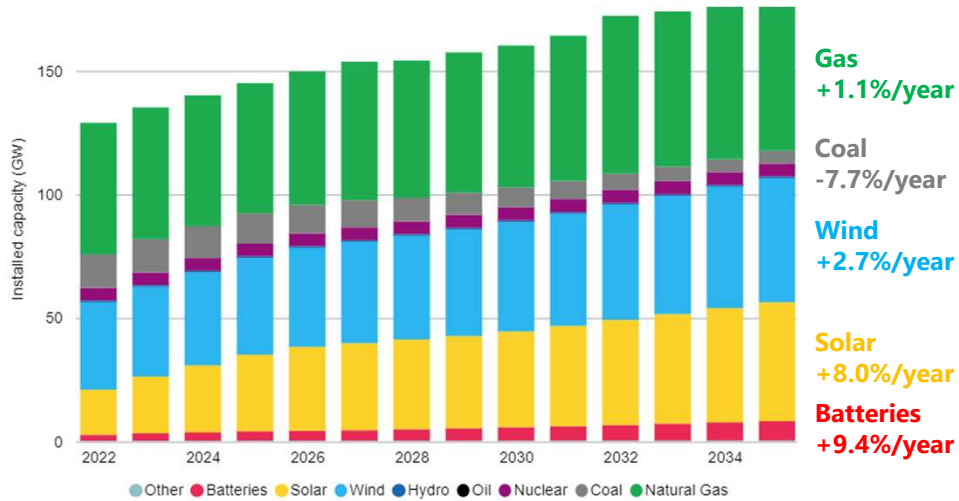
Optimal Dispatch

Bankable Results

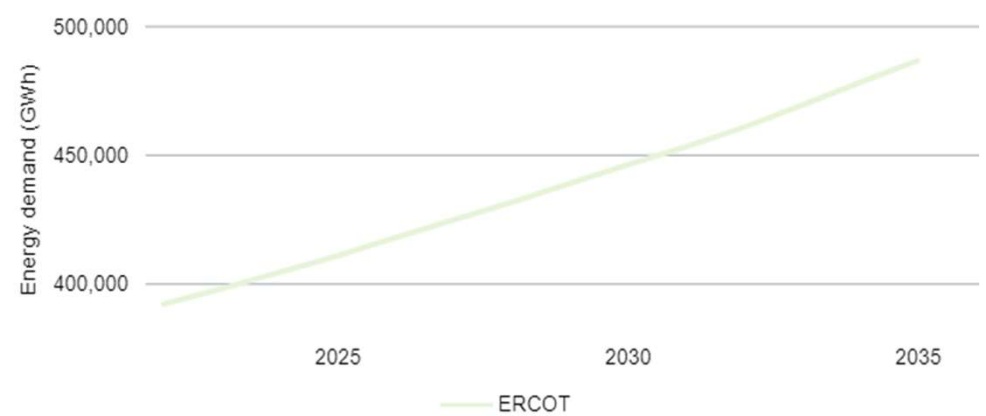
Artificial Intelligence is used to forecast prices while Mathematical Optimisation techniques are used to maximise the financial return on the asset across all available revenue streams (FTM/BTM storage, co-located renewables and Virtual Power Plant settings)

ERCOT Outlook 2035 – Installed capacity

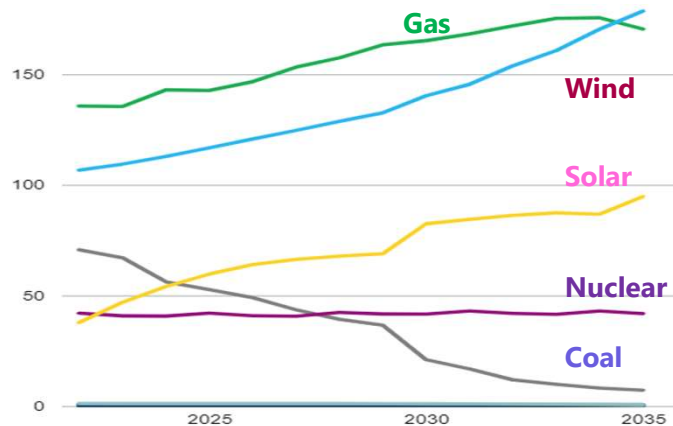
Installed capacity by fuel (GW)



Net Grid Demand (GWh)



Generation by fuel (TWh)



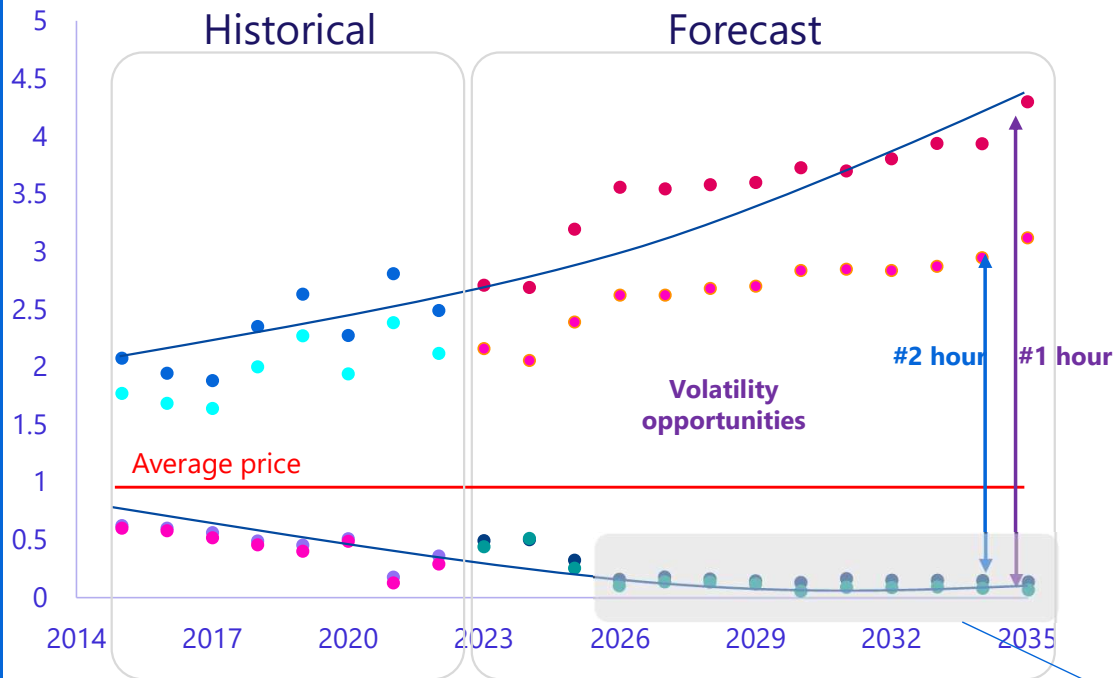
More Wind
More Solar
More Demand

More Volatility

More Opportunities

ERCOT Outlook 2035 – Wholesale market

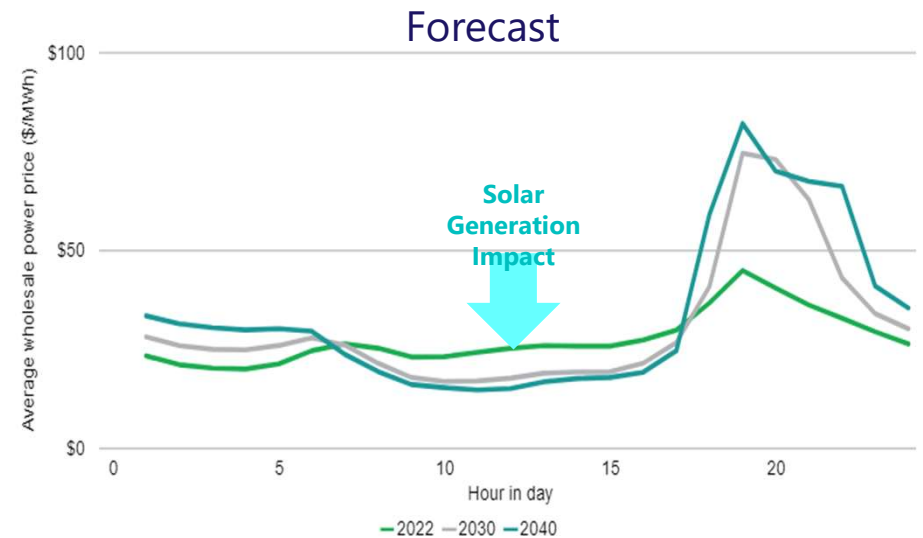
Highest and lowest daily hours compare with average



Compared with the average price:

- High prices are getting higher
- Low prices are getting lower (low price demand floor)

Average hourly wholesale prices (\$/MWh)



Higher volatility in the future:

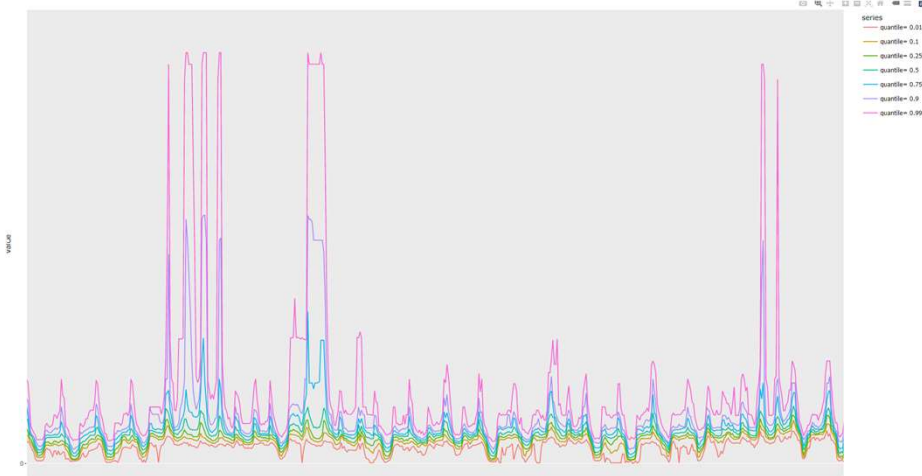
- Higher evening peak prices
- Solar impact on daily prices (starting summer/weekends)

Low price demand

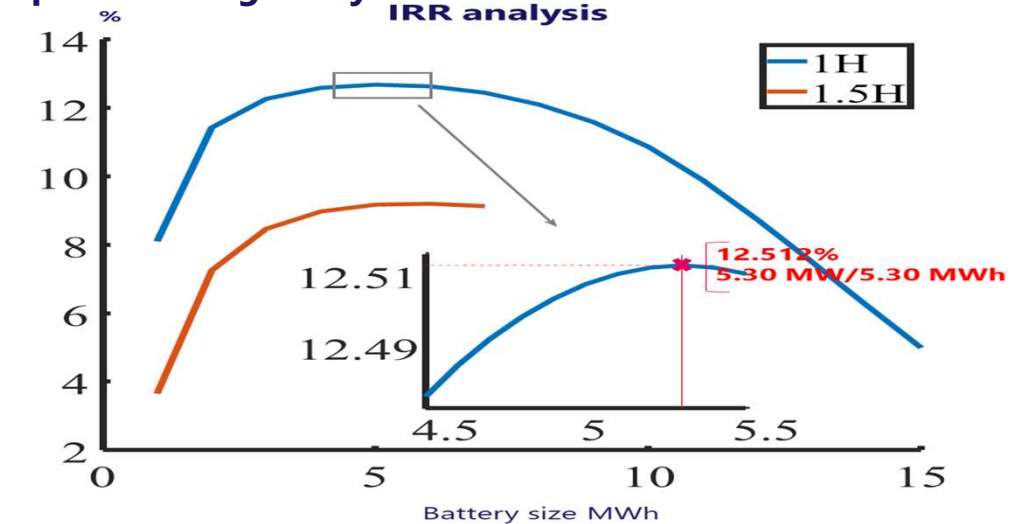
- Hydrogen electrolyzers
- Crypto currency mining

Output

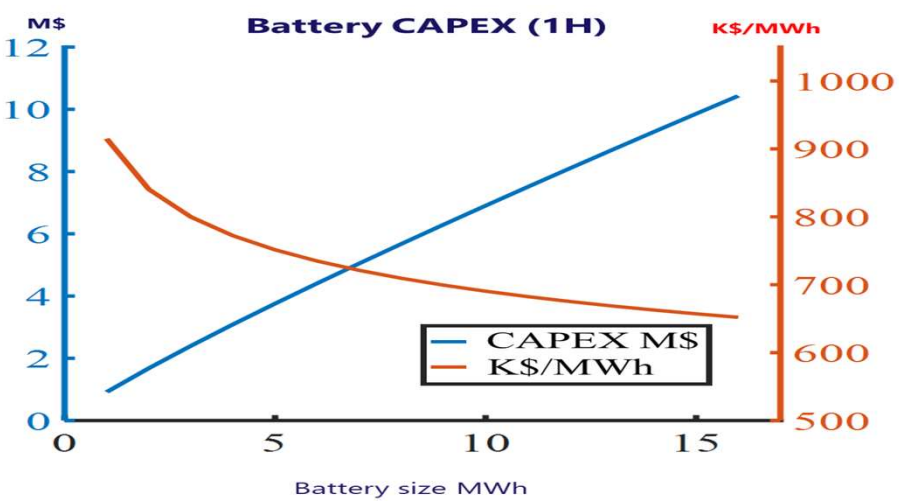
Probabilistic Price Forecasts



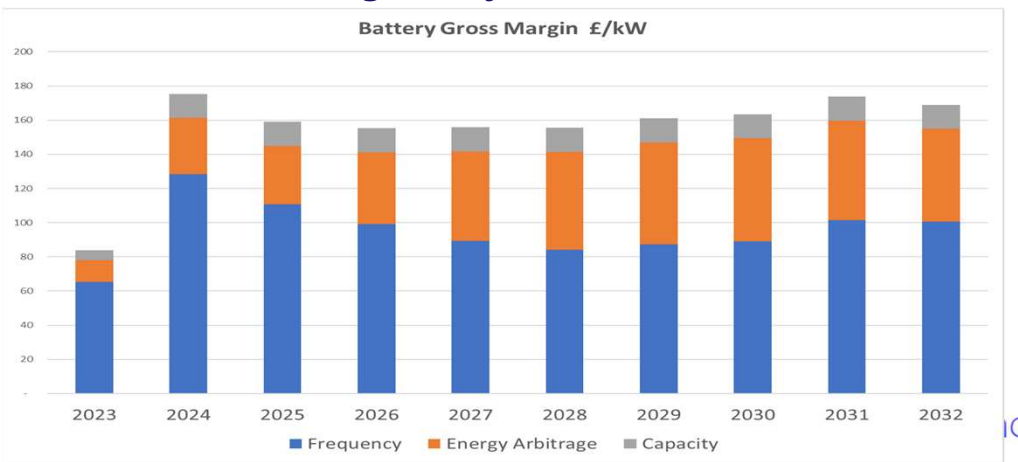
Optimal Sizing Analysis



Capex Assessment



Revenue / Gross Margin Projections



Optimizing Batteries in Modern Energy Markets



Algorithmic Trading isn't optional: it's mandatory

Wholesale Trading

£/MWh
1000
500
0

Increasing
volatility

Dynamic Containment

£/MW
50
0

Past

Daily procurement

17 £/MW

Present

EFA Block procurement

Future

HH/HR procurement

- The right answer for the battery is not trivial
- Many possible solutions in different markets
- The decisions are not based on instinct

Algorithmic Trading is the solution

- State-of-the-art forecasting
- Optimisation solvers

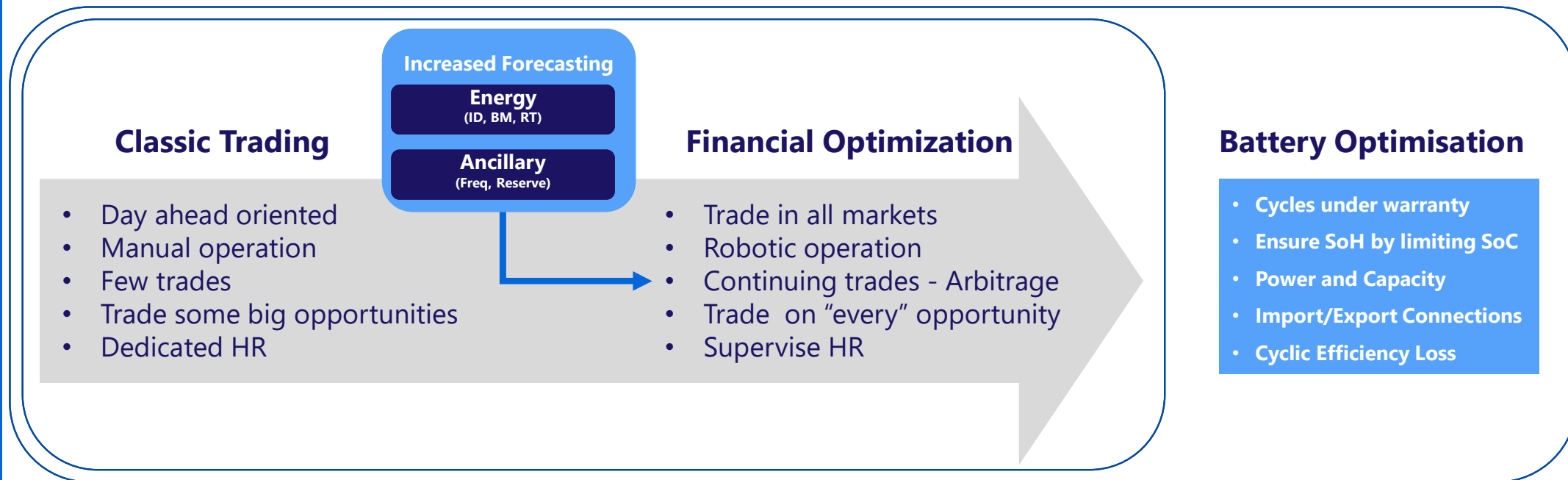
Dynamic Moderation

£/MW
50
0

Dynamic Regulation

£/MW
50
0

How must Energy Trading evolve to accommodate batteries?



Full Optimisation

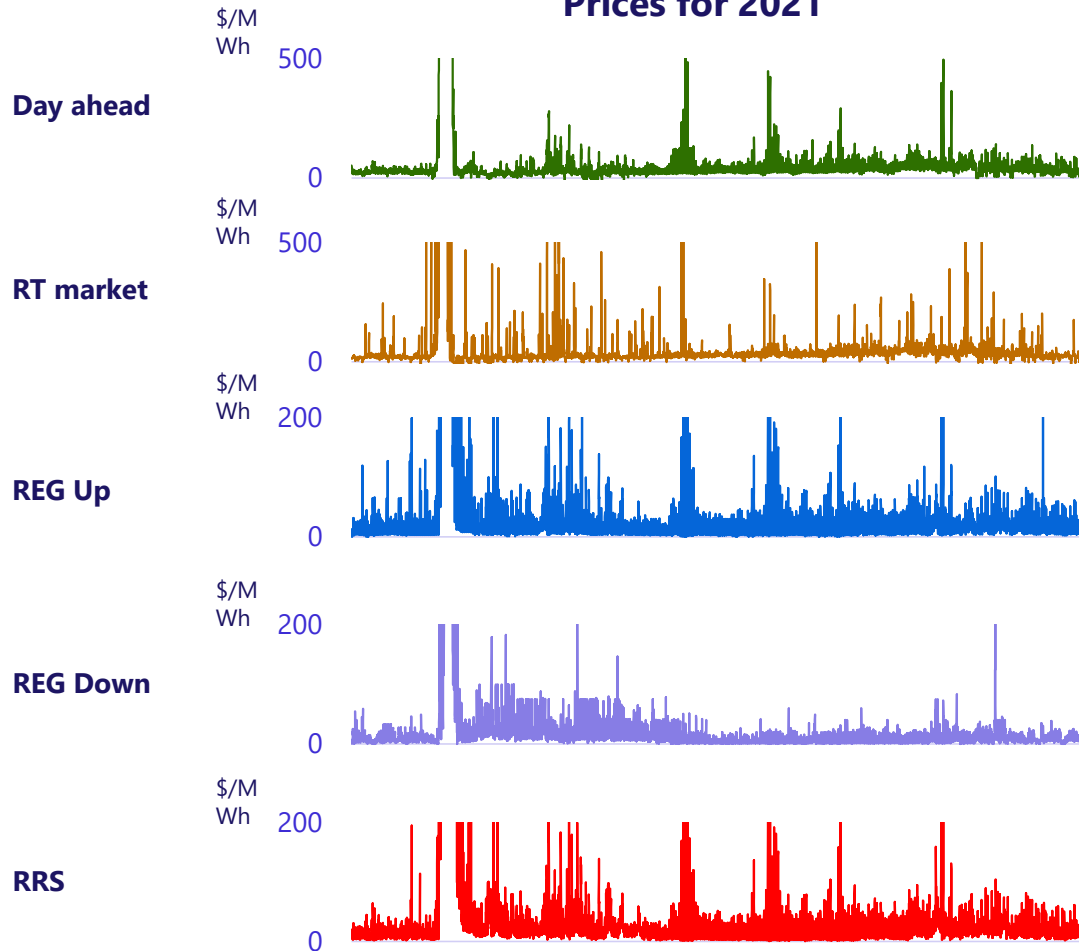
Power Markets Don't Sleep

Energy markets are 24/7 and BESS traders need to be able to respond to changes in price forecasts, traded positions and the battery physical state (e.g SoC) at any time of the day.



Battery Economic Dispatch problem

Prices for 2021



Two Dimensional Arbitrage – Fuel Limited Resource

Settlement Period	Day Ahead \$/MWh	RRS \$/MWh	Reg Up \$/MWh	Reg Down \$/MWh	Real Time \$/MWh
31	33.59	1.5	3.69	3.69	52.1
32	32.16	1.5	8.3	6.32	38.2
33	37.38	1.65	22.3	11.95	41.4
34	54.41	23.22	50.24	15.69	38.6
35	45.87	6	14.67	12.69	53.3
36	37.93	5	12.32	10	50.1
37	40.58	3.69	12.07	10.09	29.2
38	36.58	4.05	11.6	9.62	31.9

Trader needs to decide:

- When to trade, where to trade, at what price and for how much volume whilst ensuring physical constraints are met
- Optimising contracted volumes in the right market at the right time ensures the trader can extract maximum profit from the battery

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