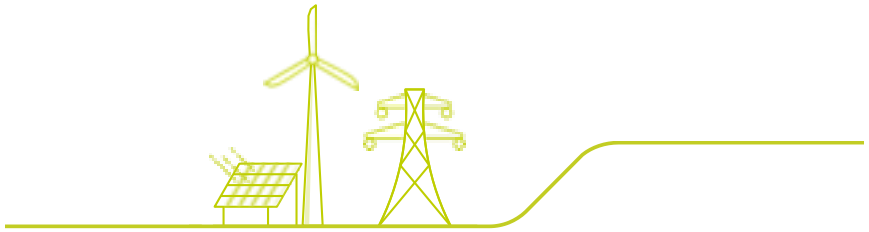
Balancing Cost Winter Report

May, 2024

ESO

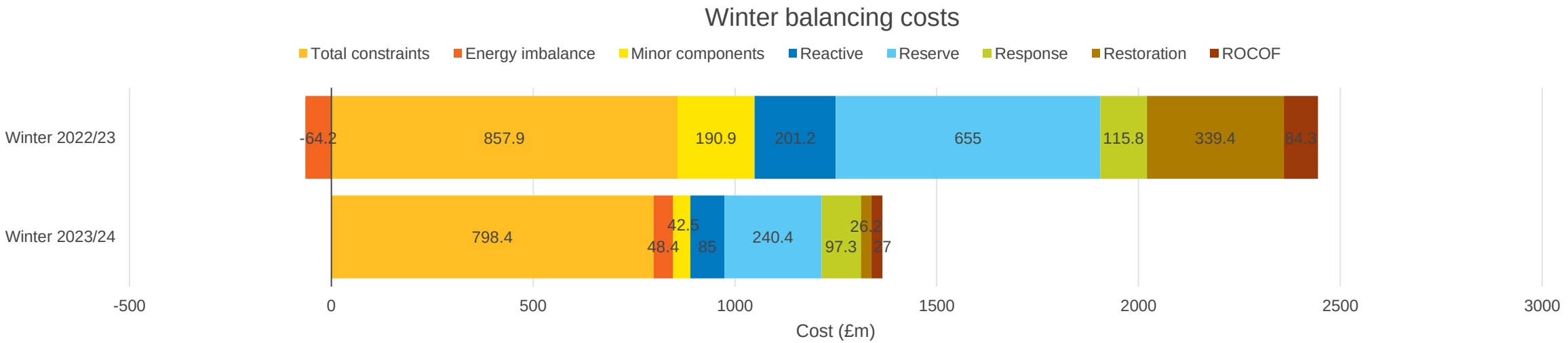
Contents



Executive Summary

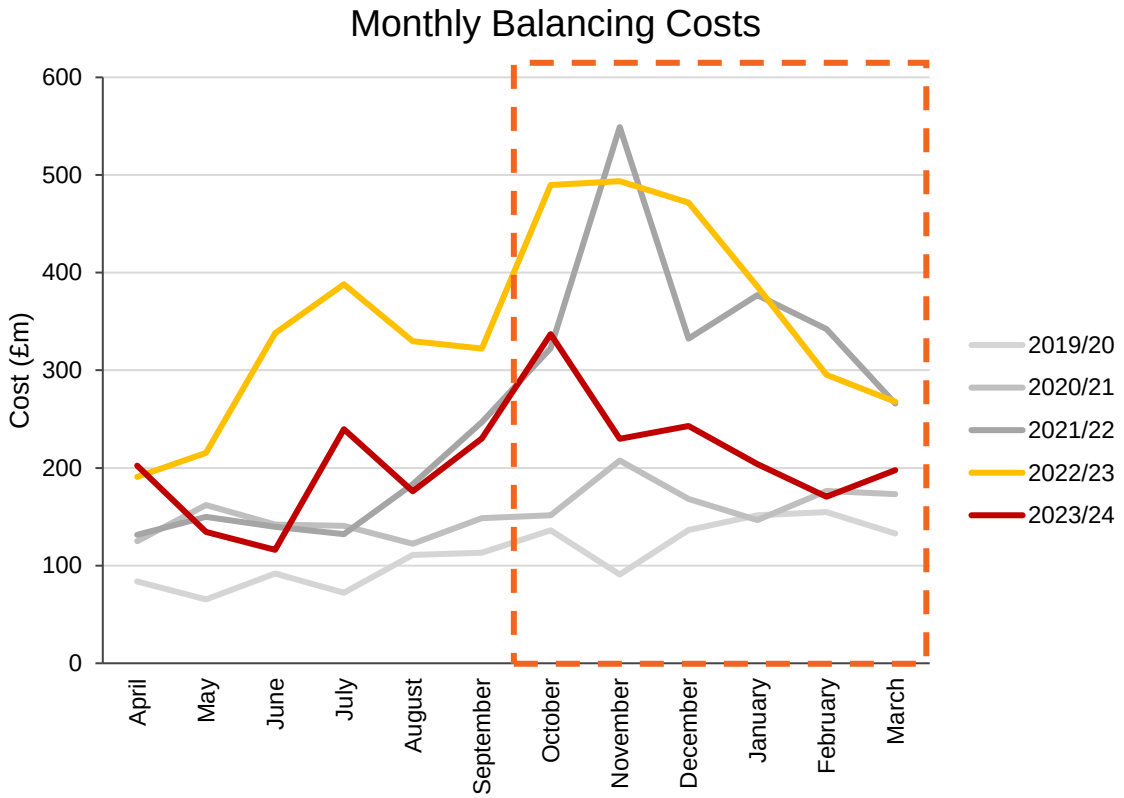
Welcome to the Winter 2023/24 Balancing Costs Report. This report provides a look back at balancing costs and associated market dynamics from October 2023 to March 2024.

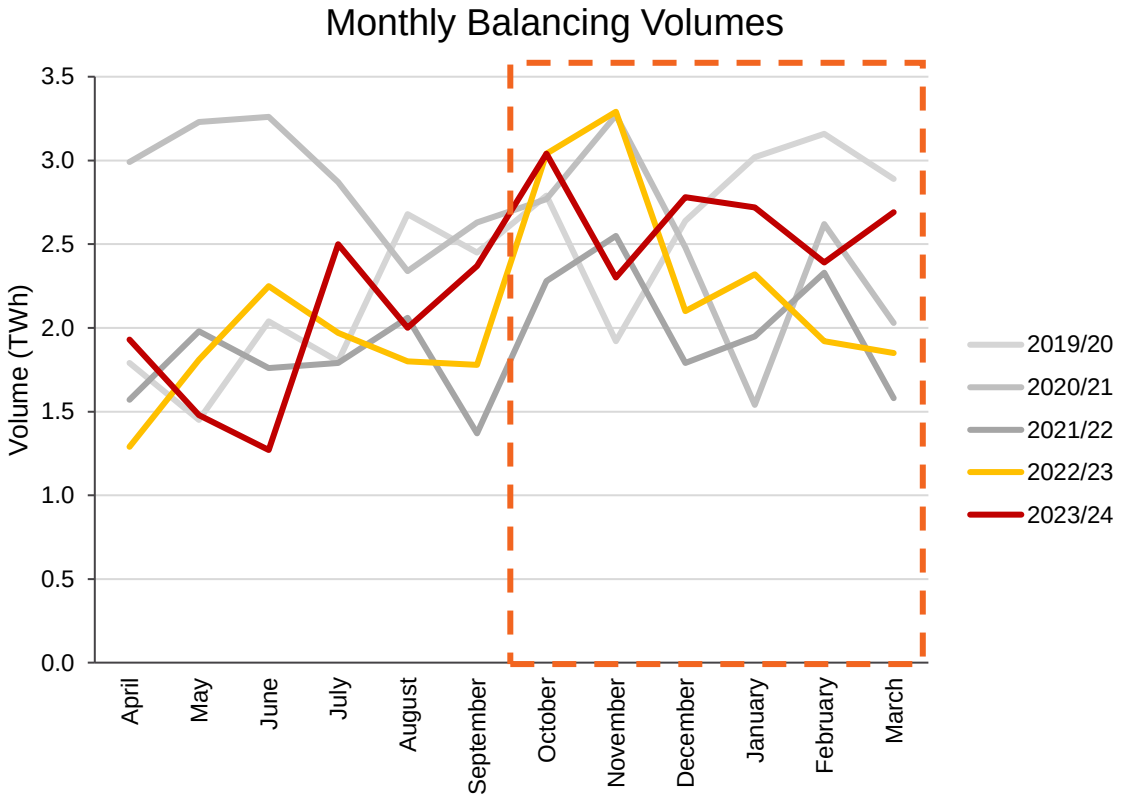
- Constraint volumes rose 15% this winter compared to the previous year. This was due to an increase in constraint volumes due to high wind output across all winter months.
- Balancing Mechanism (BM) offer prices dropped significantly with less volatile price fluctuations in winter 2023/24 than recent winters. Many of the spikes in price observed in the previous winter were due to a pricing strategy now prohibited by the Inflexible Offers Licence Condition (IOLC). BM offer prices over winter 2023/24 averaged £248/MWh compared to £483/MWh over the previous winter period.



Balancing cost overview

Balancing Costs Overview



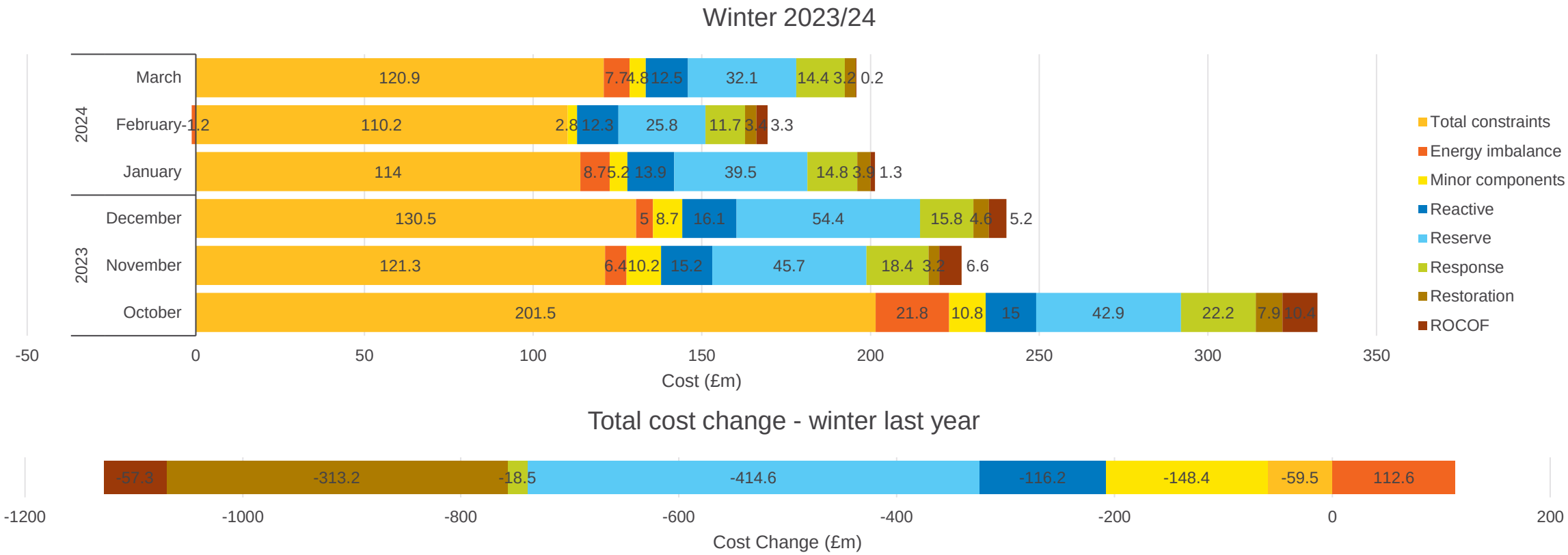


a) Despite higher balancing volumes, monthly balancing costs across winter 2023/24 were on average 43% lower compared to winter 2022/23. This is linked to a significant reduction (49%) in average wholesale prices between the two winter periods (£72/MWh across winter 2023/24 compared to £145/MWh in winter 2022/23).

b) Monthly balancing volumes this winter rose 15% compared to the previous year. High wind outturn across all months of the 2023/24 winter period was a key driver of this trend, leading to greater constraint volumes in all months except November.

Winter period

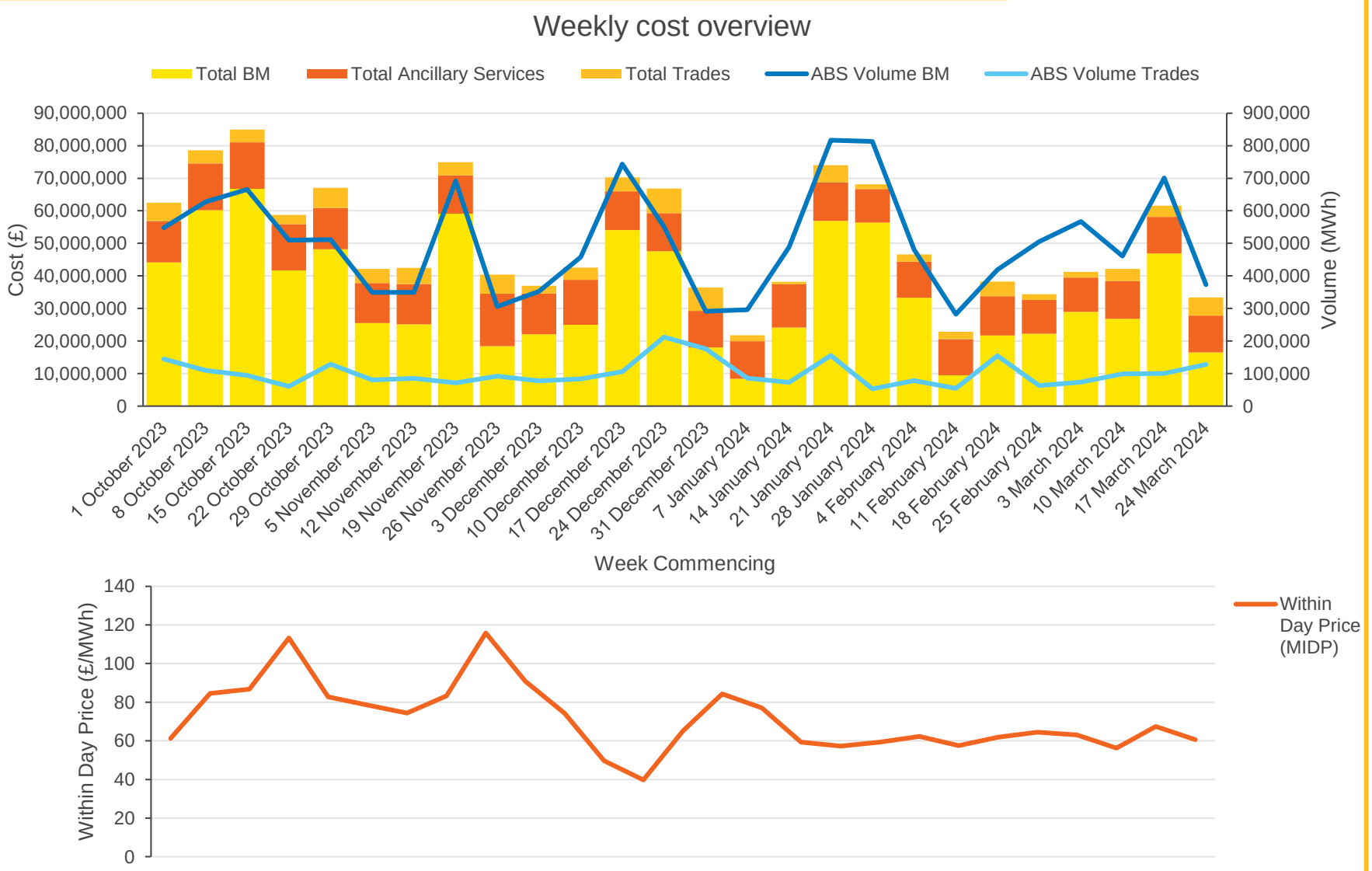
Cost bracket comparisons



A) Total balancing costs across the winter 2023/24 period decreased across all categories except energy imbalance compared to winter 2022/23. The £112.6m increase in energy imbalance cost was due to the increased volume of actions taken to balance the system across winter 2023/24, whereas broader cost reductions were mainly due to the significant downward trajectory we have observed in energy related prices year-on-year.

B) Constraint costs were the largest cost component in all months making up on average 59% of total costs across winter 2023/24. Constraints were particularly high in October as Storm Babet brought very difficult system conditions with high wind curtailment volumes.

Weekly Balancing Costs



A) The highest weekly costs over the winter period were observed in October. High wind outturn had a significant impact on costs incurred through the BM, with wind curtailment totalling 850GWh across the month, alongside a slight increase in wholesale prices compared to the previous month. Notably, Storm Babet passed through between the 18 and 21 October driving up forecasting errors and wind curtailment costs in w/c 15 October, which was the highest cost week of the winter period.

B) High cost weeks across other winter months also correlate to days of high volumes of wind curtailment. Late-January in particular saw the highest balancing volumes of the winter period, however total costs in these weeks remained slightly below the October peak due to a reduction in wholesale prices between months.

Market Dynamics

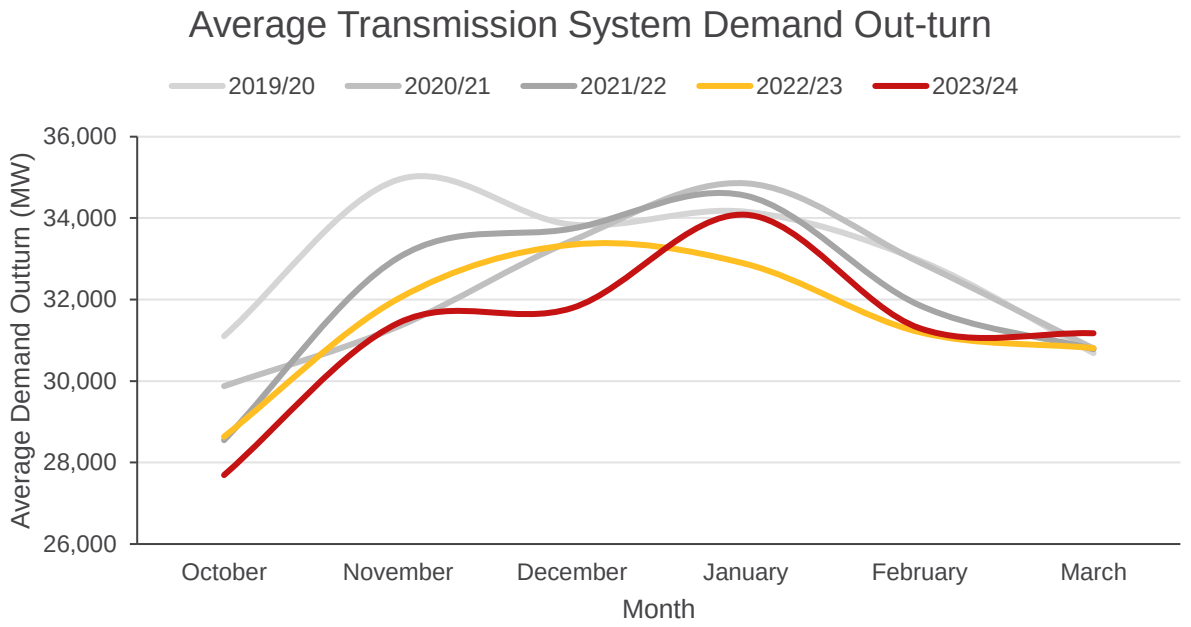
Transmission System Average Demand

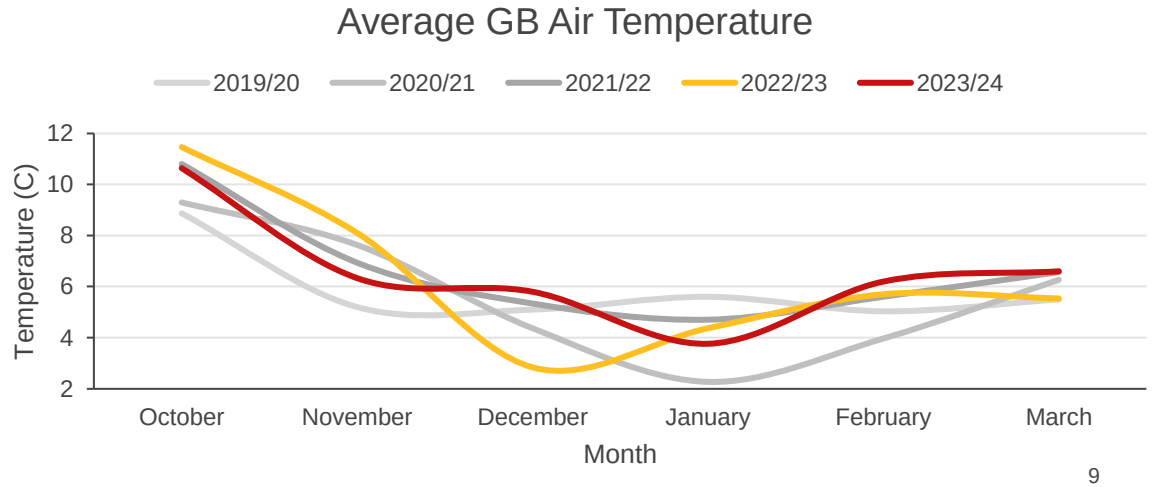
Average demand across winter 2023/2024 remained broadly consistent with winter 2022/2023 but a colder January and warmer October and December changed the peak months.

Transmission system demand across winter 2023/24 has been lower than in the previous years but remained relatively similar to the 2022/23 winter. The key factors impacting demand this winter were the warmer weather conditions and the continued high retail prices meaning that the demand reduction observed in the previous winter was maintained. Despite the significant decrease in wholesale energy prices, the transmission system demand did not increase except for January 2024 when Great Britain (GB) had much lower temperatures than in January 2023.

Key highlights for winter 2023/24:

- January remains the winter month with the highest electricity demand.
- Colder weather conditions in January resulted in demand increasing by an average of 4%.
- While lower electricity demand was observed through the months of October and November, December had the most significant monthly average decrease of up to 5% compared to 2022/23. This can be attributed to the higher average temperature this month.





Average GB Air Temperature Outturn based upon GFS data model (hourly value averaged by month)

Note: Dataset is comprised of Winter months only (November – March)

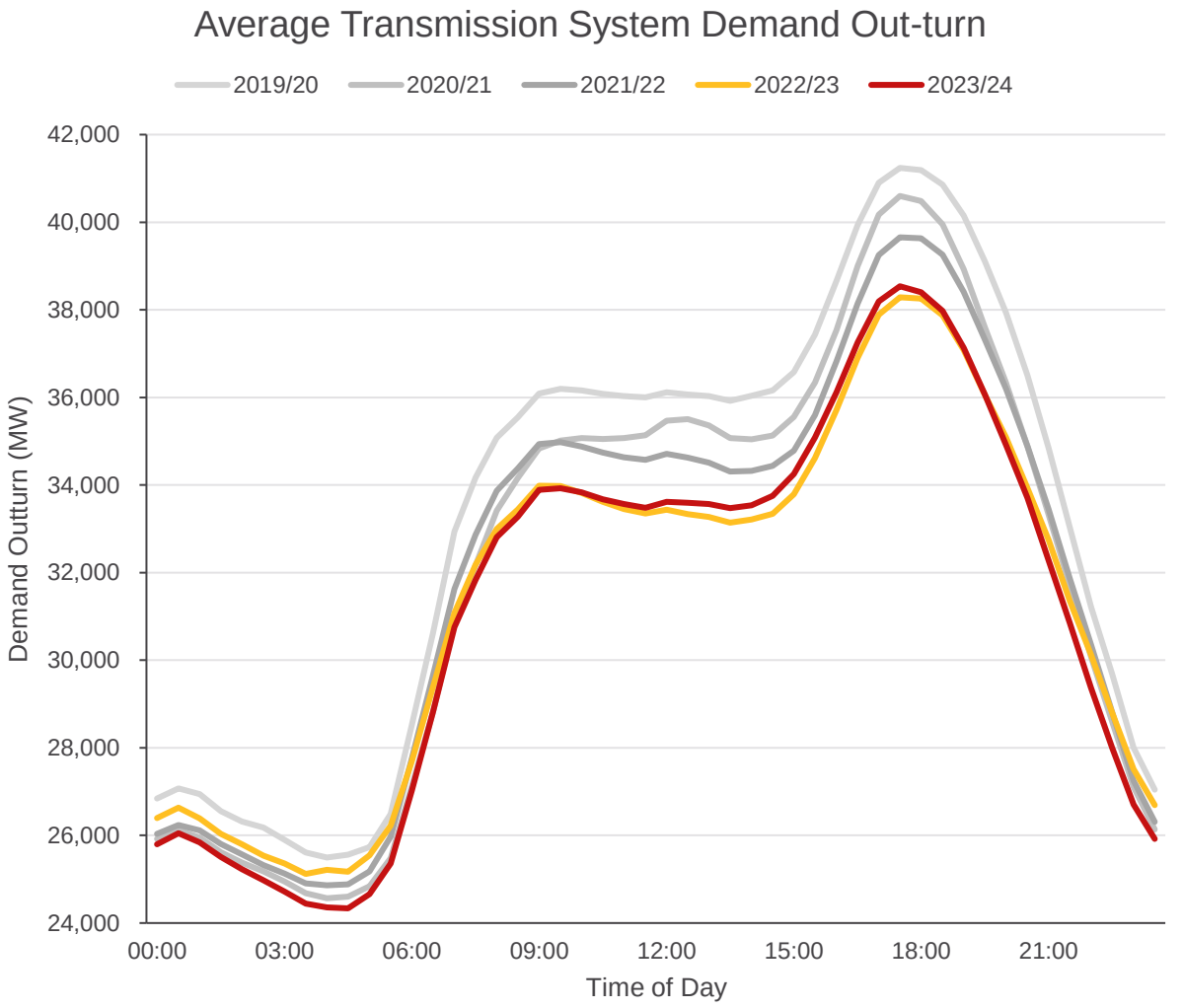
Transmission System Average Demand Hourly Profile

Hourly demand profile remains relatively similar across winter 2023/24

The hourly demand profile has remained similar throughout the day and there are no significant changes in the demand profile on an hourly basis. Across the 2023/24 winter, the average demand decreased overnight but remained relatively similar throughout the day.

Key highlights for winter 2023/24:

- Extremely similar demand curve to winter 2022/2023 when very high power prices saw price based demand reduction.
- The first winter since 2019/2020 where average demand did not fall significantly from the previous winter.
- Decrease in demand during the evening peak by up to 7% compared to 2019/20.
- Historically low transmission system demand during the overnight period.
- Demand profile across the mid-day through to evening increased by an average of 0.5% compared to winter 2022/23.
- No significant change to the profiles of time of consumption.

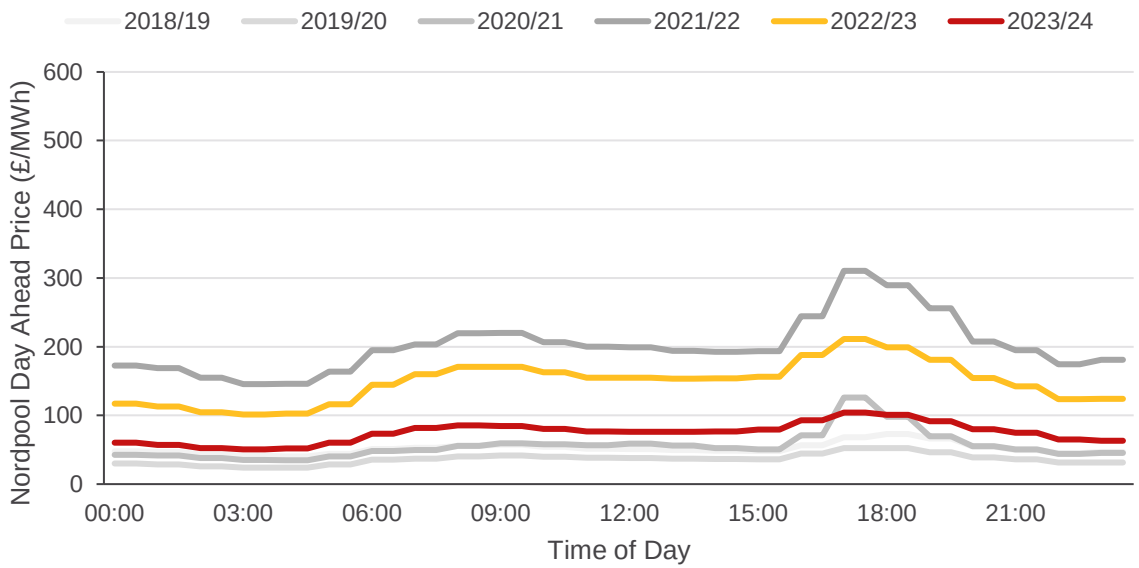


Note: Dataset is comprised of Winter months only (November – March)

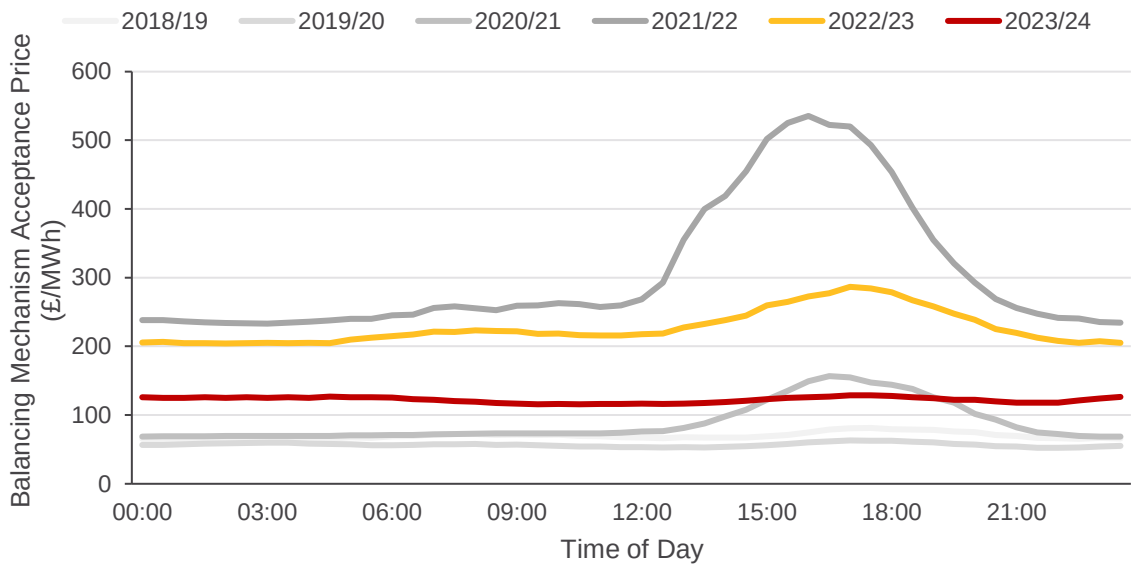
Day-Ahead Market and Balancing Mechanism Prices

Wholesale energy prices are significantly down from the winter peak of 2022/2023 but remain significantly elevated above 2019/2020 with a much flatter BM offer acceptance cost

Average Day Ahead Wholesale Market Price



Average Balancing Mechanism Offer Acceptance Price

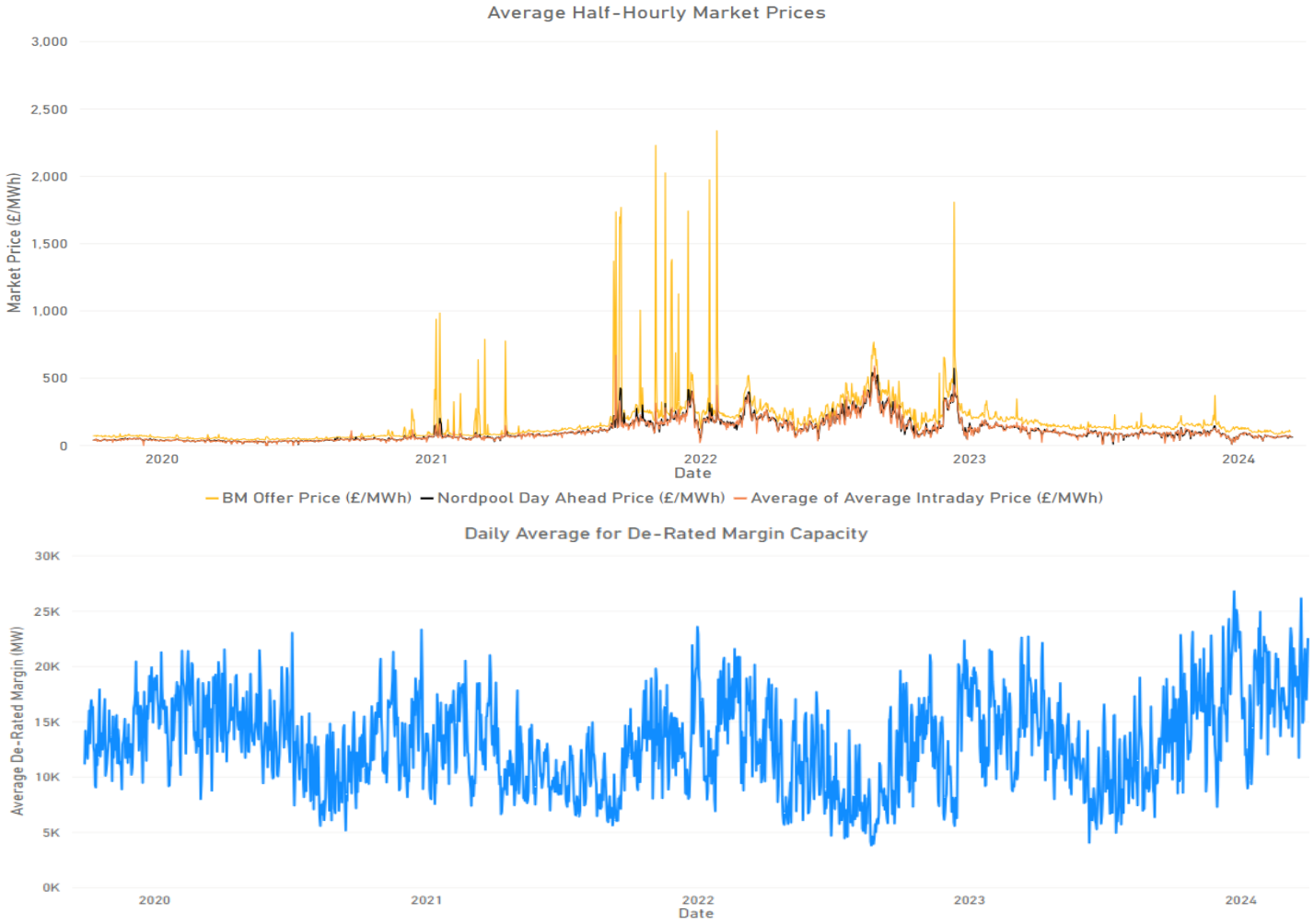


- Year-on-year, Nordpool day-ahead market prices have decreased by over 30% since the global energy price spike in 2021/2022.
- However across all time periods on average prices remained higher than winter 2020/2021 as gas prices remained elevated.
- Daily peaks were less significant than previous winters potentially due to decreased Balancing Mechanism arbitrage opportunity after the enactment of the Inflexible offers Licence condition (IOLC).
- The introduction of the IOLC prohibiting units from seeking excessive benefits when withdrawing a generating position has contributed to the removal of significant darkness peak prices paid in previous winters and the relatively flat price profile through the day.
- The peak time for BM price is no longer coincident with the peak price in prior markets as the requirement for system flagged synchronous machines meant higher overnight prices were required for system security.

Note: Dataset is comprised of Winter months only (November – March)

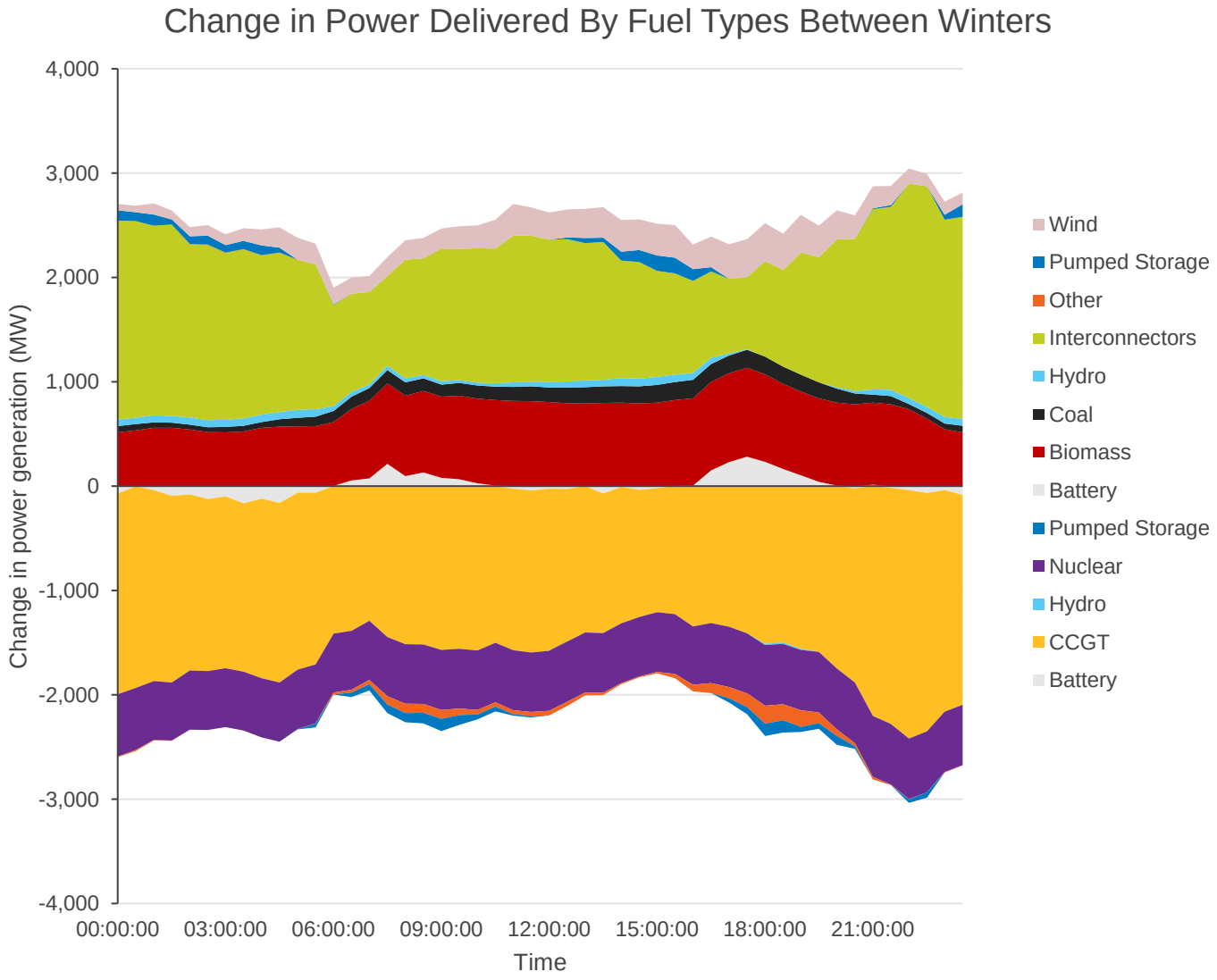
Balancing Mechanism Offer and Energy Market Prices

Periods in which the BM Offer Price spikes well above wider market prices have been mostly eliminated in winter 2023/2024 likely due to the inflexible offers licence condition and healthier margins



- BM offer prices are strongly in correlation to the wholesale spot electricity markets and dependent on the natural gas market.
- BM offer prices dropped significantly and had less radical fluctuations in winter 2023/2024 than recent winters. Most of these previous spikes in price can be attributed to a pricing strategy now prohibited in the market.
- In the winter of 2023/24, margin levels were notably healthier compared to the previous year. Specifically, in December 2023, the de-rated margin capacity was 46% higher than the previous year.
- BM offer prices had a significantly lower fluctuation between highest and lowest prices in winter 2023/24, the difference between the highest and lowest price compared to winter 2022/23 was around 350% and 1600%.
- The BM offer price has a much more significant average premium on other market prices since the end of 2023. While gas prices have fallen BM offer prices have remained elevated falling more slowly.
- There have been several instances of negative pricing in spot-markets as units holding subsidies set the clearing prices for some settlement periods. When the spot-market clears at a negative price for more than 6 hours of consecutive intervals, some units holding Contracts for Difference lose their subsidy.

Power Generation Change by Technology Type

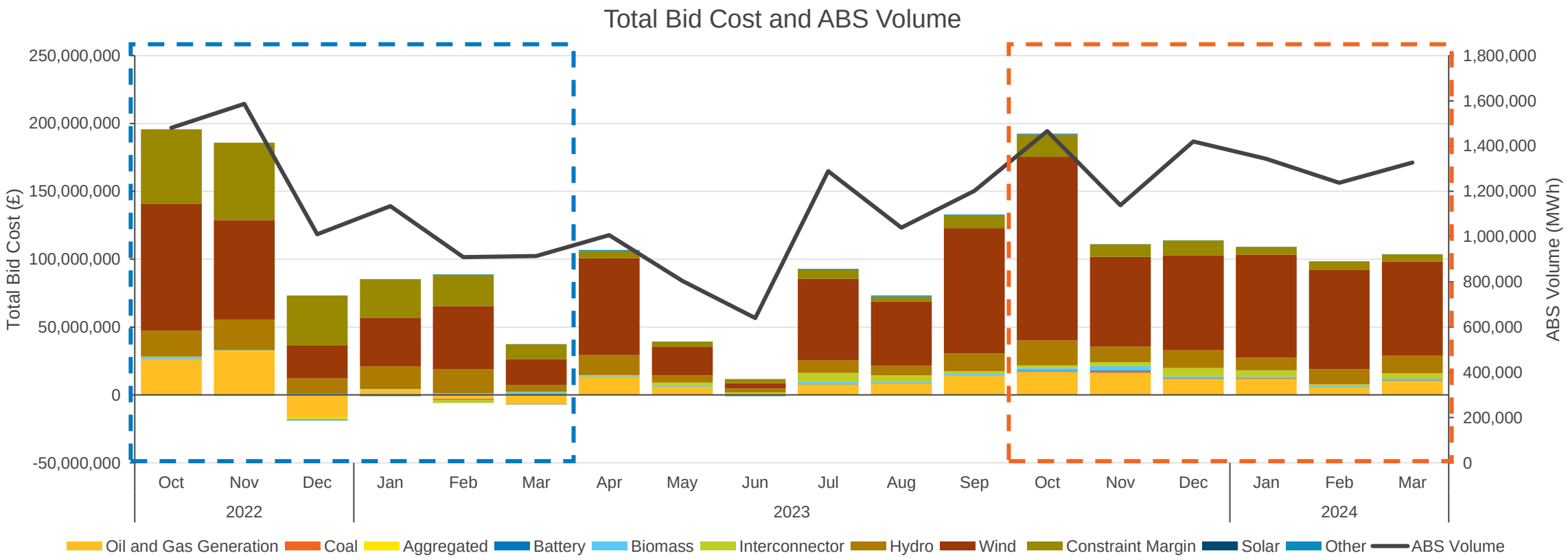


Note: Dataset is comprised of Winter months only (November – March)

- Across winter 2023/2024, there was a significant increase in the energy provided by interconnectors. This largely displaced energy previously provided by CCGTs which saw a corresponding decrease in dispatched volume.
- In winter 2022/2023 there were more significant periods where interconnectors exported from GB as lower gas prices in GB than continental Europe and French Nuclear outages reversed the typical winter imports observed.
- There was a small increase in the use of coal power stations across winter as it was consistently more economic than gas generation as stockpiles of fuel are consumed ahead of planned closure.
- Batteries saw an overall increase in utilisation particularly prominent over the darkness peak periods, however given their requirement to cycle this increased utilisation also shows an increase in periods charging during early morning hours.
- In particular battery volumes dispatched through the BM were much more significant with the launch of ESOs Open Balancing Platform.
- There was a significant increase in biomass generation volumes as newly commissioned plants generated but also as units which previously did not dispatch due to their subsidy economics became cost efficient to run as baseload.
- There was a less significant increase in average wind production despite significant newly commissioned generation due principally to constraint management meaning much of this capacity could not be realised.

Balancing Actions

Bids



A) Total monthly bid costs were on average 15% higher in winter 2023/24 compared to winter 2022/23. This was driven by a notable increase in wind curtailment resulting in a significant increase in the volume of bids made to wind generators to manage high wind outturn across all months of the winter 2023/24 period.

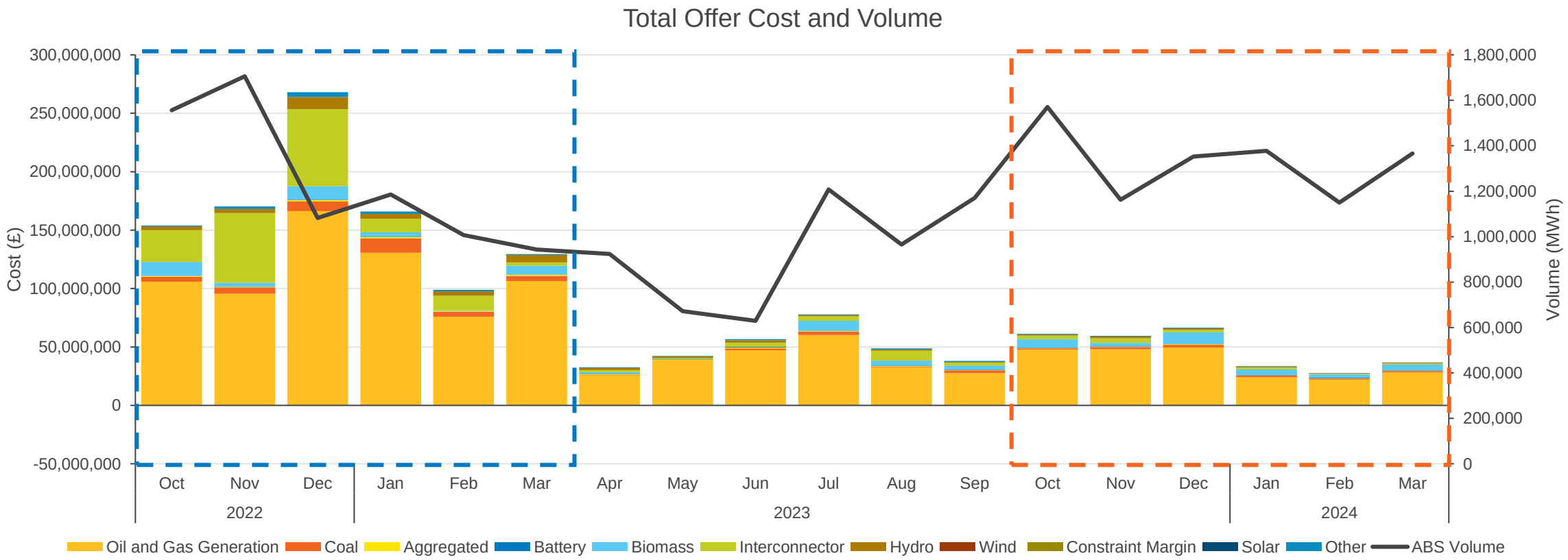
B) Constraint margin costs were lower this winter compared to last year due to less volume of actions taken to secure the system and lower average wholesale prices.

*Negative values correspond to bids taken at a positive price i.e. ESO is paid for the action

Winter 2023/24 period

Winter 2022/23 period

Offers



A) Total offer costs have reduced significantly this winter compared to winter 2022/23, with monthly costs on average 71% lower year-on-year. This has been driven mainly by the notable reduction in energy prices between the two periods. In contrast absolute offer volumes have increased this winter by 7%.

B) Total offer costs have reduced across all technology types except batteries, which have seen payments more than double this winter compared to last year (although these remain a small fraction of overall costs). The most notable reductions have been observed in Offers from interconnectors, which are 94% lower year-on-year, while payments for oil and gas have reduced 65%.

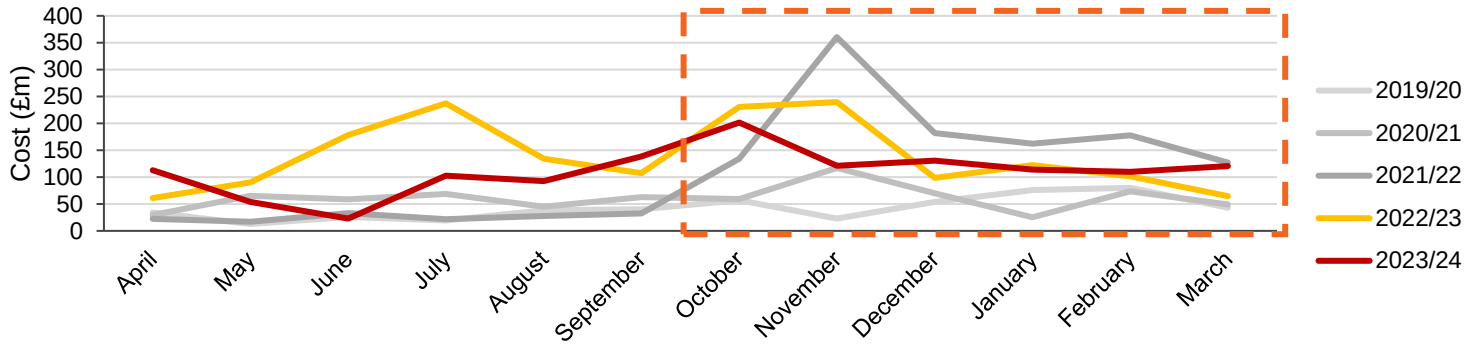
*Negative values correspond to offers taken at a negative price i.e. ESO is paid for the action

Winter 2023/24 period

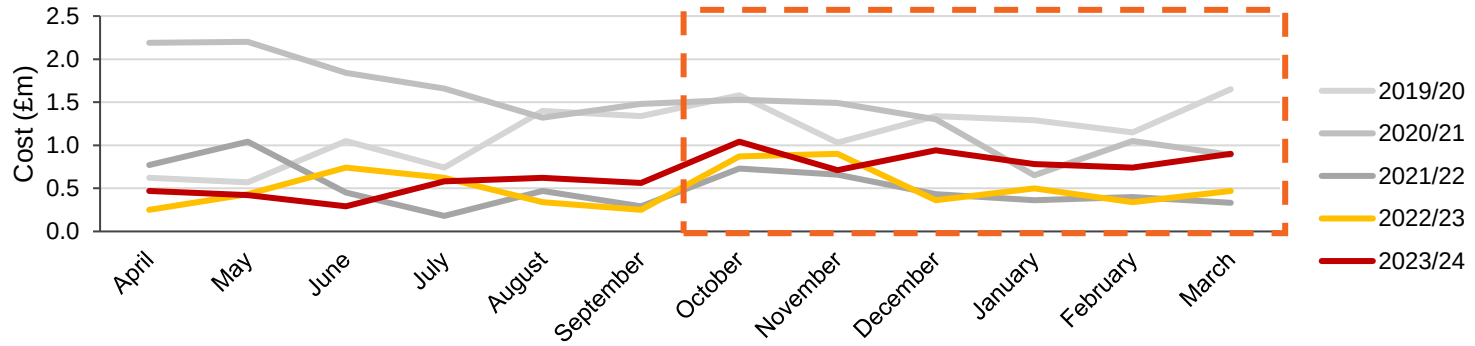
Winter 2022/23 period

Constraint Costs (1/2)

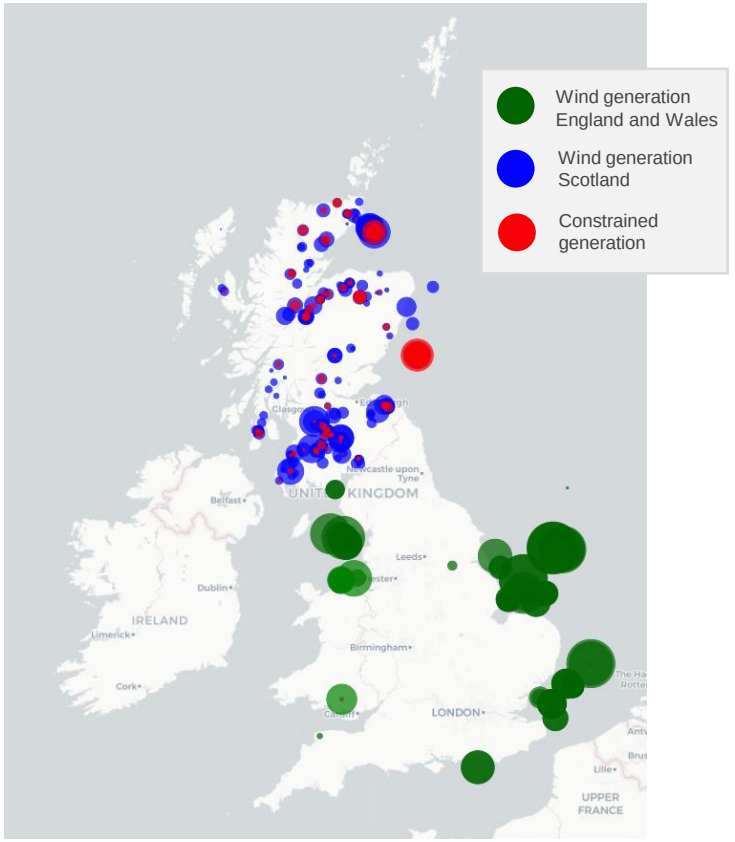
Monthly Constraint Cost



Monthly Constraint Volume



Wind generation and constraints October 2023 – March 2024

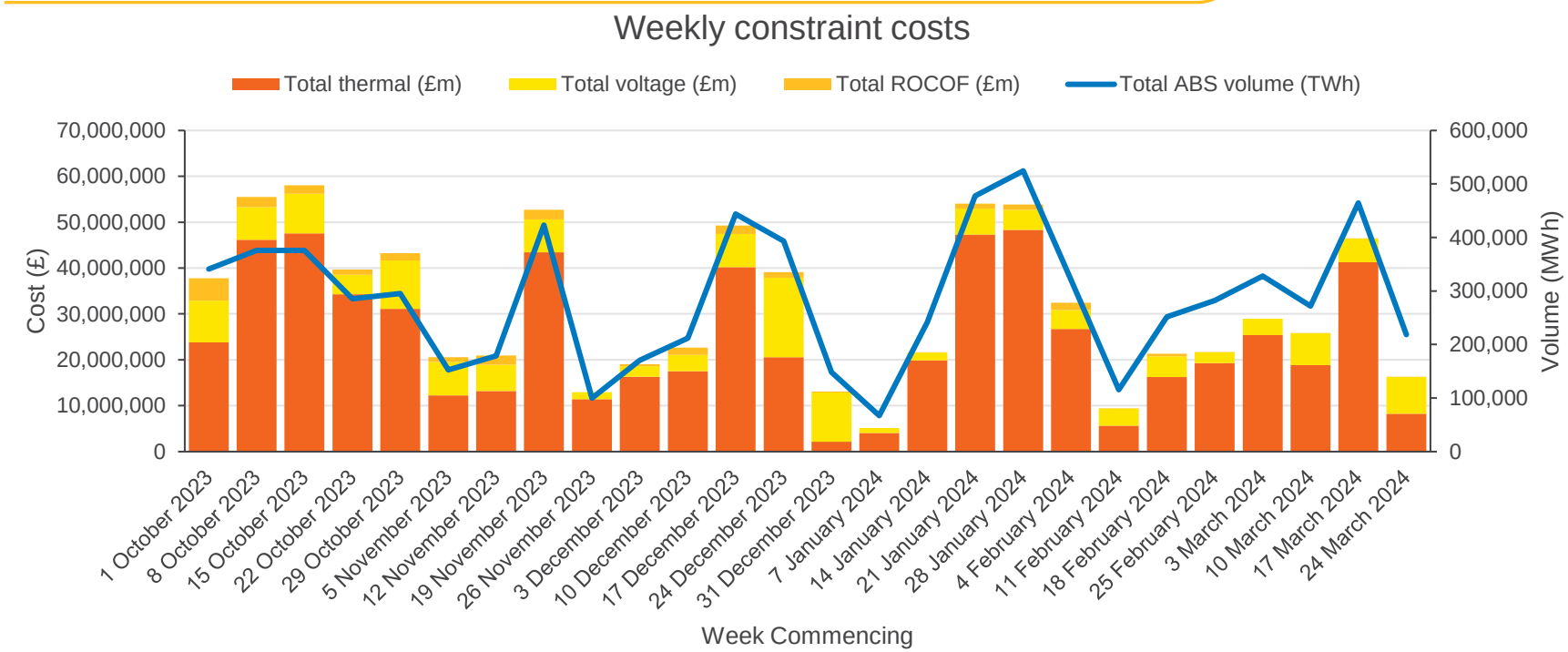


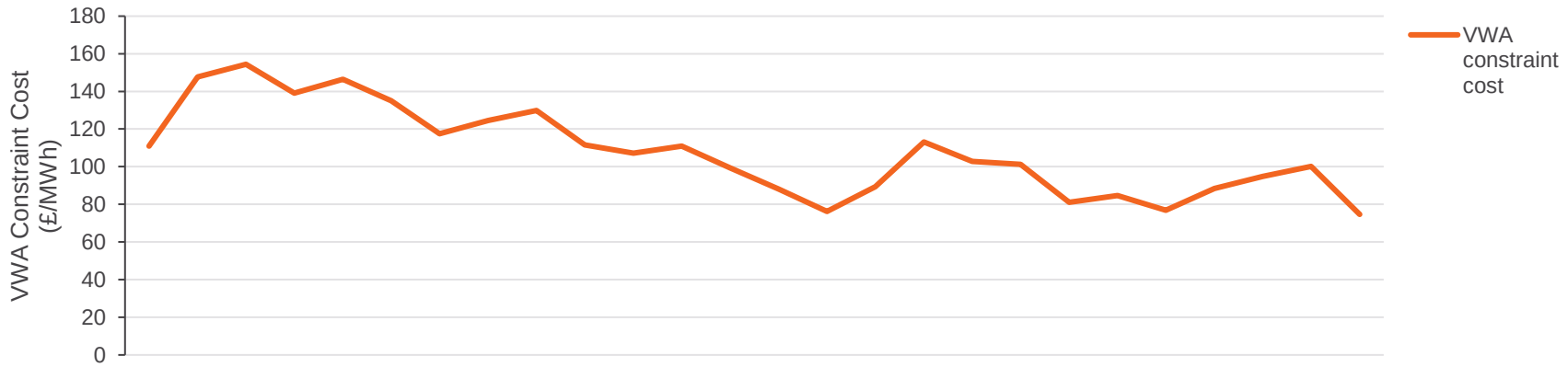
A) Constraint costs were lower this winter compared to winter 2022/23, despite the higher volume of actions, due to lower average wholesale prices.

B) In contrast, the total constraint volumes have increased compared to last year in all months except November. High wind outturn has contributed to this increase. Although December had the highest monthly wind outturn, October experienced the highest volume of wind curtailment. This is due to the regional distribution of wind output. Wind outturn was particularly high in Scotland in October leading to notably high overall constraint volumes in this month, compared to higher wind output in England and Wales in December which had a lesser impact on overall constraints.

Winter period

Weekly Constraint Costs



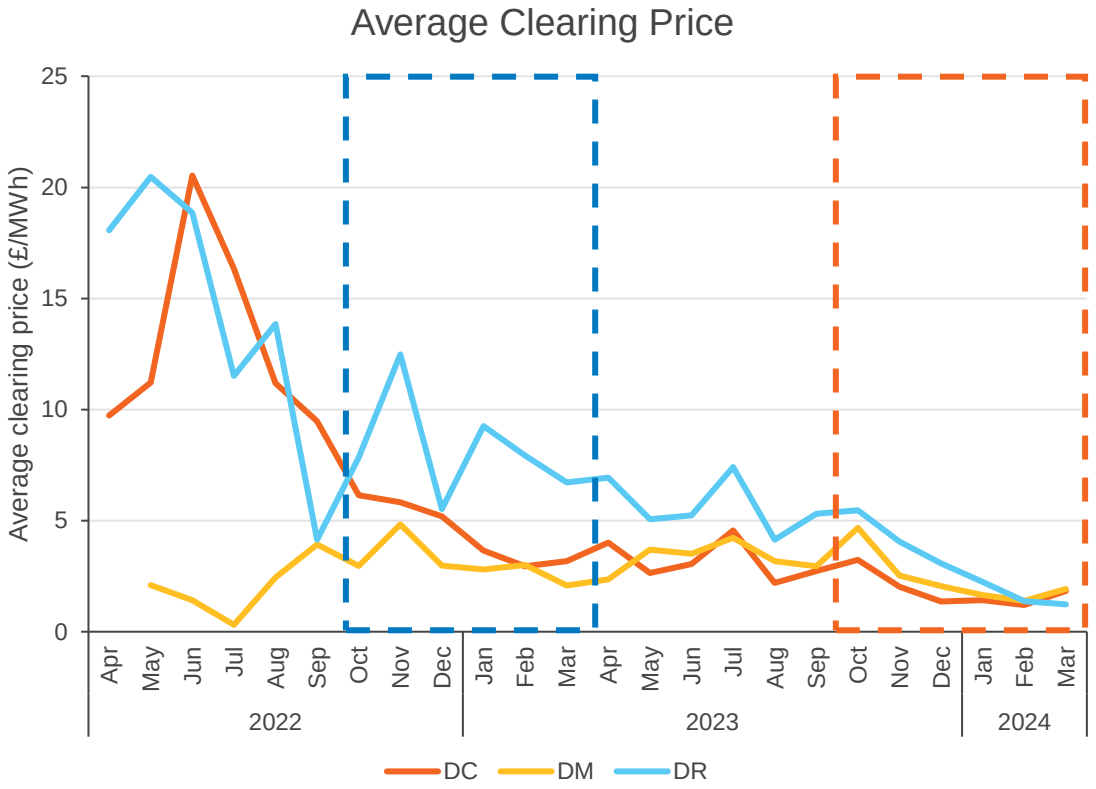


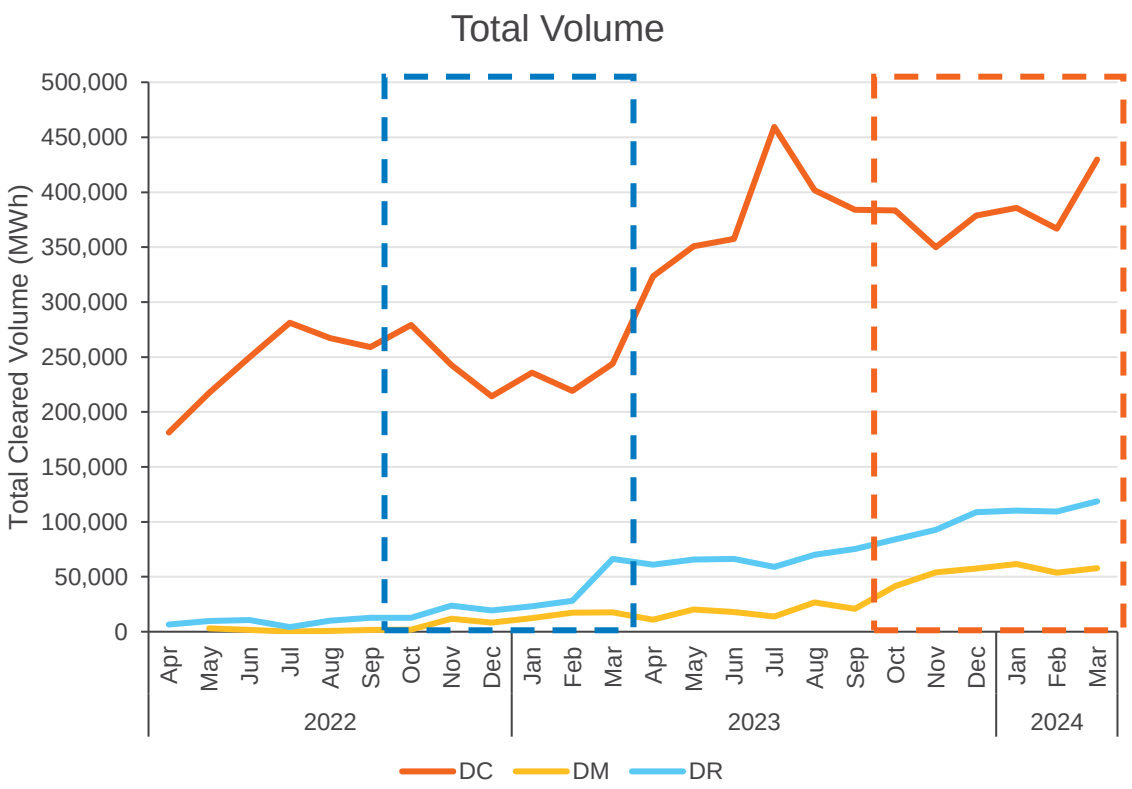
A) Thermal constraints are closely linked to periods of high wind outturn with the highest costs occurring on days of increased volumes of wind curtailment and on storm days such as 18 and 21 October, which increase forecasting error.

B) Voltage costs tend to be higher during lower off-peak demand periods as units may need to be instructed for voltage support. Voltage constraints were consequently highest in w/c 24 and 31 December, coinciding with lower demand periods over the winter holiday period.

C) Higher stability (ROCOF) constraints correlate with weeks of high wind output requiring increased ESO intervention to manage system inertia by instructing turn up of synchronous generation. Stability costs have reduced significantly in recent years due to the implementation of ESO initiatives such as the FRCR and stability pathfinders.

Ancillary Service Prices





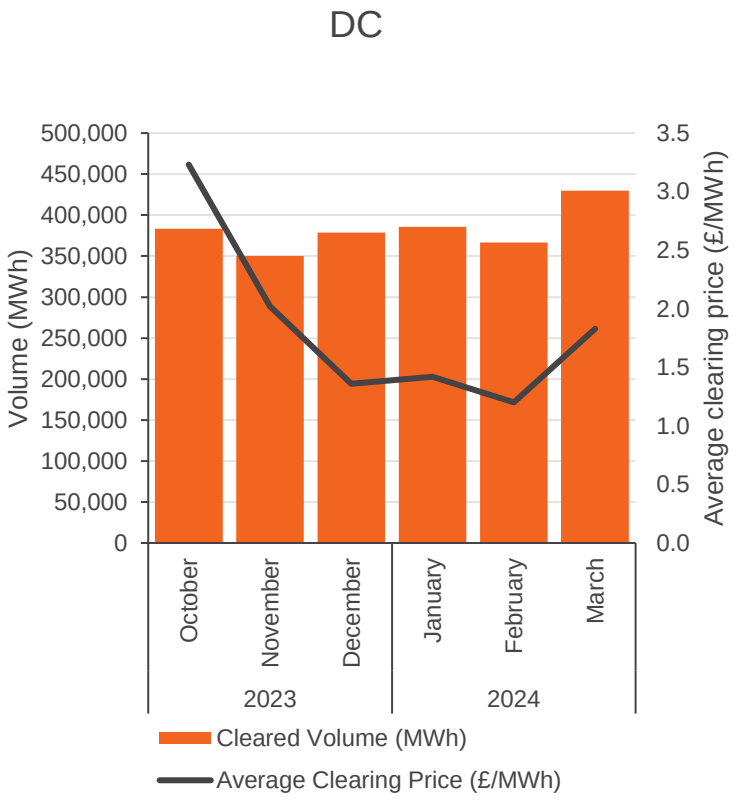
A) Dynamic Containment (DC), Dynamic Moderation (DM), and Dynamic Regulation (DR) prices have seen notable reductions in average clearing prices (high and low combined) since last year. This is because of an increase in the number of market participants, certainty around requirements and the auction process due to the continued development of the Single Market Platform. Reductions in the average clearing price for DM has been less pronounced because the DM market is less developed than the DC and DR markets (having launched in May 2022). We have been taking action to develop the market and we are now procuring larger volumes than last year.

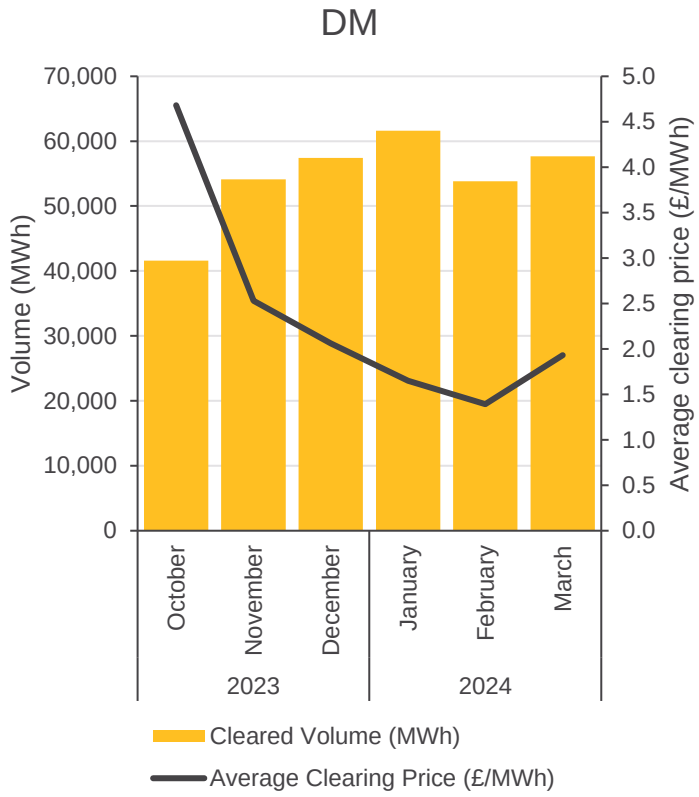
B) Total volumes have increased for all three services over the last year with volumes this winter markedly higher compared to last year as the markets have become more established.

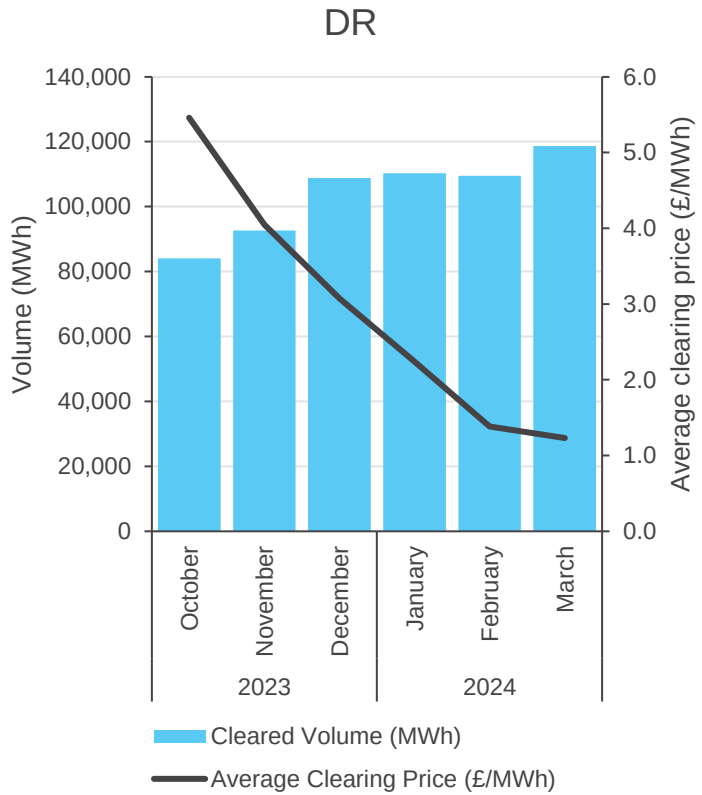
Winter 2023/24 period

Winter 2022/23 period

Ancillary Service Prices





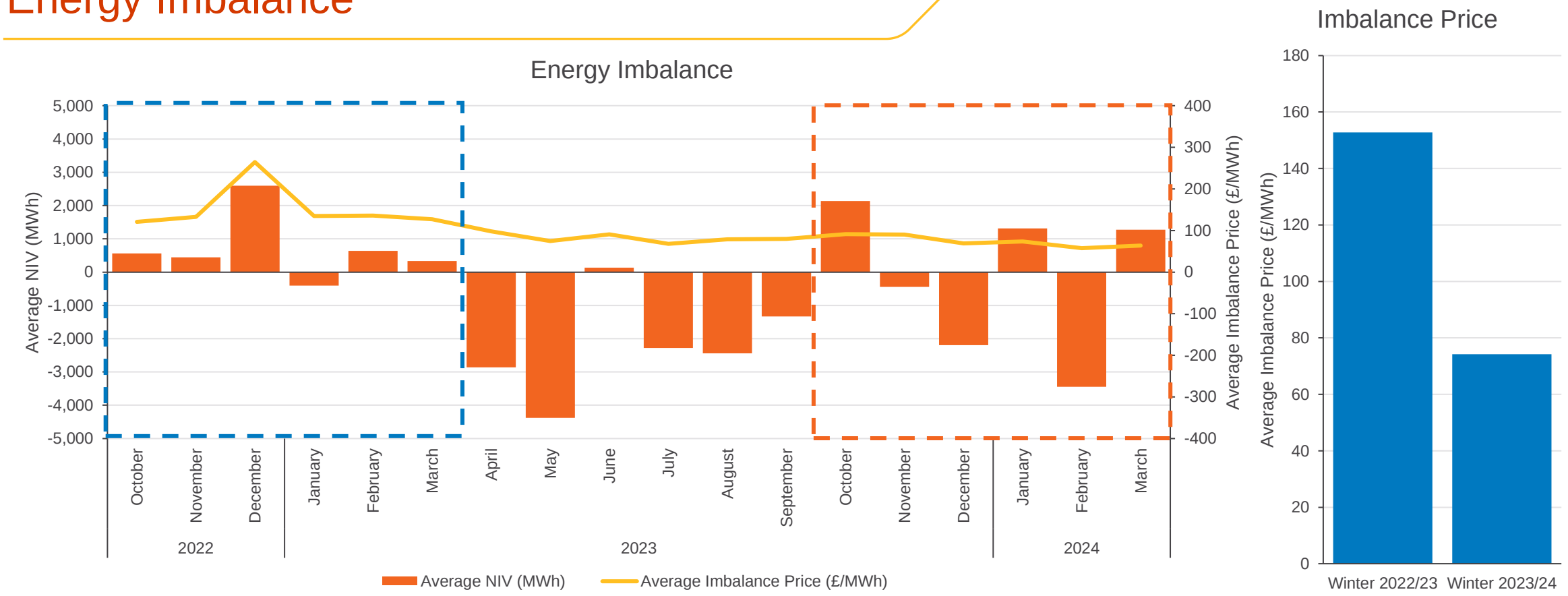


A) The mean average clearing price for winter 2023/24 is £1.8/MWh, £2.37/MWh and £2.91/MWh for DC, DM, and DR respectively, compared to an average price of £4.49/MWh, £3.11/MWh and £8.29/MWh across winter 2022/23. This is a 59%, 24% and 65% reduction year-on-year.

B) Total monthly volumes averaged 382GWh, 54GWh, and 104GWh for DC, DM and DR respectively across winter 2023/24 compared to 239GWh, 12GWh, and 29GWh across winter 2022/23. This is a 60%, 367%, and 260% increase year-on-year.

C) In March we saw a rise in average clearing prices correlated with a drop in offered capacity and competition. This coincides with both an increase in requirements due to a change in requirement settings and seasonal lowering of inertia. Despite this small increase prices are still well below their historic average year on year.

Energy Imbalance



A) The average imbalance price has reduced in winter 2023/24 (£76.32/MWh) compared to winter 2022/23 (£152.77/MWh).

B) The monthly average Net Imbalance Volumes (NIV) was highest in December at 2.1GWh, while February saw the lowest NIV at -3.4GWh. However, the highest and lowest daily average NIV both occurred in January, on 21 January (22.5GWh), coinciding with Storm Isha, and 9 January (-19.3GWh) respectively.

Winter 2023/24 period

Winter 2022/23 period

Market Developments

Market Development Overview

There have been a few notable market developments over the Winter 2023/24 period. These are outlined in more detail in the following slides.

DFS trials

- The ESO ran a series of test events for the Demand Flexibility Service (DFS) over the Winter 2023/24 period.
- Prices have progressively improved as DFS events continued.

OBP launch

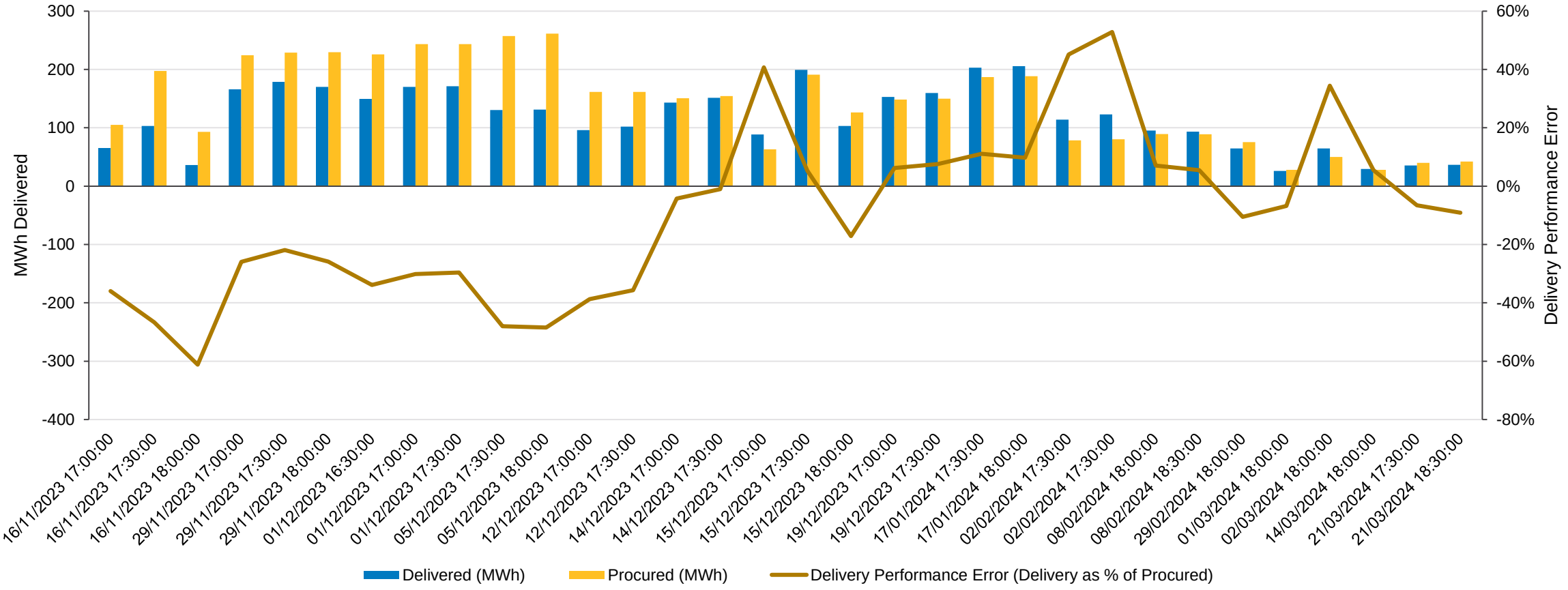
- The first stage of our new platform to support the bulk dispatch of battery storage and small Balancing Mechanism Units, the Open Balancing Platform (OBP), went live on 12 December 2023.

Balancing Reserve launch

- The ESO held the first auction for the Balancing Reserve (BR) service on 12 March.
- The BR service enables us to move to day-ahead procurement energy reserves.

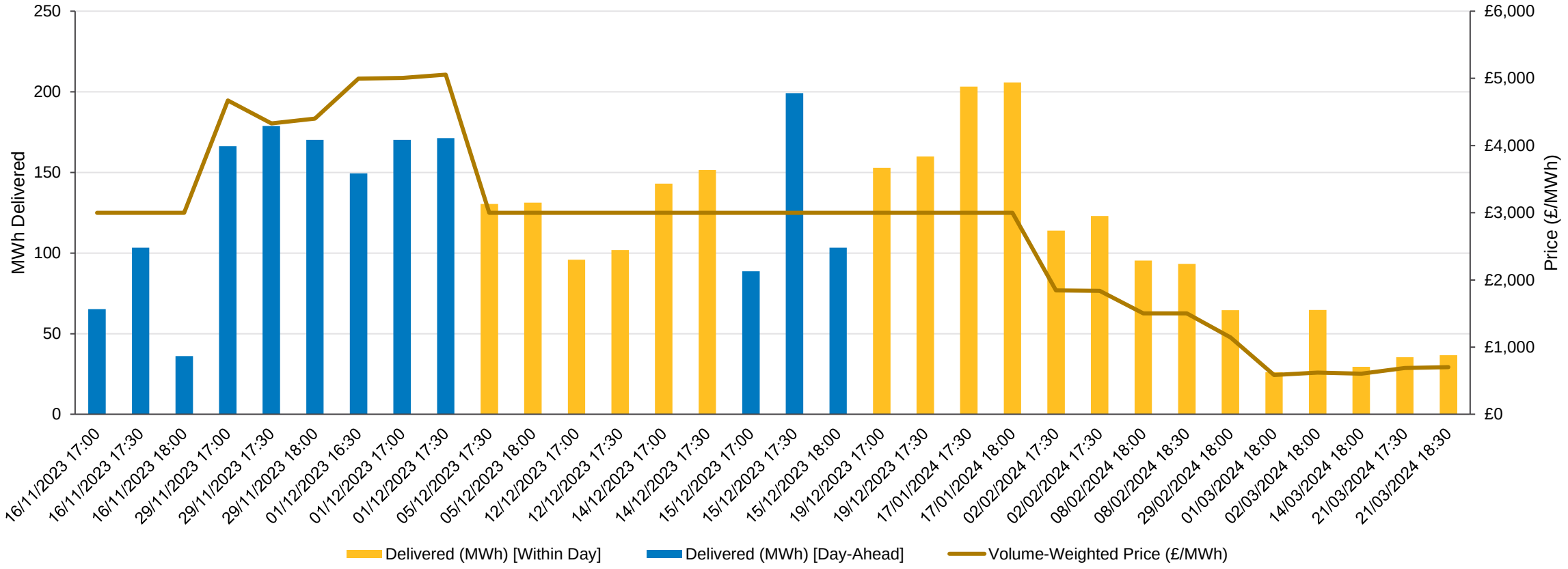
The ESO used DFS over 36 occurrences in Winter

Delivery of DFS volumes improved performance to within -9% and 5%, or within 4 MWh in the last three uses.



The ESO used DFS over 36 occurrences in Winter

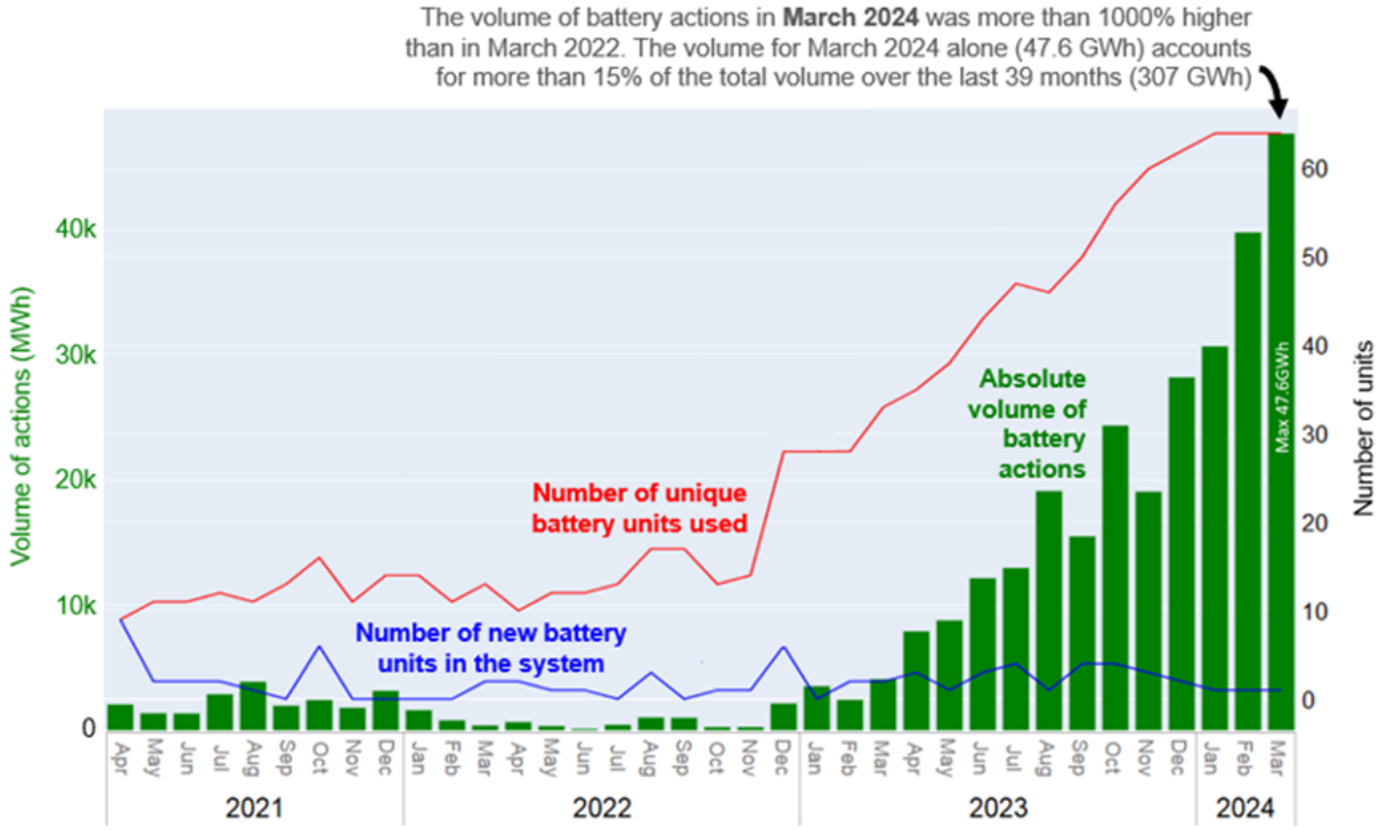
Prices progressively improved as DFS events continued, reaching as low as £585/MWh. However, some delivered volume, albeit small (<1 MWh) was procured as low as £150/MWh



Open Balancing Platform Launch

The first stage of our new platform to support the bulk dispatch of battery storage and small Balancing Mechanism Units, the Open Balancing Platform (OBP), went live on 12 December 2023.

- Control room engineers can now send hundreds of instructions to smaller Balancing Mechanism Units and battery storage units at the press of a button.
- Utilisation of storage assets has grown significantly across 2023/24. February had the highest battery dispatch volume of bids and offers (39.8GWh) since April 2021. This illustrates our commitment to maximising the flexibility of energy offered by battery storage over the last year.



Balancing Reserve

The ESO held the first auction for the Balancing Reserve (BR) service on 12 March. The BR service enables us to move to day-ahead procurement of the energy reserves we need to respond to system demand in real time, rather than the current on-the-day system – reducing costs and improving system security.

- We utilise 'Regulating Reserve' to correct energy imbalances (differences between generation and demand) on the GB power system. We have previously used optional bids and offers in the Balancing Mechanism (BM) to create Regulating Reserve in real time. The cost of bids and offers has risen significantly and during periods of scarcity procuring reserve through BM bids and offers can be extremely expensive.
- The new BR service allows us to procure Regulating Reserve on a firm basis at day ahead. This will help reduce balancing costs and improve system security as the reserve capacity is guaranteed for the Control Room to access when they need it.
- BR enables the ESO to procure firm Regulating Reserve capacity through a Day Ahead auction, both reducing balancing costs and providing improved system security by guaranteeing headroom (reduced consumption or increased generation) and footroom (reduced generation or increased consumption) for the Control Room to access when needed.
- An August 2023 cost benefit analysis commissioned by the ESO found this will deliver £639m of savings for consumers over the next four years in the base case, and up to £821m in our high case.

Case Studies

Case Study Days Reviewed in Further Detail

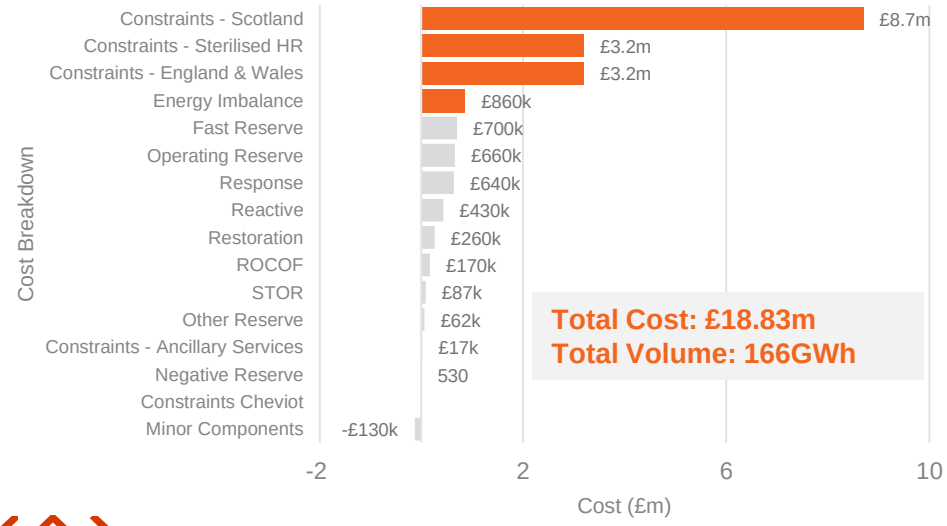
The below table features a list of the cases studied in this report.

Date	Total Cost (including ancillary services)	Volume of actions	Reason for review
20 October 2023	£18.83m	166GWh	Highest balancing cost day across winter 23/24
01 December 2023	£10.62m	64GWh	Highest accepted offer price day across winter 23/24

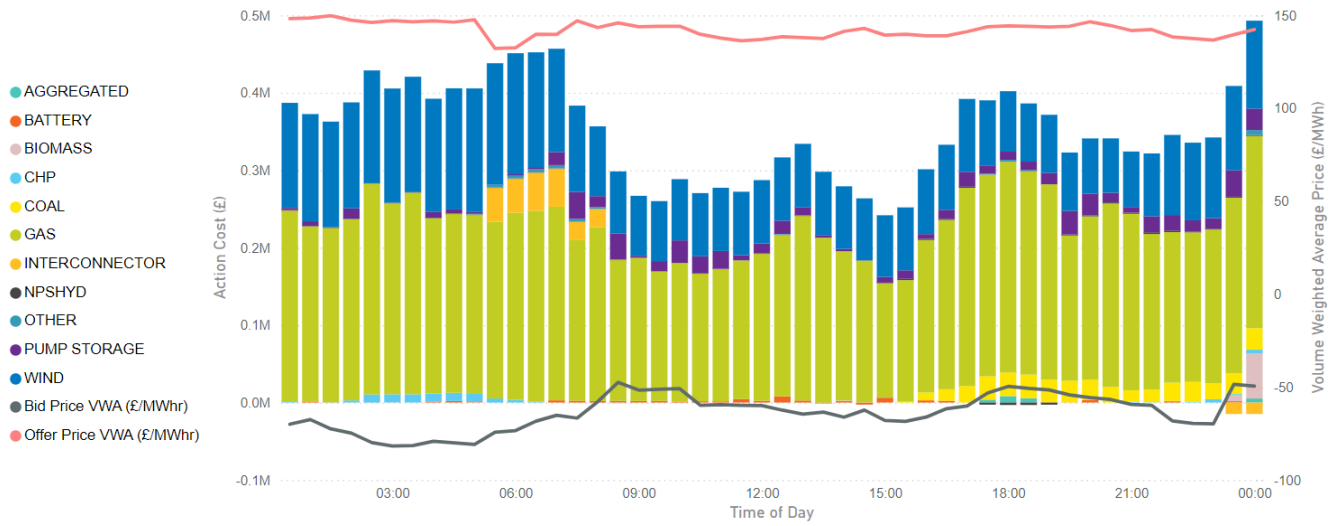
20 October 2023: High-Cost Day Case Study

- 20 October 2023 was the highest cost day across Oct 23 – Mar 24 totalling £18.83m including ancillary service costs.
- There was high wind out-turn reaching up to 14.7GW and maintaining a range of 12GW – 14.7GW across the majority of the day as a result of Storm Babet. This led to several circuit trips with deviations in frequency within operational limits as a result of loss of output from several wind farms.
- Despite this with continued high wind generation, actions were taken to curtail wind units to manage thermal constraints in Scotland at low bid prices with subsequent replacement energy.
- In addition, many gas units were either traded or accepted in the balancing mechanism for voltage support and managing inertia.

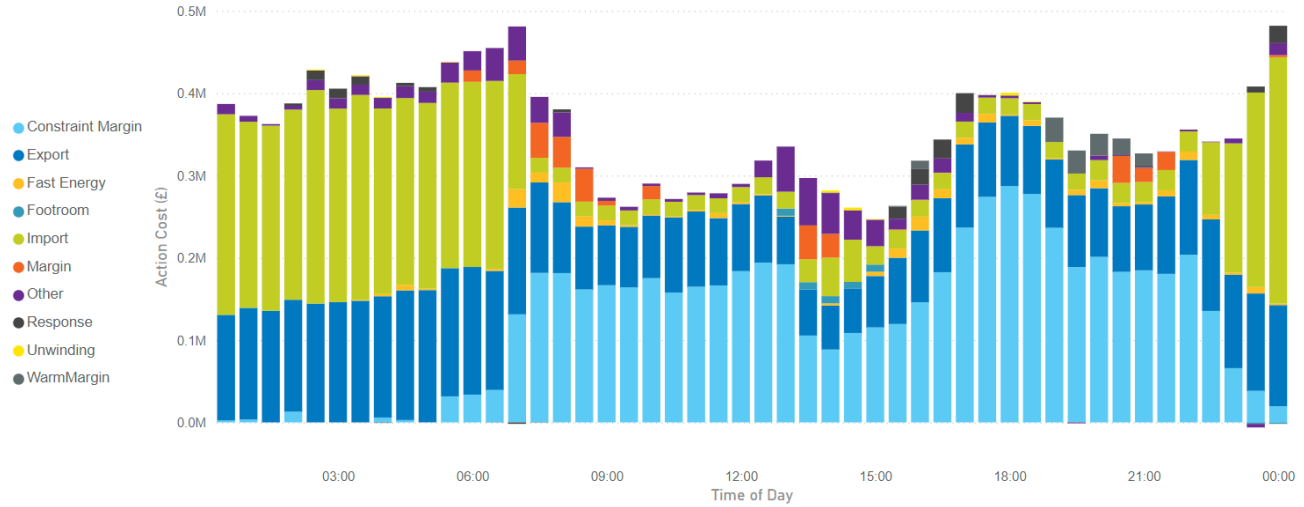
Cost Breakdown - 4 most expensive categories highlighted - total cost £18.83m



Balancing action cost by Fuel Type



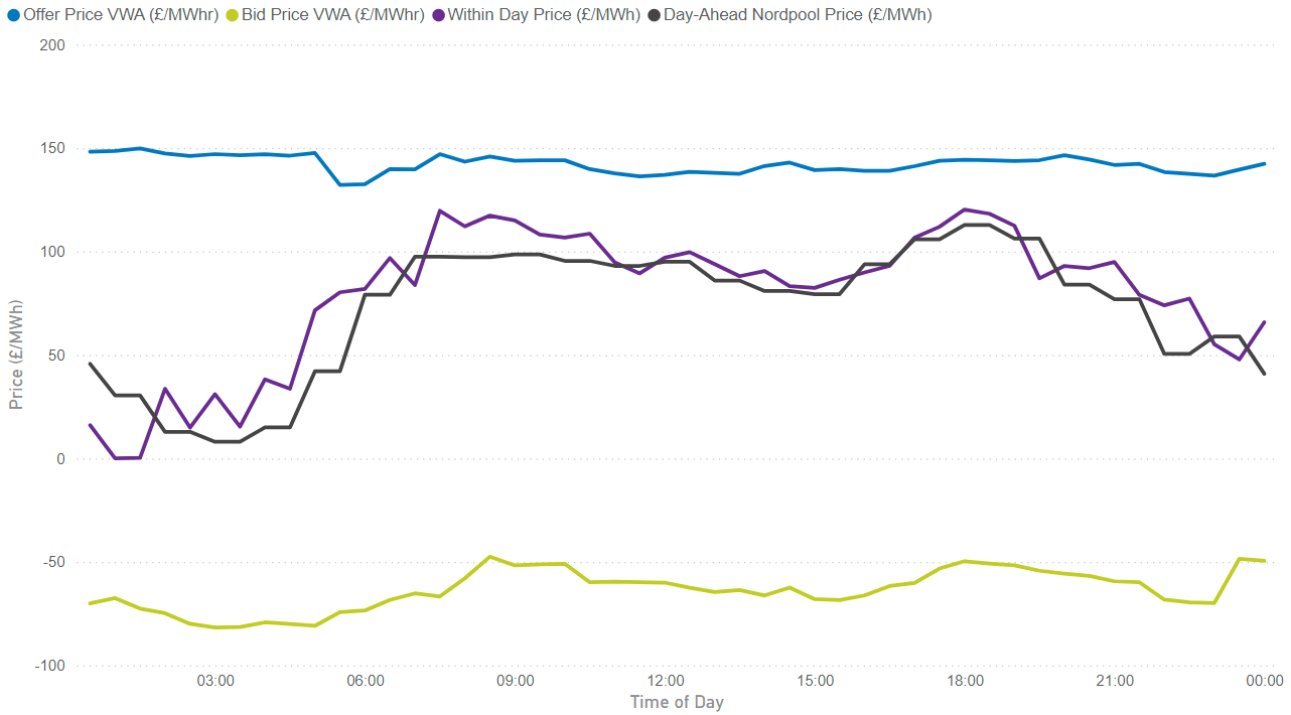
Balancing action cost by Reason



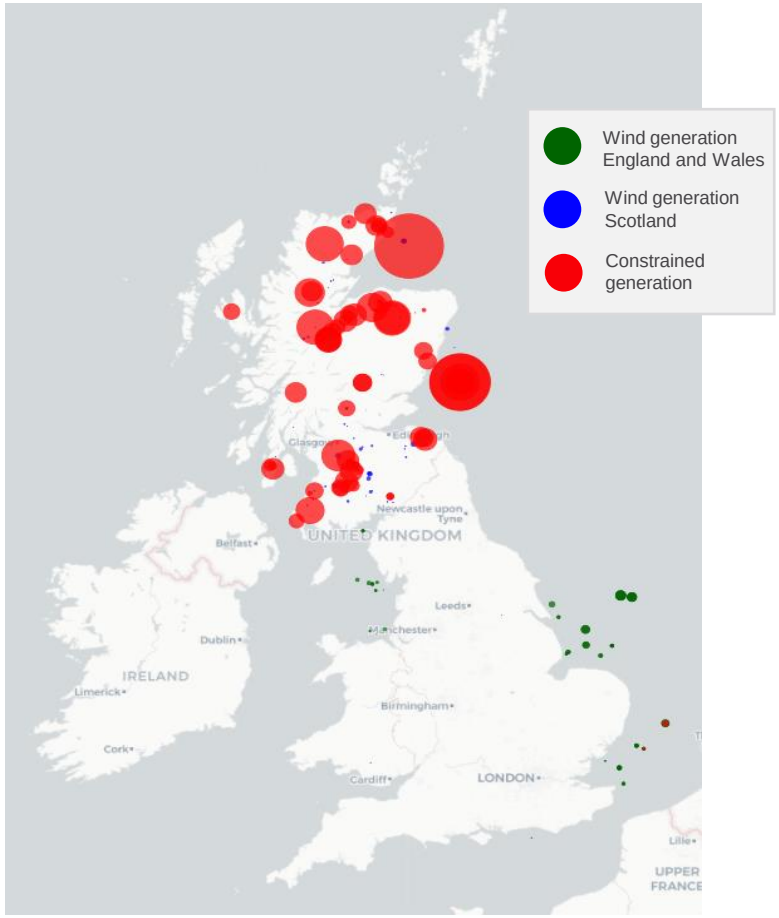
20 October 2023: High-Cost Day Case Study

- Within Day market pricing dropped very low across the morning period between 00:00 – 04:30 before increasing to a more stable level for the majority of the rest of the day.
- Both volume weighted average offer and bid pricing remained relatively consistent and did not fluctuate much with the changes in market pricing. This will be attributed to wind bid actions across the whole day and gas units being accepted or traded in the BM for the overnight periods.
- No individual action was extremely expensive, but a consistently lower average bid pricing and higher average offer price combined with the total number of actions taken across 20 October 2023 resulted in high balancing costs.

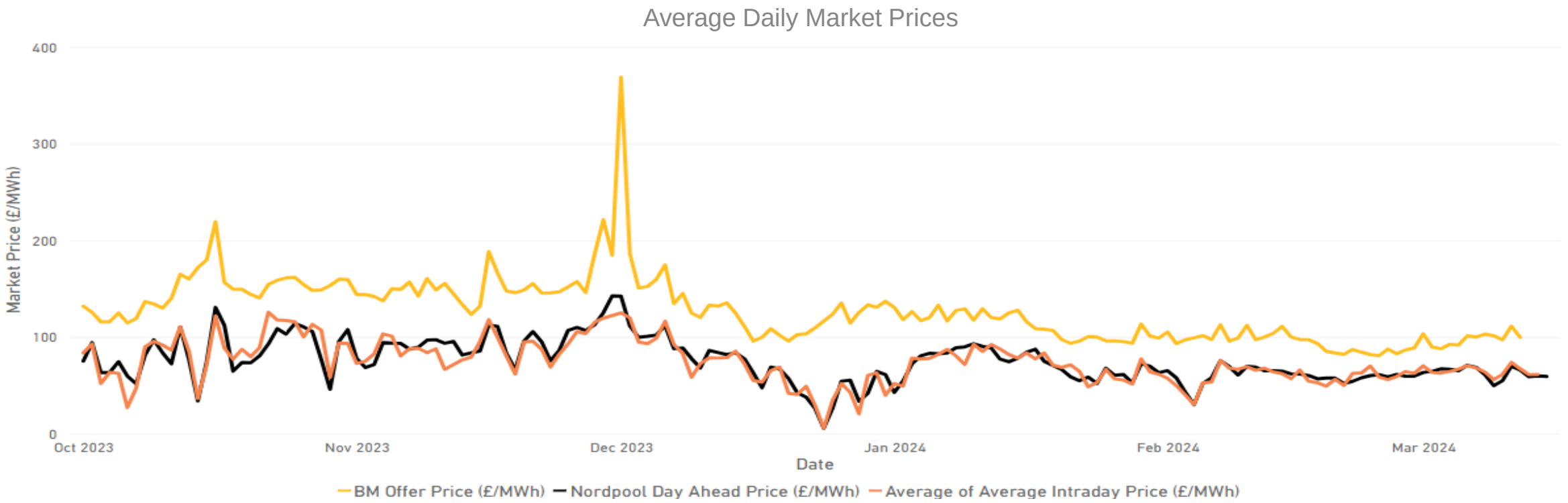
Average Offer and Bid pricing against Market Pricing



Wind generation and constraints 20 October



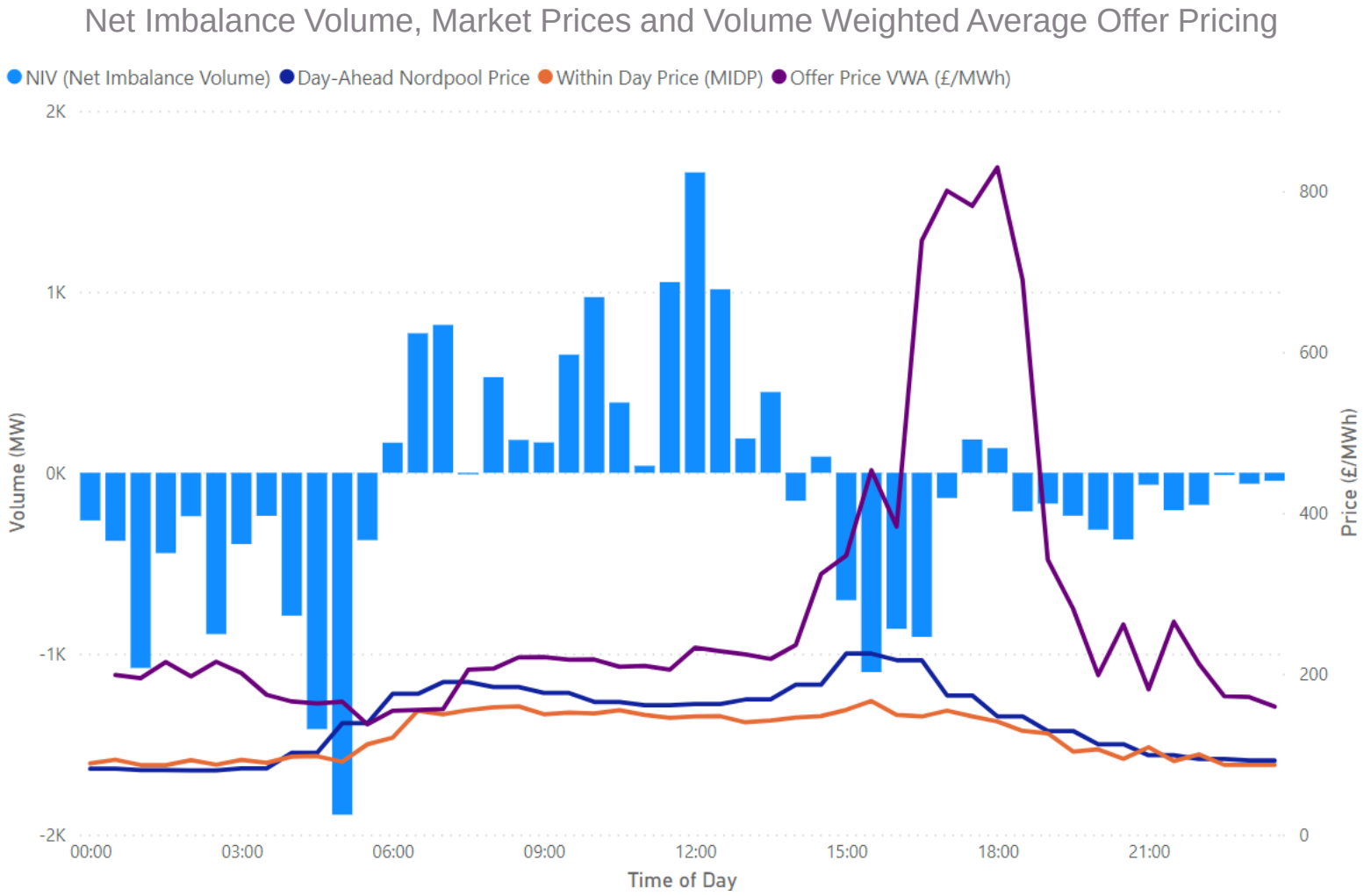
1 December 2023: High-Price Day Case Study



- 1 December 2023 had the highest BM average offer price across the winter of October 2023 and March 2024 at a price of £368.80/MWh. The average daily Nordpool day-ahead and intra-day prices were calculated to be £142.19/MWh and £124.93/MWh respectively.

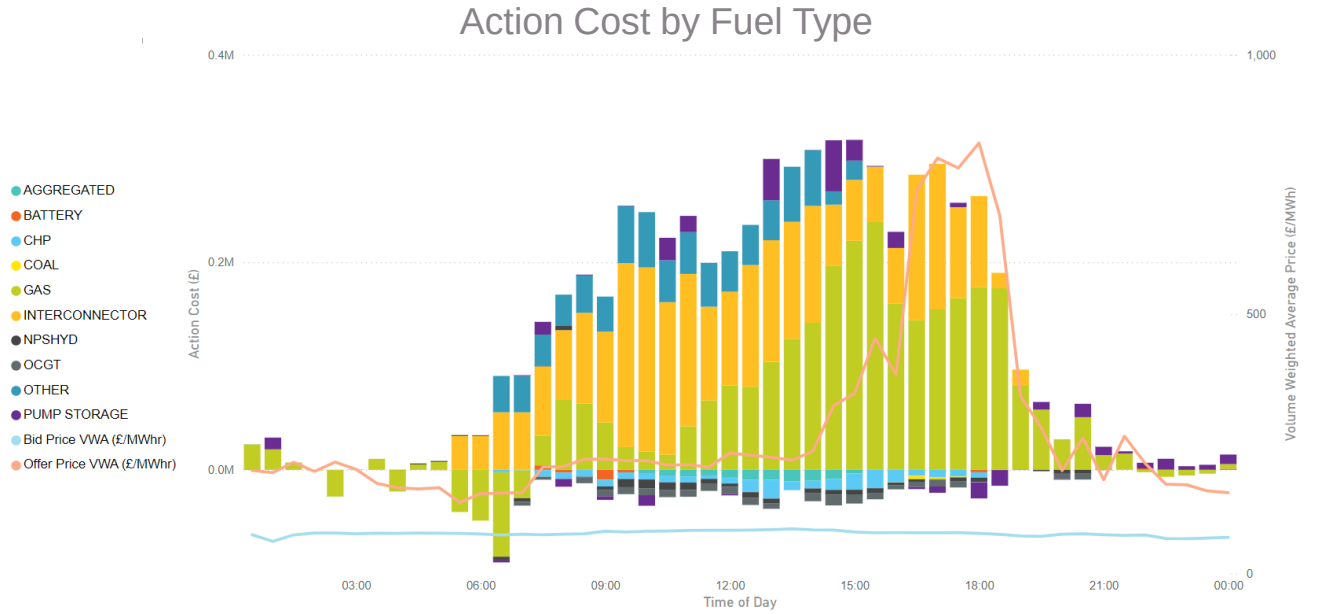
1 December 2023: High-Price Day Case Study

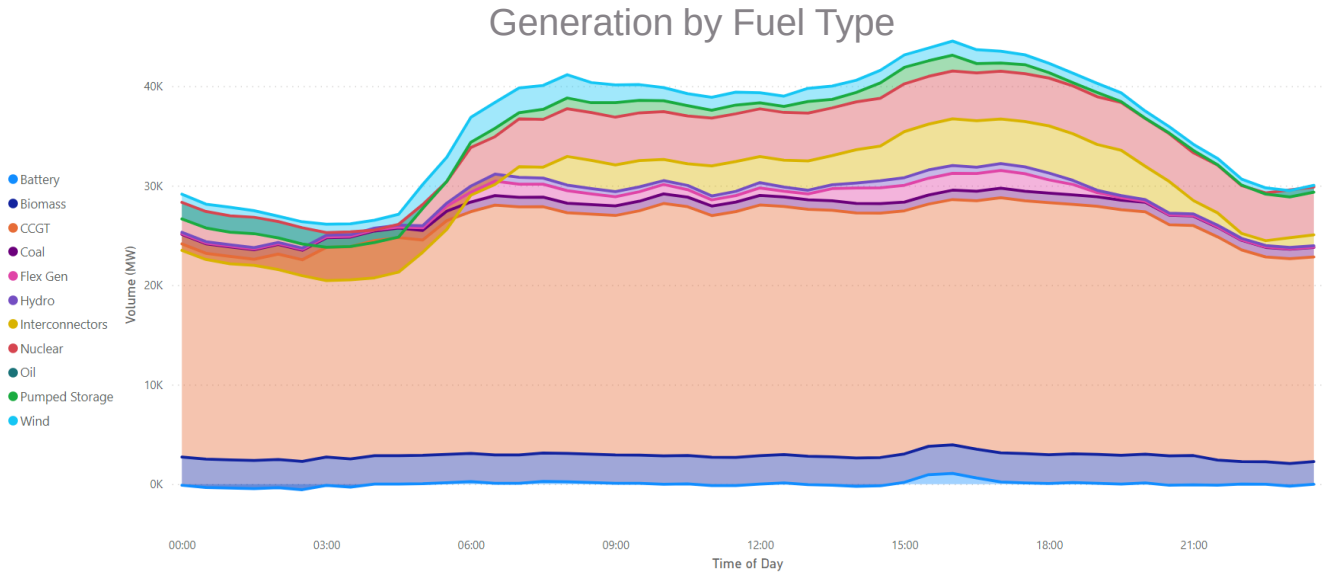
- The market witnessed a positive net imbalance volume where demand began to exceed generation after 07:00am and the volume for offer actions started to increase.
- Nordpool day ahead and intraday market prices started to increase around the time net imbalance volume (NIV) started declining from negative volume to 0MW coinciding with the increase in the offer actions taken, and the BM offer prices started to increase.
- The steep price increase in the BM offer price at around 16:30 to 19:00 can not be explained by the market alone. The market witnessed a negative NIV for most of the time and the Nordpool market prices increase did not have equal significant to BM offer price increase. Subsequently, the steep decrease in BM offer price after 19:00 is not an exact reflection of Nordpool market price drop, as the market had a slower step decline until end of day.



1 December 2023: High-Price Day Case Study

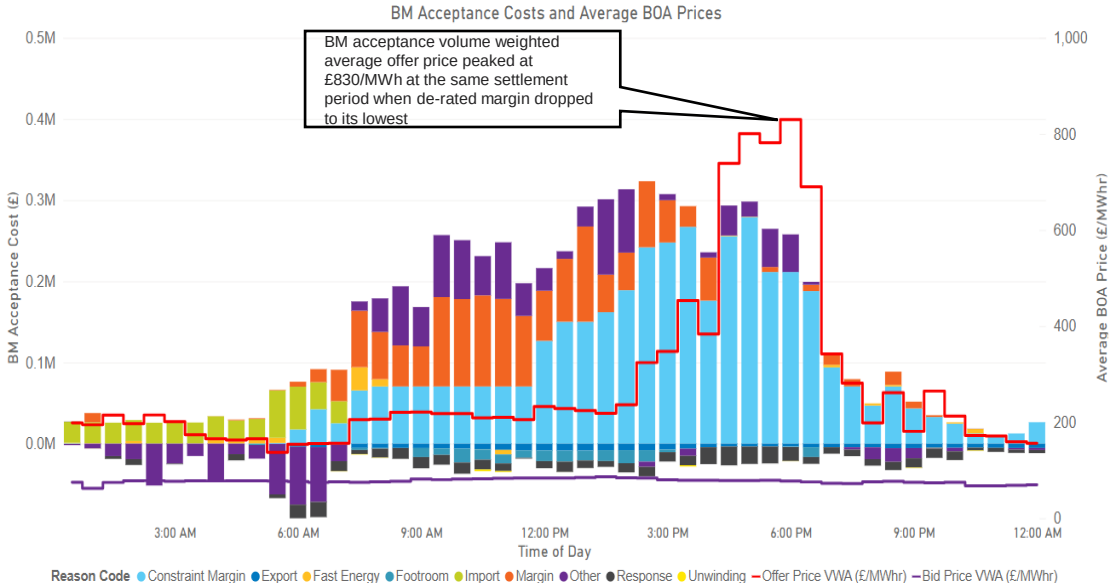
- The total cost of balancing actions incurred on the system was £5.35m which was significantly less than other higher cost days across winter 23/24. When including ancillary service actions, this total cost rises to £10.62m.
- This is likely due to a combination of very low wind out-turn ranging between 0.6GW – 2.6GW across the majority of the day and hence no bid offer acceptance actions needing to be taken on wind units to manage export thermal constraints; and voltage requirements being fulfilled by self dispatching plant. As a result only one action was taken for voltage management. Inertia was also adequate across the day.
- Around 70% of total cost incurred were offer actions taken to manage constraint margins from two CCGT units.
- Interconnectors had the highest volume of offer actions taken equal to 12.7GWhrs followed by CCGT 11.4GWhrs. However, the volume weighted average offer price for CCGT was twice that of interconnectors at £394.50/MWh.

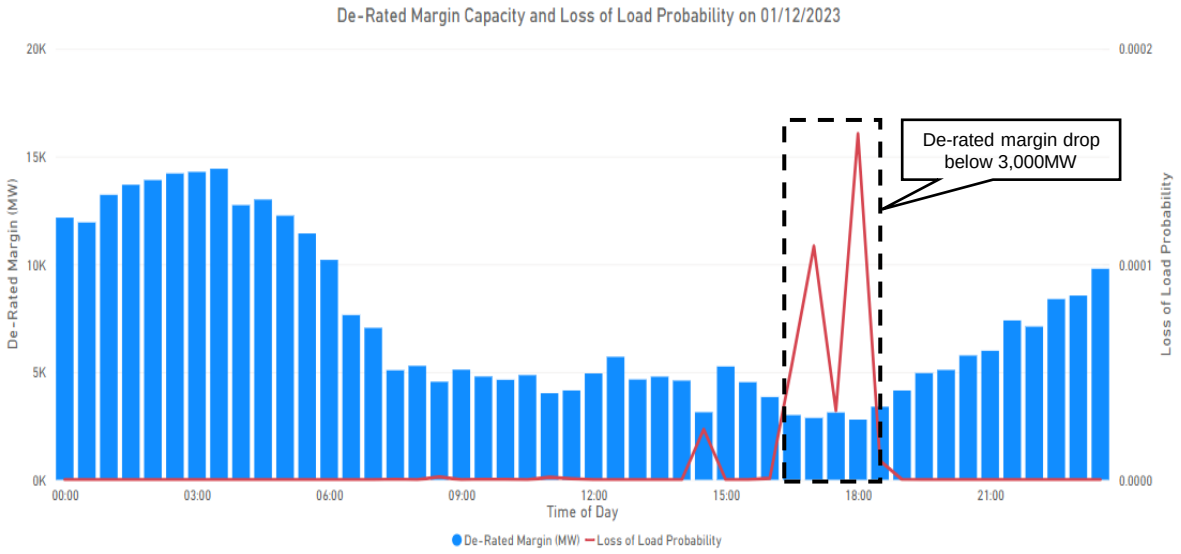


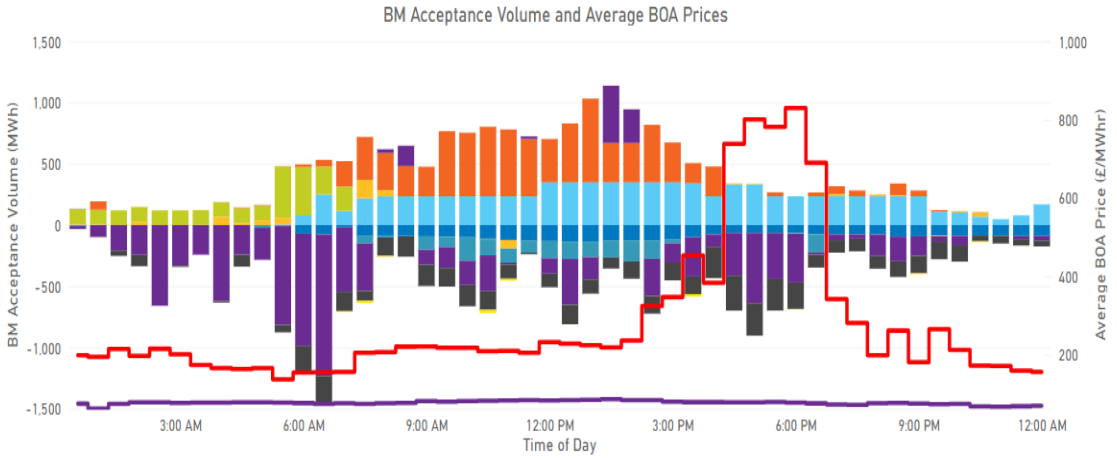


1 December 2023: High-Price Day Case Study

- The share of costs incurred due to actions taken to manage constraint margins increased after 07:00 and 12:00 simultaneously with BM offer price increase.
- There is a strong correlation between the total cost incurred to managed constraint margins and higher BM offer prices, unlike the correlation between BM offer prices and volume for offer actions taken where correlation is much weaker.
- The drop in the de-rated margin capacity and the increase in loss of load probability would likely have had a very strong impact on the BM offer prices, reaching up to £975/MWh. The volume of energy taken for offers started to decrease after 12:00 yet the costs incurred and BM offer price continued to increase. As the de-rated margin capacity dropped to below 3,000MW after 16:00 the BM offer price spiked.







If you have any questions or queries relating to Balancing Costs, please reach out to box.Balancing.Costs@nationalgrideso.com

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