Public

2025 Annual Balancing Costs Report

June 2025

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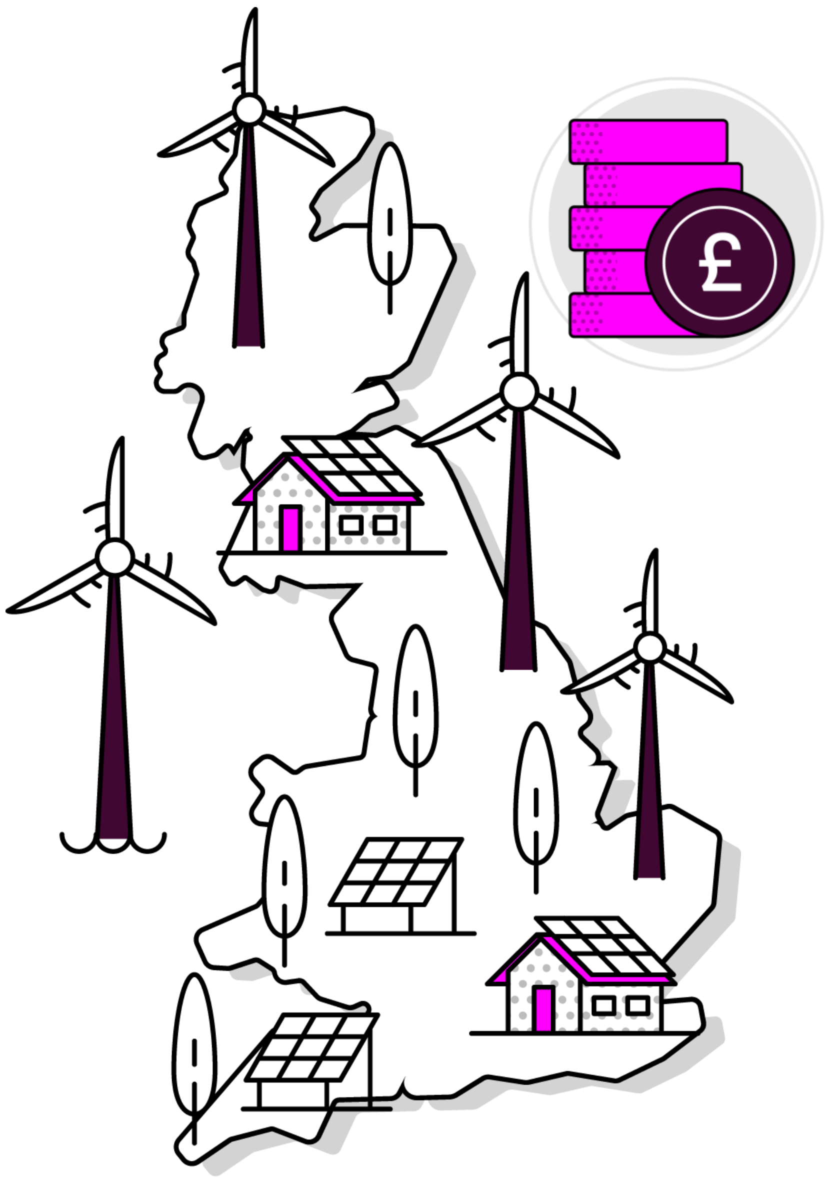
National Energy System Operator



Report structure

01 Executive Summary 3

Methodology and Assumptions 6

02 System & Market Conditions 7

Overview of system and market conditions influential to balancing costs and their impact across FY2024/25.

03 Looking Back 17

Outturn balancing costs and explanation of trends and drivers for FY2024/25 across key cost components.

04 Looking Forward 24

Future drivers for balancing costs and projections of how balancing costs may evolve under different scenarios.

05 NESO Balancing Costs Strategy and Delivered Savings 34

NESO's 2025 strategy to reduce balancing costs and calculated savings achieved through key NESO initiatives in FY2024/25.

06 Initiatives to Reduce Balancing Costs 42

Overview and update on NESO and industry initiatives that have the potential to influence balancing costs.

Appendix 54

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Executive Summary

Welcome to the 2025 Annual Balancing Cost Report. This report provides a look back on recent balancing cost trends and drivers and provides a broad view of potential future balancing costs along with NESO's role in minimising costs.

One of our roles as the National Energy System Operator (NESO) is to ensure electricity supply meets demand second-by-second, as well as managing the physical constraints of the network. This is what we refer to as 'balancing' the grid. Balancing costs pay for the wide range of tools, such as the Balancing Mechanism and balancing services, that help us to keep the electricity system stable and secure.

GB is leading globally on decarbonising electricity and connecting renewable and low carbon intermittent sources of generation. The balancing market was historically designed for taking residual actions to balance the system. However, the variable nature of these energy types (i.e. wind and solar) can require us to undertake additional balancing actions which is managed by either turning down generation when there is too much or bringing on generation when there is too little. This requirement is currently growing which has knock-on consequences for balancing costs. Large scale changes to the physical system and market design are consequently necessary to facilitate system changes and manage rising costs.

Network reinforcement continues to be the most impactful lever available to minimise balancing costs as we progress with the energy transition. We continue to recommend new transmission infrastructure to support a fully net zero carbon grid. In our Clean Power 2030 (CP30) Advice to Government we outlined that a major expansion of the electricity networks is needed to facilitate clean power pathways and minimise balancing costs. Current plans for network expansion are sufficient, but must overcome many barriers to deliver on time, and some vital projects need to be accelerated to deliver by 2030. The proposed network build in our CP30 Advice could directly reduce energy bills by ~£4bn in 2030 through reduced thermal constraints. We consequently welcome the endorsement of these recommendations in Government's Clean Power 2030 Action Plan.

NESO is also developing a wide portfolio of initiatives aimed at minimising balancing costs. We are now tracking delivered savings from some of our key initiatives, including Network Services (NS), inertia requirement reductions, and trading, which provided over £1bn of savings across the BP2 period. These savings represent just part of the range of active initiatives currently delivering benefits which are expected to be worth billions of pounds to consumers out to 2030.

We will continue to balance generation and demand, manage system constraints, and operate a safe and secure network. Delivering these in the most economically efficient manner is paramount and why we closely monitor and report on system balancing costs. Balancing costs are predicted to rise out to 2030, and NESO will do everything within its control to minimise this as outlined in this report. We will continue to work closely with industry to identify and accelerate new activities which will help us achieve savings.

Balancing costs in the future are also not fixed and can be lowered through proactive measures from NESO and industry. NESO strongly welcomes the Government's Clean Power 2030 Action Plan and its progress with the Review of Electricity Market Arrangements – both of which contain measures that can bring balancing costs down further in the coming years.

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NESO is playing a central role in reducing balancing costs and delivering millions of pounds of savings each month

NESO is working hard to ensure that the balancing component in consumer bills is kept as low as possible while maintaining security of supply and utilising market principles.

People are at the heart of the energy transition, and as Great Britain decarbonises, we will be a trusted independent voice for all, considering costs and the tough challenges, ultimately delivering the fairest result. Our Balancing Cost Strategy sets out our approach for managing balancing costs and how we aim to leverage our expert insight and analysis to drive the development and prioritisation of cost saving initiatives in collaboration with industry.

NESO is continuing to undertake many significant endeavours, initiatives, and reforms to equip ourselves and the industry with the right systems, markets and capabilities to be able to manage an evolving electricity market and system at the optimal cost. We are working with industry to deploy new, world first technologies and services to balance the system, drive innovation and growth in the energy sector and create new opportunities for both businesses and consumers. Additionally, we will help provide certainty for future investment and growth in the UK economy, utilising cutting-edge technologies of tomorrow for a decarbonised future.

We continue to see significant industry engagement with new workstreams and greatly welcome and value this support from across the energy sector. Continued input and collaboration will help us to keep balancing costs as low as possible.

How we are delivering savings:

NESO is already delivering significant savings in balancing costs worth millions of pounds each month. We are now tracking savings from some of our key initiatives including our Network Services (NS) projects which have already realised **~£324m** of savings in thermal, voltage, and stability constraints across the BP2 period (April 2023 to March 2025). NESO trading actions have also delivered **~£724m** savings across BP2. Significant reductions to the system's inertia requirements from February 2024 have delivered an additional **~£122m** savings this year (further detail of these savings can be found in Section 5).

This work represents just part of the range of initiatives targeted at reducing balancing costs which are expected to deliver savings worth billions of pounds to consumers that we can achieve out to 2030. We will continue to work with Ofgem, Government and industry to realise these savings and identify further opportunities to minimise balancing costs.

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Key Messages

In 2024/25 Balancing Services Use of System (BSUoS) charges contributed to ~3.4% of electricity bills for an average domestic consumer which works out to be about ~£3 a month on a typical domestic electricity bill. Although we are projecting balancing costs to rise out to 2030, it is important to recognise that balancing costs are just one of many components making up energy bills for which the energy transition will have variable impacts. For example, our Clean Power 2030 analysis concludes that the cost of generation is likely to reduce due to lower contract prices associated with wind and solar compared to existing gas-fired power stations.

This report focuses only on costs related to balancing the electricity system.

For more information on BSUoS contributions and wider electricity bill costs see our BSUoS in Consumer Bills Dashboard.

System and Market Conditions

We are continuing to balance the system through evolving system and market conditions. FY2024/25 saw the connection of new interconnectors and generators while also marking an end to coal on the system. A rise in wholesale prices and demand over the winter were also key drivers for balancing costs this year.

Looking Back

Balancing costs increased by 10% in FY2024/25. Higher costs are due to a rise in thermal constraints as a result of increased congestion on the system, partly linked to planned outages in Scotland aimed at enhancing the transfer capacity across key constraint boundaries which coincided with high wind outturn.

Looking Forward

Balancing costs are expected to rise in the short term, reaching a peak of ~£8bn in 2030. However, this peak in costs can be avoided, delivering savings of up to ~£4bn in 2030, if critical network projects are brought forward and delays to plans for wider network expansion are avoided, as outlined in our CP30 Advice.

NESO Balancing Costs Strategy and Delivered Savings

We are tracking savings from key balancing cost initiatives which saved over £1bn across the BP2 period (and represents just part of the range of initiatives currently delivering savings). This analysis is supporting evidence-based decisions for the development and prioritisation of current and future initiatives.

Initiatives to Reduce Balancing Costs

Future balancing costs are not fixed and can still be influenced by proactive initiatives from NESO and industry to reduce costs. We are undertaking a wide range of initiatives within our balancing costs strategy that are aimed at minimising balancing costs.

Methodology and Assumptions

This Annual Balancing Costs Report shares the costs incurred in FY24/25 and provides insights into how these costs breakdown into different components. This report aims to provide:

- A detailed overview of past balancing costs trends and what is driving them,
- Projections of how future balancing cost may evolve under different scenarios,
- A summary of the things NESO and industry are actively doing (and will continue to do) to reduce balancing costs.

For further details on NESO's approach to managing balancing costs see our Balancing Costs Strategy and portfolio of initiatives to minimise balancing costs. Additionally, please refer to our Markets Roadmap for details on our forward-looking view of our markets, our market design principles and plans to reform and evolve our markets.

NESO has varying levels of control over factors that impact balancing costs, and this report aims to provide clarity of these factors. It is not a definitive projection of future costs, but rather an overview of anticipated trends and the factors that influence them. This report outlines NESO-led initiatives to minimise costs and key inflection points and factors that may impact costs beyond our direct influence.

Within this report we provide a view of how future balancing cost projections may evolve under different scenarios

What these projections are:
They are a best view of trends in future balancing costs based on historical cost components and potential future scenarios. These projections offer a forward view of the future key inflection points over the next decade as well as a relative scale of how different influencing factors will impact balancing costs.

What these projections are not:
These are not a forecast or an accurate prediction of balancing costs and they will continue to be updated along with decisions of policy, markets and most significantly are entirely dependent and linked with wholesale energy prices.

Methodology:
To create the projections outlined in this pack we have looked at historical system balancing costs and overlaid these onto a combination of NOA7r (Pre-2030) and TCSNP2 residual thermal constraints. These have then been adjusted for future changes to system conditions and new transmission connections. Please note that wholesale market reform is not included within these projections.

From historical data (last 5 years) we have assumed as a baseline that:
- Thermal constraints based on NOA7r and TCSNP2 projections
- Voltage costs for 2024 rolled forwards
- Stability costs for 2024 rolled forwards
- Operating Reserve costs for 2024 rolled forwards
- Response costs for 2024 rolled forwards

System & Market Conditions

We are continuing to balance the system through evolving system and market conditions. 2024/25 saw the connection of new interconnectors and generators while also marking an end to coal on the system. A rise in wholesale prices and demand over the winter were also key drivers for balancing costs this year.

See our Operability Strategy Report for further detail on operability challenges we expect to face as we transition to a clean power electricity system in 2030 and a net zero system beyond 2030.

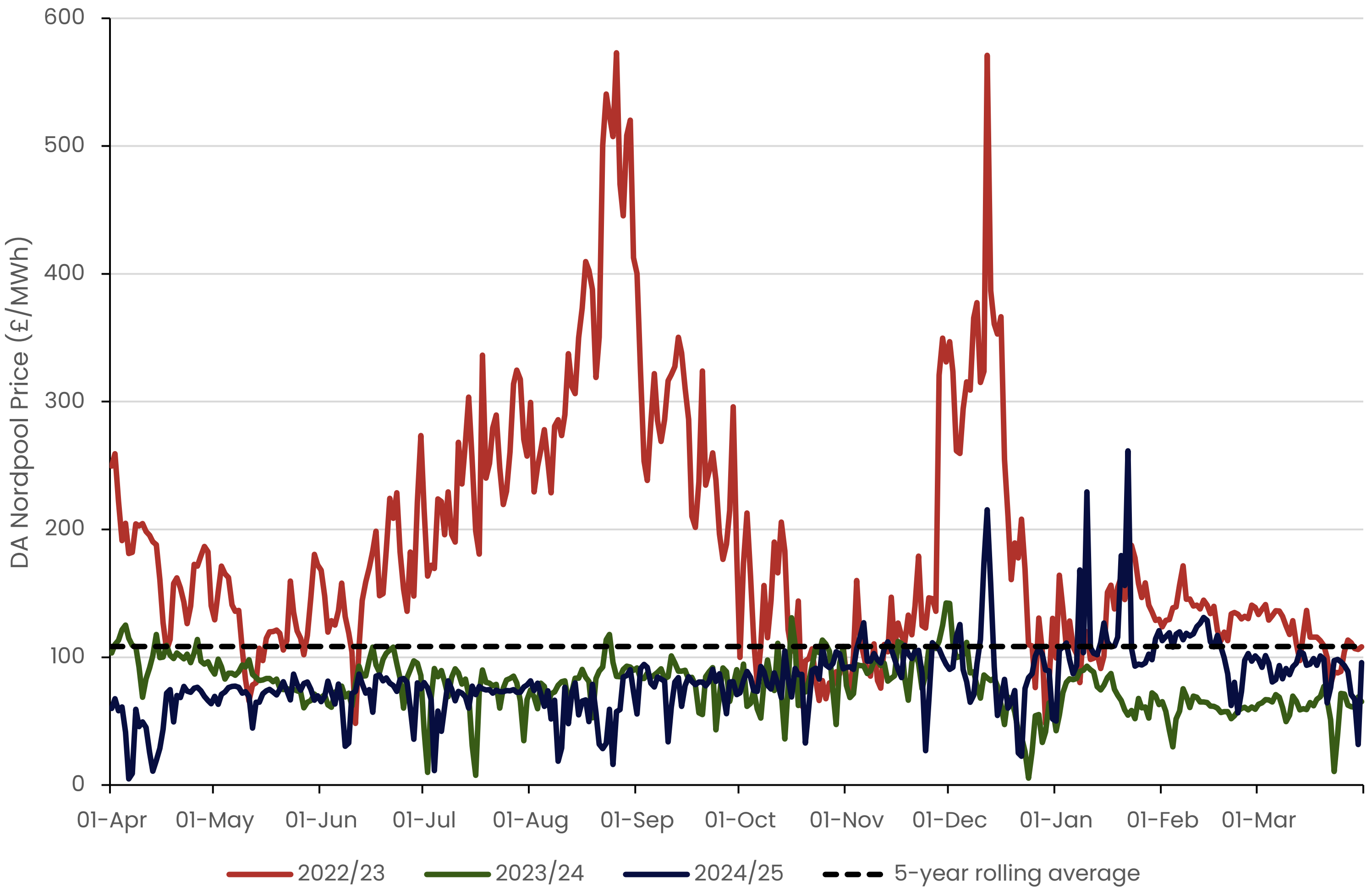
Wholesale Price

Balancing costs are closely tied to wholesale prices. These prices fall outside the control of NESO but directly impact the cost of the actions we need to take via the BM and trades to keep the system balanced. In recent years this has been a significant driver of higher balancing costs.

The average day ahead wholesale electricity price in 2024/25 has increased by 5% compared to 2023/24 but falls 24% below the 5-year rolling average cost.

The overall rise in wholesale costs was linked to an increase in prices over the winter 24/25 period while costs over summer 2024 were lower year-on-year.

Figure 1. Day ahead wholesale electricity price April 2022 – March 2025



BOA Volumes & VWA price

NESO takes bids and offers through the BM to balancing supply and demand and secure the system.

The absolute volume of bids and offers to balance supply and demand in 2024/25 has increased by 17% to 32.6TWh, up from 27.8TWh in 2023/24. The biggest driver of volumes continues to be thermal constraints which increased in 2024/25 due to increased congestion on the system in part linked to planned outages in Scotland and high wind outturn over the summer period.

In contrast, the volume weighted average (VWA) price of bids and offers in 2024/25 has decreased to -£7.4/MWh and £124.0/MWh respectively, compared to -£6.4/MWh and £127.8/MWh in 2023/24. This is despite a year-on-year increase in wholesale prices. We are currently developing our markets to support accessibility for assets and improve dispatch efficiency which is enabling lower costs.

Figure 2. Total Bids and Offers Instructed (April 2022 – March 2025)

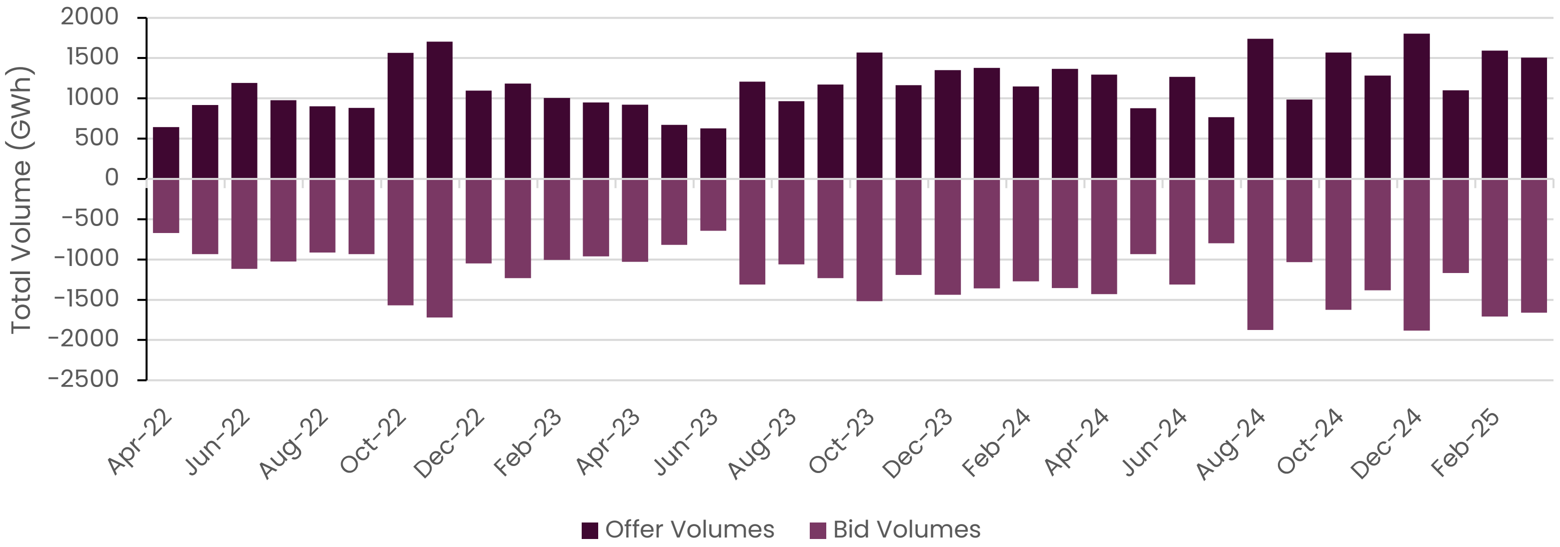
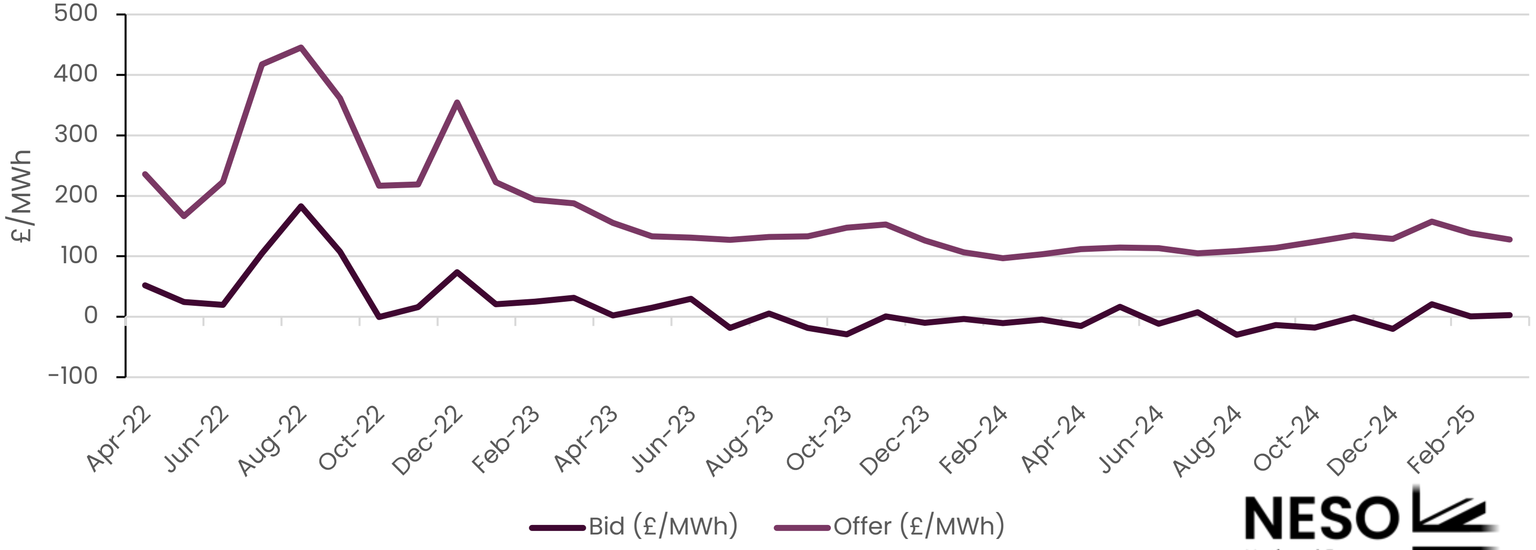
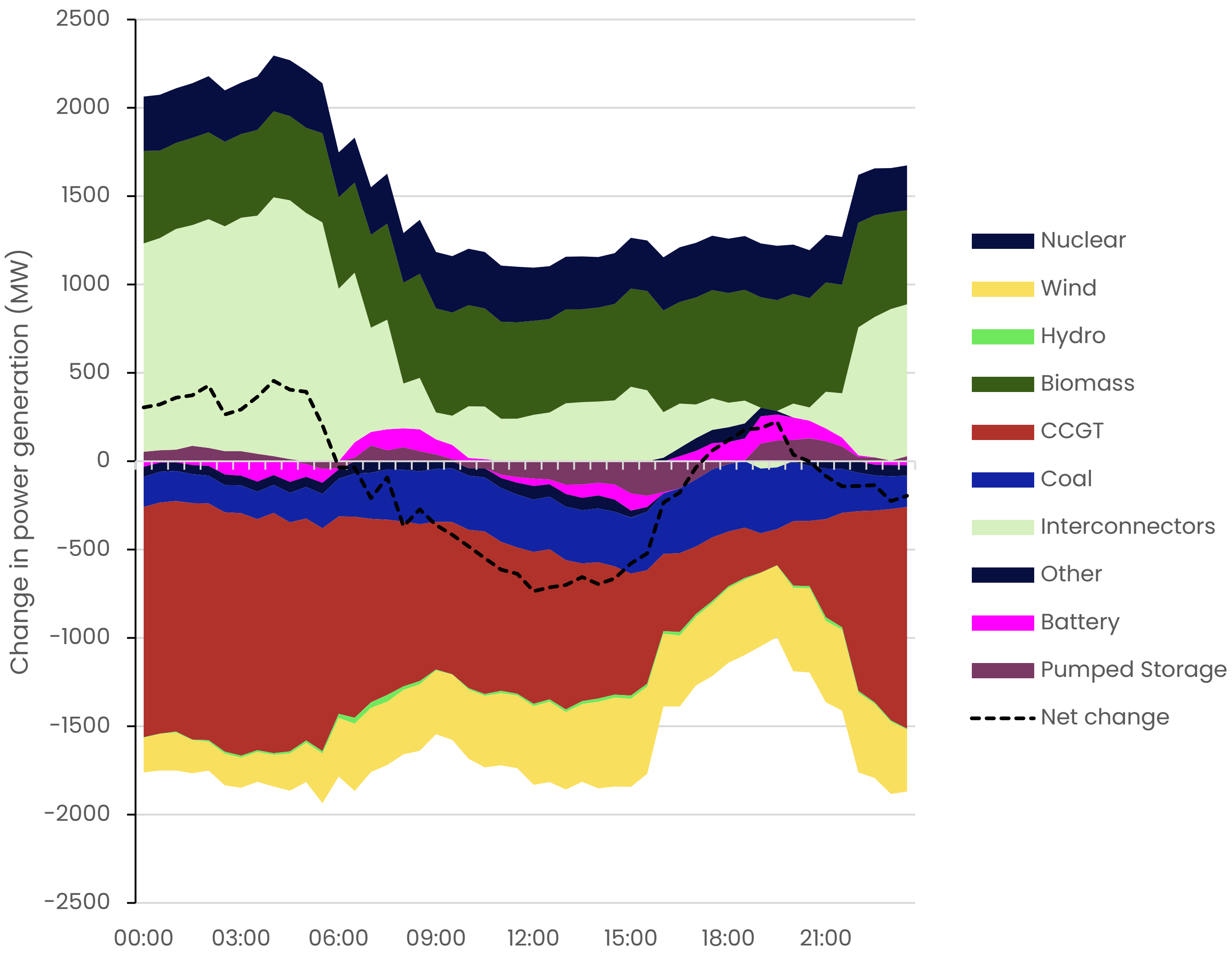


Figure 3. Monthly Bid and Offer Volume Weighted Average Price (April 2022 – March 2025)



Power Generation Change by Fuel Type

Figure 4. Change in Power Delivered By Fuel Types (FY23/24 vs FY24/25)



Across 2024/25 there was a significant decrease in energy provided by gas and coal, and a smaller reduction in wind generation. This was broadly displaced by energy provided by nuclear, biomass, and interconnectors.

The reduction in wind generation was linked to lower year-on-year output specifically across the winter 2024/25 period, which was partly linked to higher curtailment volumes over this period. In contrast, wind outturn over the summer 2024 period was higher than the previous year.

This year GB saw an end to 142 years of coal powered generation as Ratcliffe-on-Soar stopped generating on 30th September 2024. With no coal on the power system over the winter 2024/25 period, these volumes have consequently fallen year-on-year.

There was a significant increase in biomass generation volumes as units which previously did not dispatch due to their subsidy economics became cost efficient to run as baseload.

There was an increase in interconnector imports over 2024/25 as higher gas prices in GB than continental Europe incentivised flows into GB. Additional interconnector capacity would have also contributed to this change, as the Viking and Greenlink interconnectors became operational in December 2023 and January 2025 respectively. Interconnector imports have also been utilised for constraint management across 2024/25.

Batteries saw an overall increase in utilisation which is particularly prominent over the morning and evening peaks, however given their requirement to cycle this increased utilisation also shows an increase in periods of charging during off peak hours. In particular, battery volumes dispatched through the BM were much more significant with the launch on the Open Balancing Platform (OBP) in December 2023.

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BOA Generation Mix

The total cost of offers (generation being paid to turn up) has increased in 2024/25 by £222m. Higher prices are linked to an increase in offer volumes, rising 2.2TWh in 2024/25 compared to the previous year. Similar to previous years, gas continues to dominate the generation mix for offers.

The total cost of bids (generation being paid to turn down) has increased in 2024/25 by £33m. This is primarily driven by an increase in the total volume of bids accepted between the two periods compared to 2023/24, and specifically a larger volume of bids accepted for wind.

The volume of bids and offers accepted for battery units has also increased significantly compared to last year (rising 284% in total). The launch of the Open Balancing Platform In December 2023 is supporting greater utilisation of battery units in the BM.

Figure 5. **Total offer cost and volume by generation type**

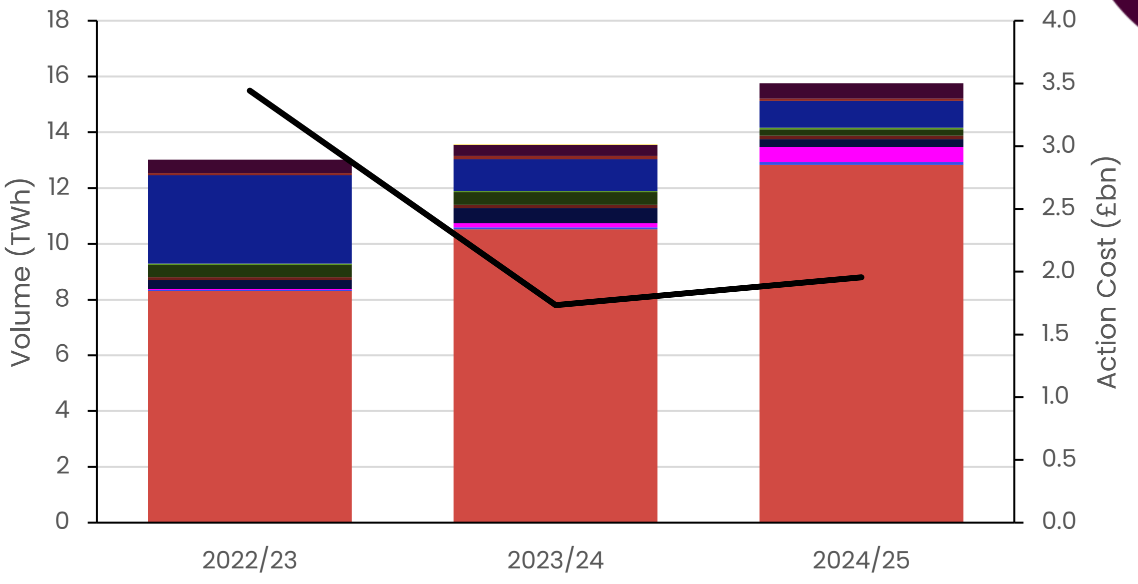
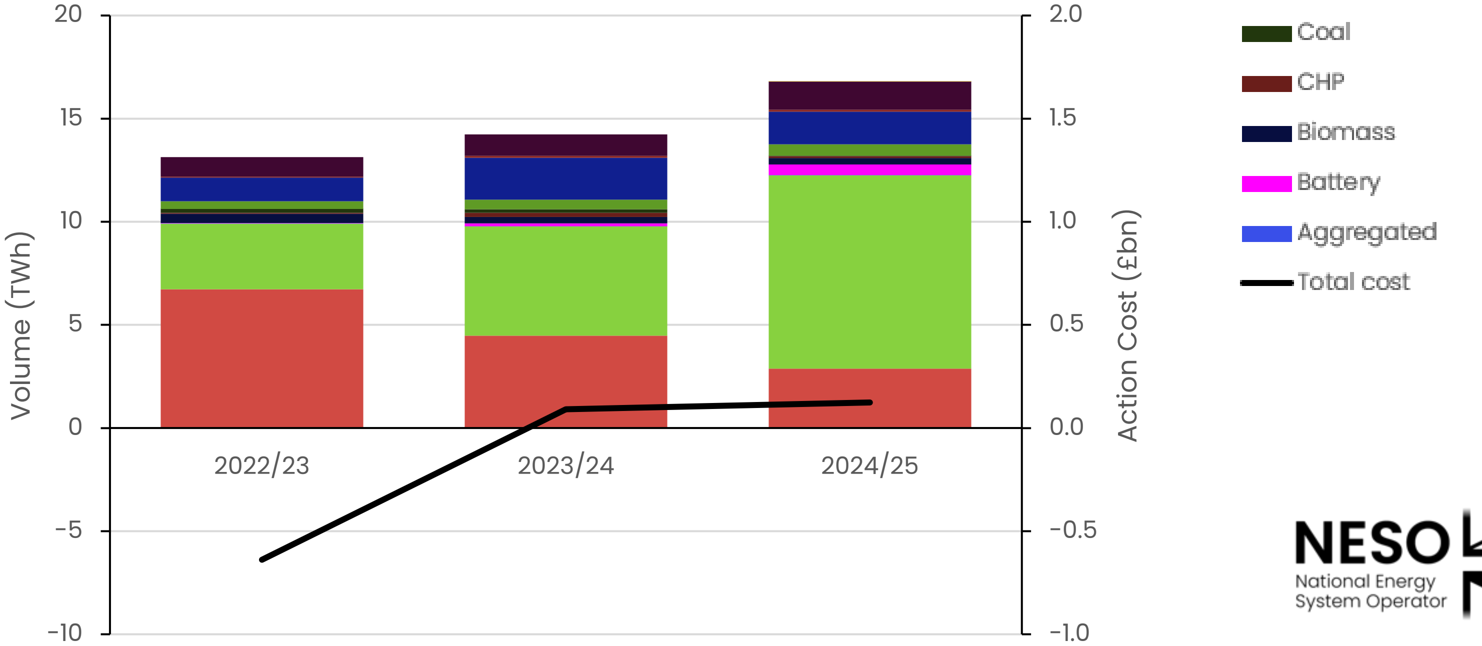


Figure 6. **Total bid cost and volume by generation type**



Note: Analysis includes BM and Trades

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Whilst payments to generators are distributed throughout the country the cause of cost is concentrated in Scotland.

High Cost

Low Cost

We can view balancing costs in two ways:

Action cost

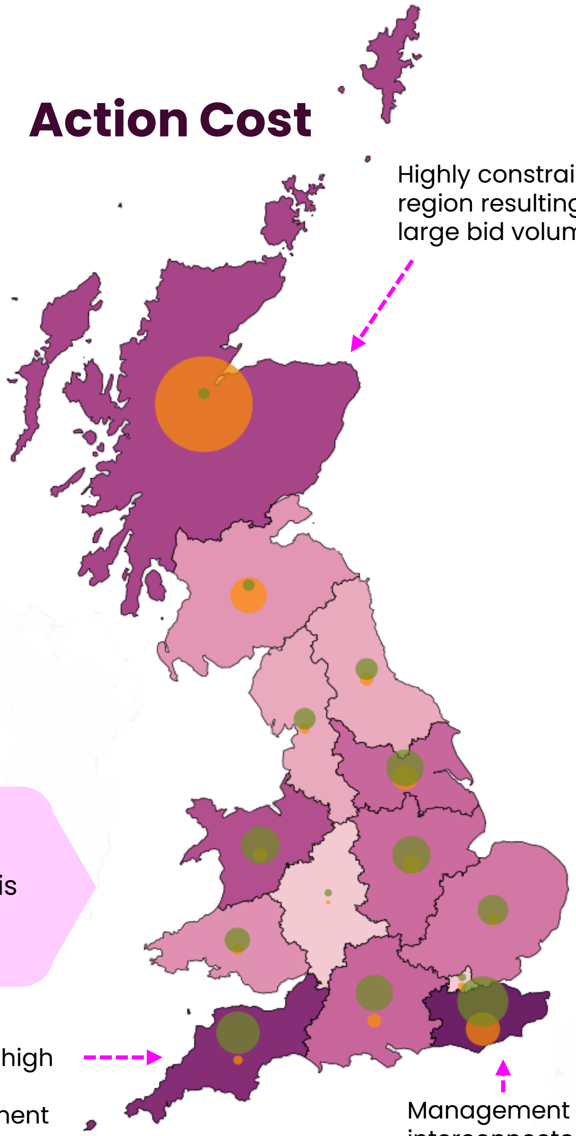
The cost paid to BMUs for direct turn-up/turn-down actions. This view of costs is useful to understand the cashflow of balancing costs to regions across GB.

Whole System cost

NESO's method of allocating second order actions with an initial action. Accommodates all costs associated with an action, including replacement energy costs and imbalance costs. This view of costs is useful from the perspective of system operations to understand the original cause of costs.

High action costs in Northern Scotland reflect a high volume of bid actions to manage system constraints in this region, while Southern England is dominated by offers for replacement energy and other system needs.

Action Cost

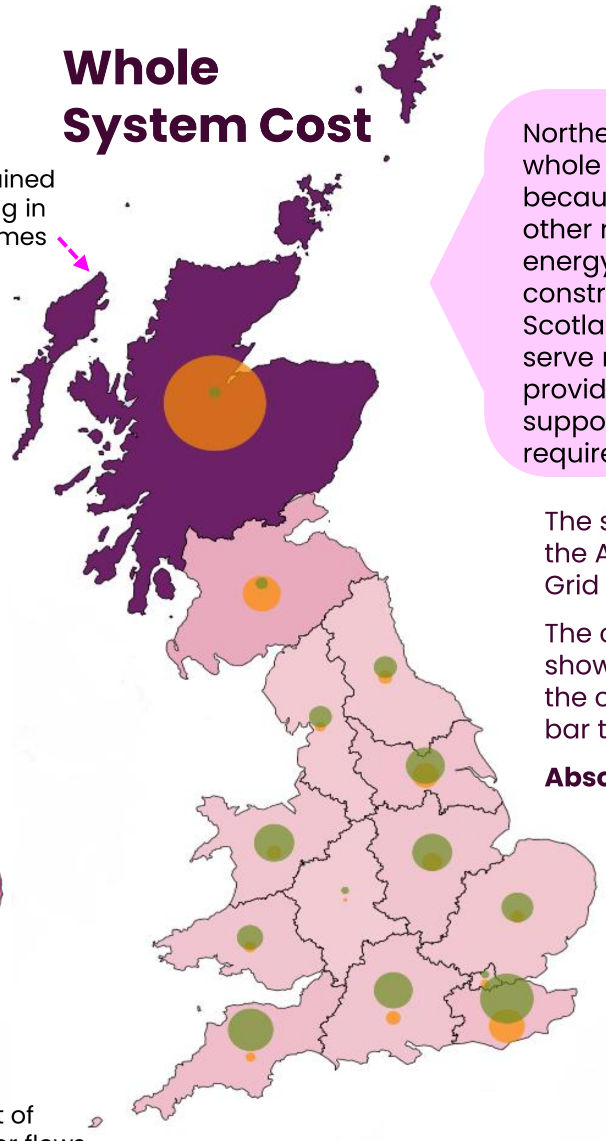


Highly constrained region resulting in large bid volumes

Region of high voltage management

Management of interconnector flows and CCGTs

Whole System Cost



Northern Scotland dominates whole system costs. This is because many actions we take in other regions are replacement energy actions linked to constraint management in Scotland. These actions can serve multiple purposes, such as providing access to reserve, or supporting voltage/stability requirements.

The size of the bubble represents the Absolute Volume (MWh) per Grid Supply Point (GSP)

The colour of each GSP location shows the Total Cost according to the colour range indicated on the bar to the left

Absolute Volume: 32.6 TWh

Bid

Offer

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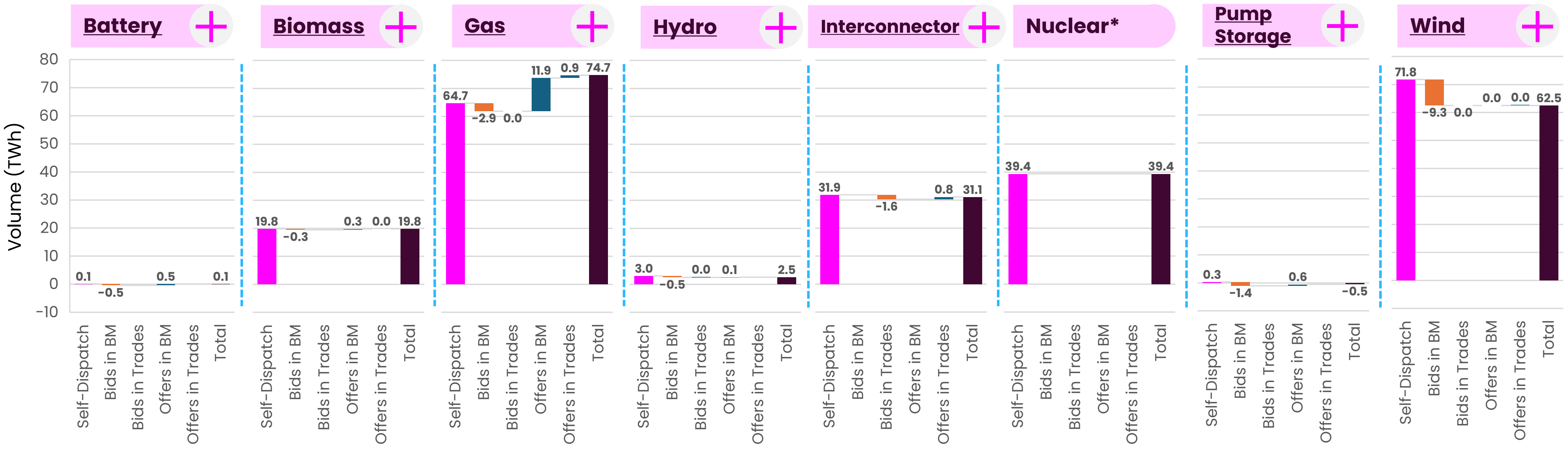
Re-dispatch volumes

Self-dispatch and re-dispatch strategies are used in the GB energy market to handle supply and demand imbalances and system constraints.

The majority of the market requirement is met via self-dispatch and NESO then takes re-dispatch actions to address any residual balancing requirements. The need for re-dispatch actions is currently growing as system requirements are becoming more complex over time.

In 2024/25, re-dispatch actions accounted for 13.67% of final generation volumes. This contribution varies significantly by fuel type. Follow the links below for a breakdown by technology type or see whole system redispatch here.

Figure 7. **Self-dispatch compared to Bids and Offers in BM and Trades FY2024/25**



*Nuclear is not typically re-dispatched by NESO due to its operational characteristics

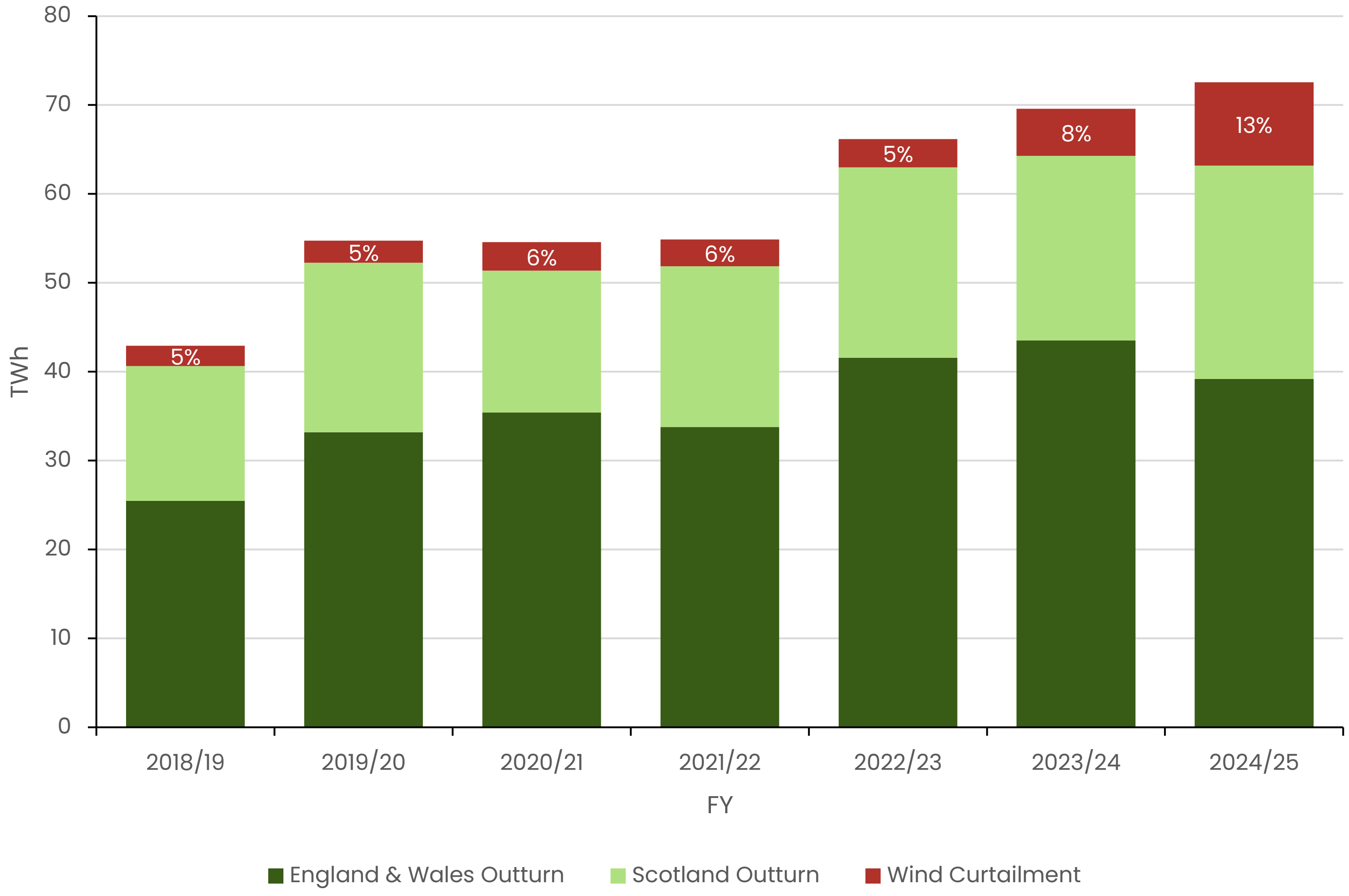
'Other' category not show above. Further details here.

Wind

Wind curtailment is currently a major driver of balancing costs. This is because a large proportion of wind capacity in GB is connected in Scotland, which at present is a constrained region of the network. This means that when wind generation is high we must take actions to turn down wind output and turn on replacement energy in unconstrained regions to keep the system balanced.

In 2024/25, wind curtailment volumes increased to 13% of hypothetical wind outturn (wind outturn if no curtailment had taken place). Wind curtailment volumes were exacerbated by increased congestion on the system in part linked to planned outages in Scotland aimed at enhancing the transfer capacity across key constraint boundaries and high wind outturn over the summer period while transfer capacity was at its lowest.

Figure 8. Operational wind outturn and wind curtailment volume FY2018/19 – FY2024/25



Note: Percentages represent % of hypothetical total wind outturn that was curtailed

Temperature and Demand

Average transmission system demand saw a slight rise compared to last year, totalling 250TWh in 2024/25 compared to 245TWh in 2023/24, which amounted to a 1.9% increase overall.

The month with the highest electricity demand in 2024/25 was January. There were particularly low temperatures early in the month, which acted to push up demand and contributed to tight margins. In order to manage these conditions, we take actions to increase available generation which can incur higher balancing costs at these times (see further details on how we managed 8th January margins here).

Figure 9. Monthly Transmission System Demand

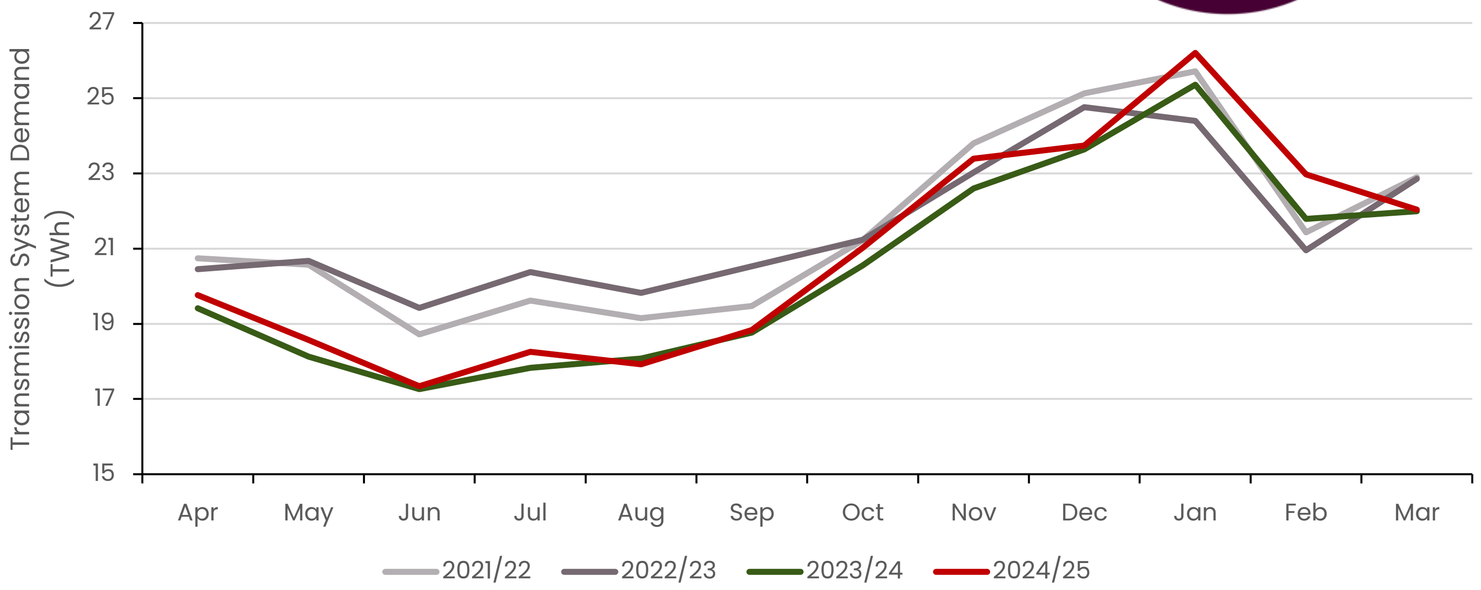
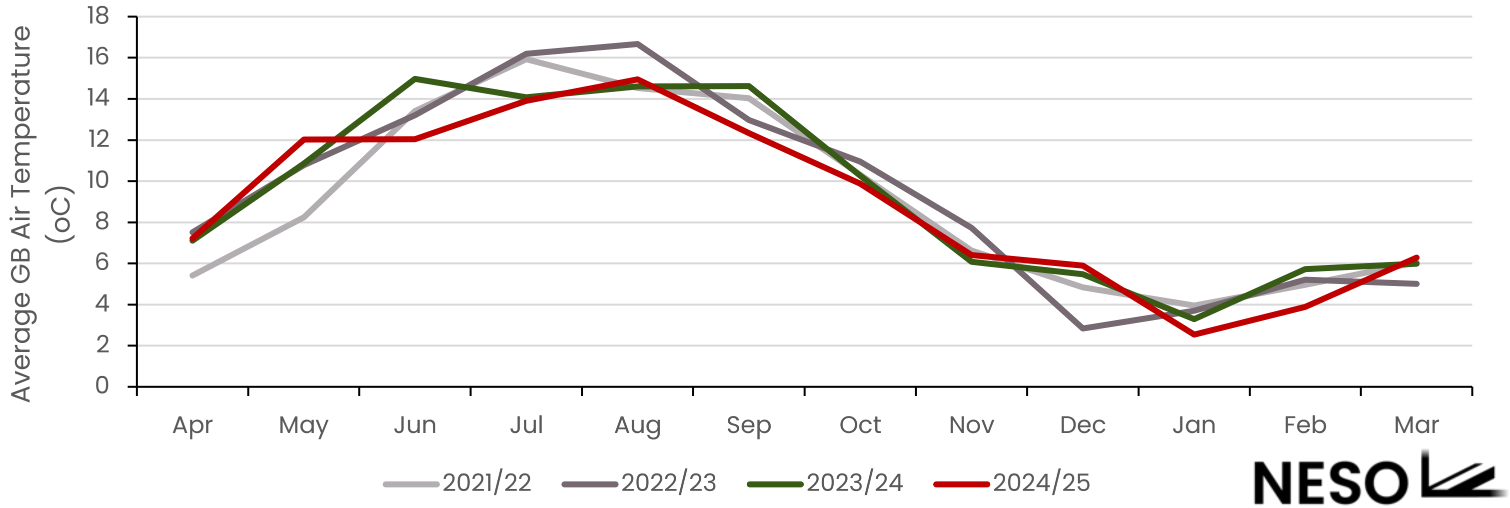


Figure 10. Average Monthly GB Air Temperature



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New Network and Generation

Development of the physical network is influential for balancing costs. In 2024/25 we saw ongoing integration of new network infrastructure and generation.

01 Greenlink Interconnector

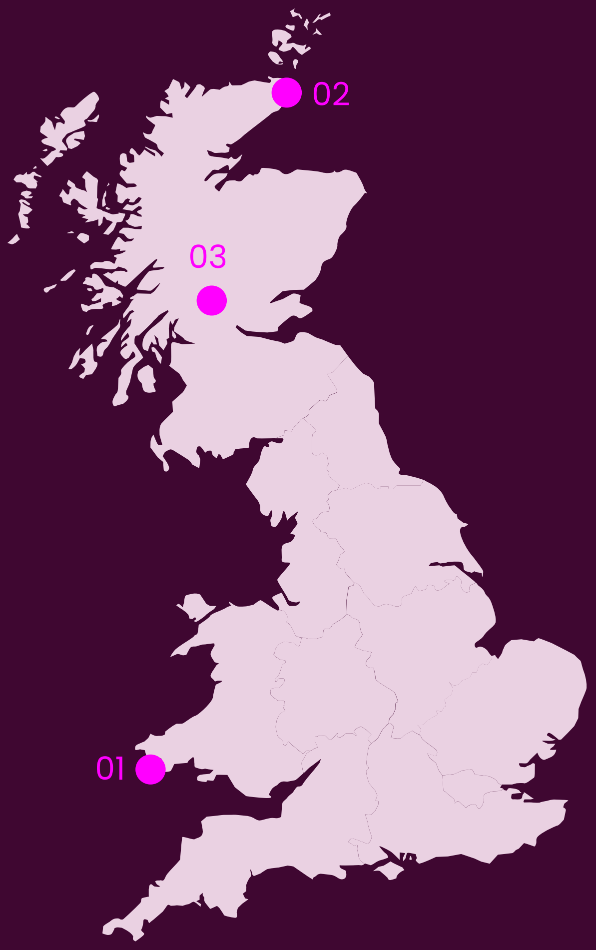
The Greenlink Interconnector became fully operational on 30 January 2025. Greenlink is the third interconnector between Ireland and GB, connecting substations in County Wexford, Ireland and Pembrokeshire, Wales via a subsea cable. Since becoming operational Greenlink has allowed access to additional reactive capacity in South Wales and South-West England which has supported lower spend on voltage constraints.

02 New generation connections

New generation has been connecting to the transmission system across 2024/25. At present increased power flows in constrained parts of the network (e.g. Northern Scotland) are contributing to higher thermal constraint costs, until network reinforcement can alleviate constraints. Reductions in synchronous generation and increased volatility in output from weather driven generation is also increasing the need for NESO to manage voltage and stability requirements (our Transmission Entry Capacity (TEC) register lists existing and future connection projects for the Transmission System).

03 Network Reinforcement

Network upgrades are helping to lower and facilitate net zero by increasing network capacity and supporting energy flows from newly connected generators. In 2024/25 we have seen the progression of reinforcement projects, including work to increase the network capacity in Scotland (B4/B5 boundaries). In the short term this work is resulting in higher costs due to the need for network outages, which has been a key driver of higher thermal constraint costs in 2024/25. However, over the long-term, this work is expected to provide significant cost benefits.



Looking Back

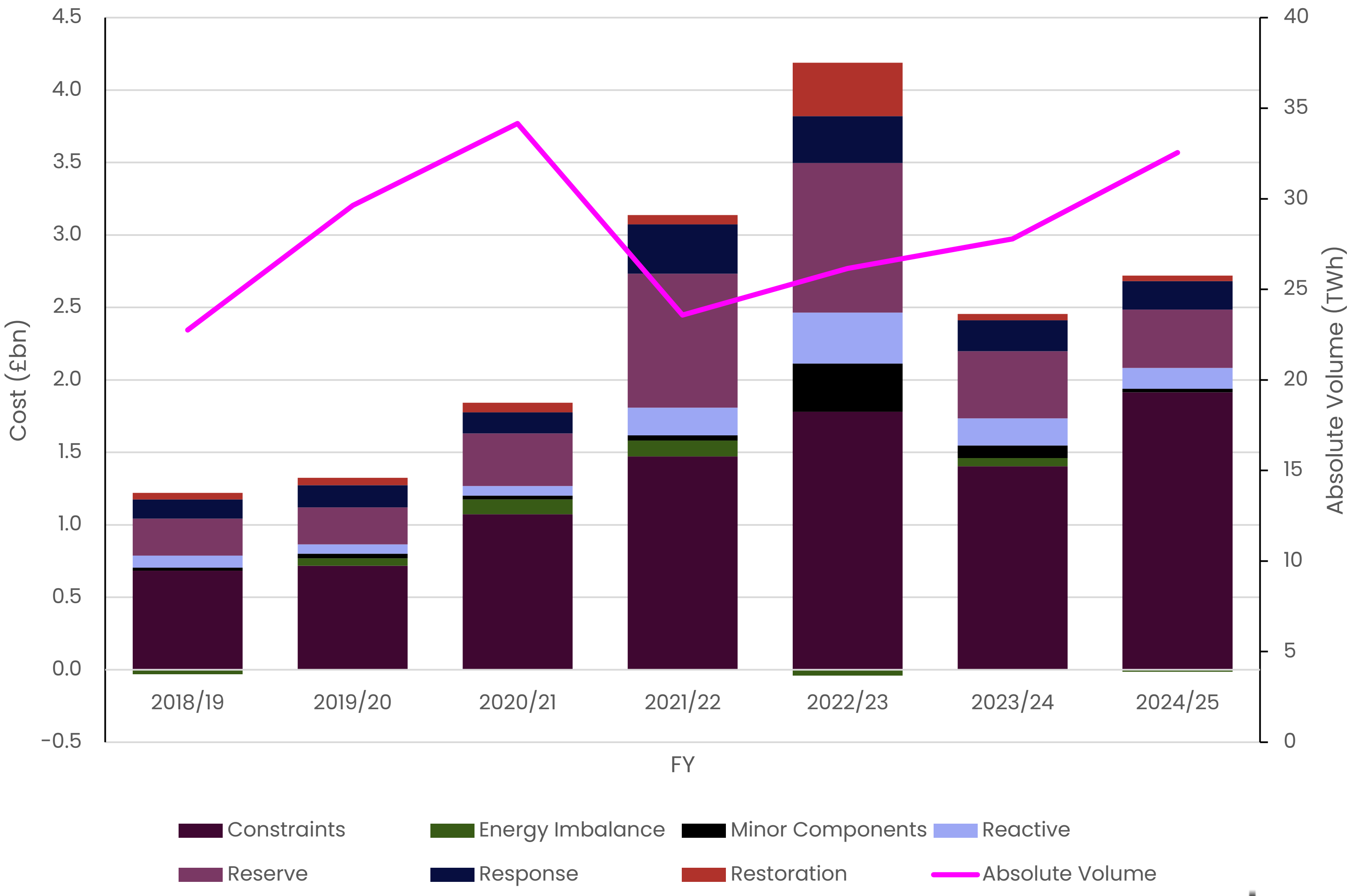
Balancing costs increased by 10% in 2024/25. Higher costs are due to a rise in thermal constraints as a result of increased congestion on the system, partly linked to planned outages in Scotland aimed at enhancing the transfer capacity across key constraint boundaries which coincided with high wind outturn.

Outturn balancing costs and volumes

Overall balancing costs totalled £2.7bn in 2024/25, an increase of 10% compared to 2023/24 where total spend was £2.5bn. The absolute volume of balancing actions increased 17%, from 27.8TWh in 2023/24 to 32.6TWh in 2024/25. The increase in balancing costs is attributed to a rise in constraint costs/volumes, while cost components for other categories decreased year-on-year.

Constraint costs have increased due to a rise in thermal constraints as a result of increased congestion on the system in part linked to planned outages in Scotland aimed at enhancing the transfer capacity across key constraint boundaries and high wind outturn over the summer period while transfer capacity was at its lowest.

Figure 11. **Outturn balancing costs and volumes 2018/19 – 2024/25**



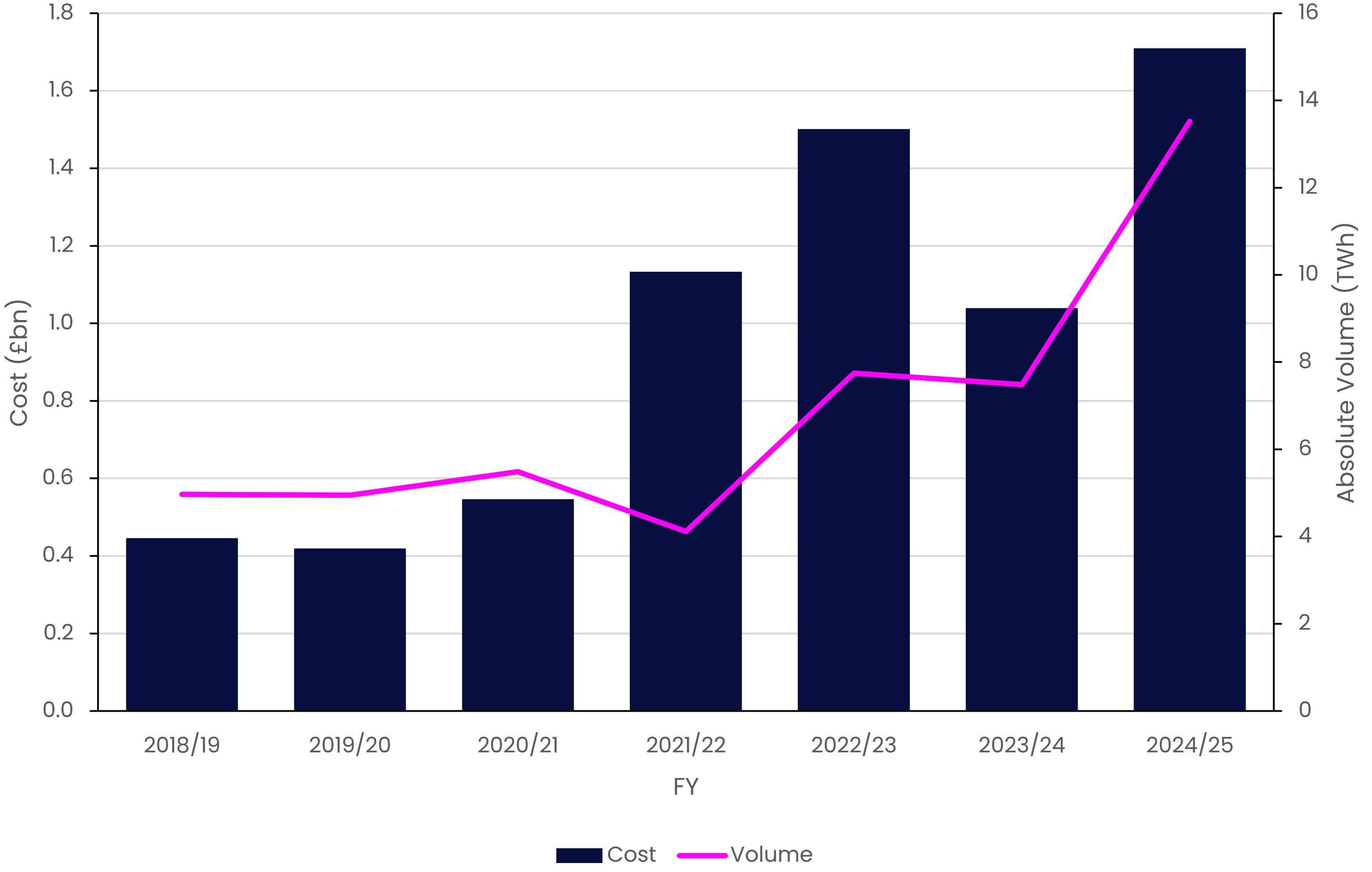
Outturn thermal constraint costs and volumes

Thermal constraint costs have increased by 64% in 2024/25, totalling £1.7bn. This follows a large increase in thermal constraint volumes, rising 81% year-on-year to 13.5TWh.

Higher costs have been driven in part by planned outages in Scotland which have reduced constraint limits across key boundaries. These outages are facilitating work to enhance the transfer capacity of the network in this region which is expected to provide significant cost benefits over the long-term. The impact of these outages was amplified by high wind outturn over the summer period while transfer capacity was at its lowest causing us to take a greater volume of bid actions on wind generators.

Thermal constraint costs are currently the main driver of balancing costs, causing overall costs to rise in 2024/25 compared to the previous year. We expect this trend to continue over the 2020s as new generation connections in constrained regions outpace network build, which makes initiatives to manage thermal constraint particularly significant for managing balancing costs.

Figure 12. **Outturn thermal constraint costs and volumes 2018/19 – 2024/25**



Note: Constraint costs include replacement actions

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Outturn reserve costs and volumes

Total reserve costs decreased 13% to £403m in 2024/25 and reserve volumes fell 52% to 1.4TWh.

Cost have lowered in line with a reduction in utilised volume. Volume has decreased as we have optimised our reserve holding, resulting in less reserve held for wind shortfalls on average and the launch and growth of our dynamic suite of response products have reduced the amount of reserve needed to secure response capability in real time.

In 2024 we delivered Balancing Reserve and Quick Reserve and are planning to launch Slow Reserve in 2025. We are also continuing to optimise our reserve requirement setting and considering opportunities for introducing locational procurement of reserve to improve the efficiency of our procured reserve volumes.

Figure 13. Outturn reserve costs and volumes 2018/19 – 2024/25

Note: Balancing Reserve (BR) costs are included in the STOR category

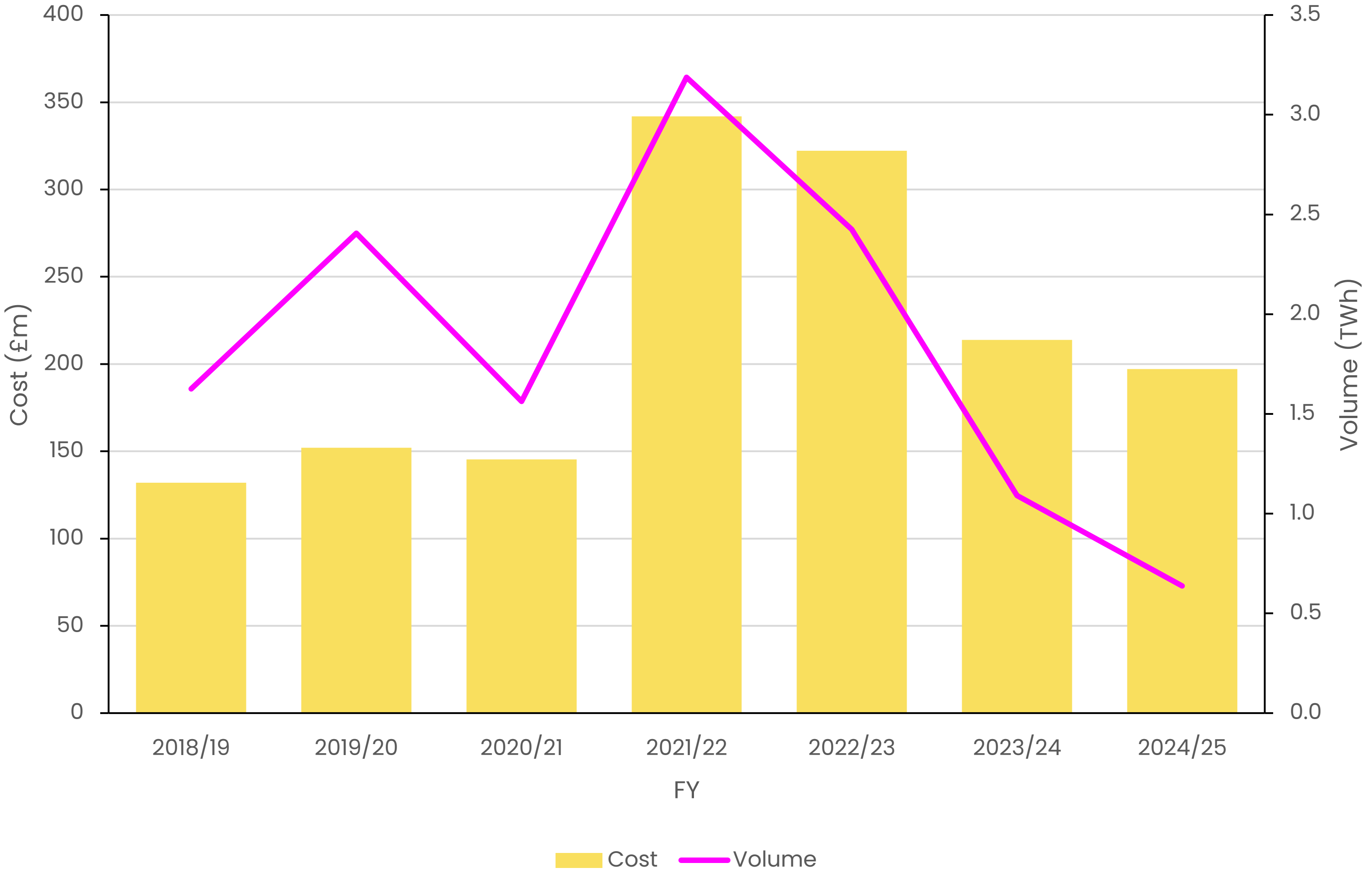
Outturn response costs and volumes

Response costs have continued to fall in 2024/25, decreasing 8% to £197m, and volumes have fallen 42% to 637GWh. This is largely due to major improvements in our response ancillary services which impacts volumes in the BM shown here.

Volumes of Mandatory Frequency Response (MFR) are significantly lower compared to the previous year as a result of the increased used of our Dynamic Services.

In November 2023 the procurement of our Dynamic Services was moved to the Enduring Auction Capability (EAC) platform which offered enhanced functionality such as splitting, co-optimisation and negative pricing leading to greater efficiency and reduced prices. We saw impressive early cost benefits from launch and this has continued throughout 2024/25 helping achieve a reduction in clearing prices for all services despite a considerable increase in volumes. The markets have been well supplied throughout 2024/25 with significant liquidity enabling relatively stable low prices

Figure 14. Outturn response costs and volumes 2018/19 – 2024/25



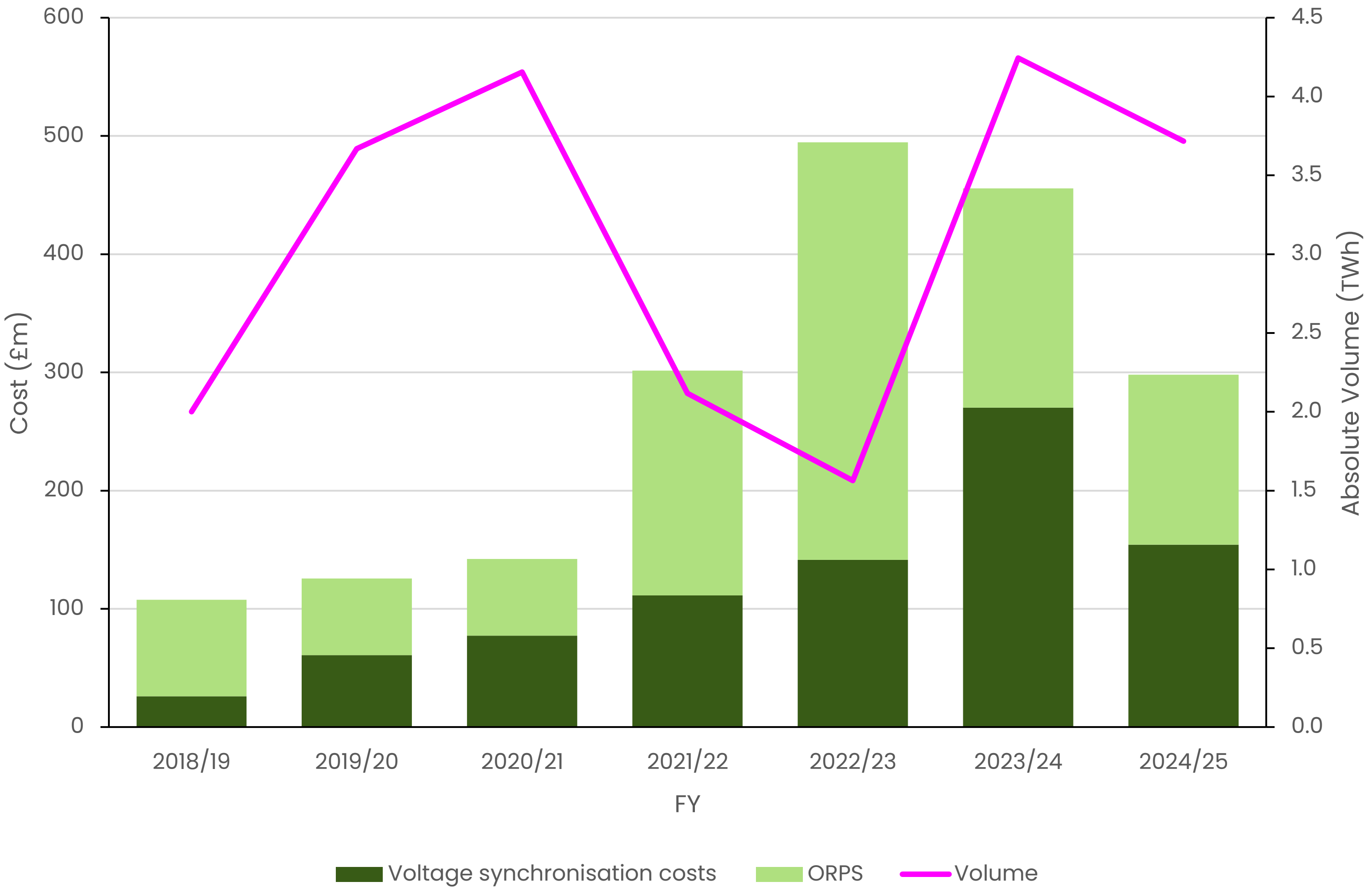
Outturn voltage costs and volumes

Total voltage costs have decreased by 35% in 2024/25 to £298m, and the volume of actions has reduced 12% to 3.7TWh.

Reduced volumes for voltage control have supported lower voltage synchronisation costs compared to last year. NESO's Voltage Network Services (NS) services are also helping to reduce costs, as well as continued collaboration with Transmission owners to return reactive equipment on outage. Furthermore, the commissioning of Greenlink interconnector in January 2025 has allowed access to an additional reactive capacity in the South-West, supporting lower voltage costs in the final months of 2024/25.

Obligatory Reactive Power Service (ORPS) costs have also decrease in 2024/25. NESO is currently undertaking a review of ORPS to ensure the service design remains fit for purpose.

Figure 15. Outturn voltage costs and volumes 2018/19 – 2024/25



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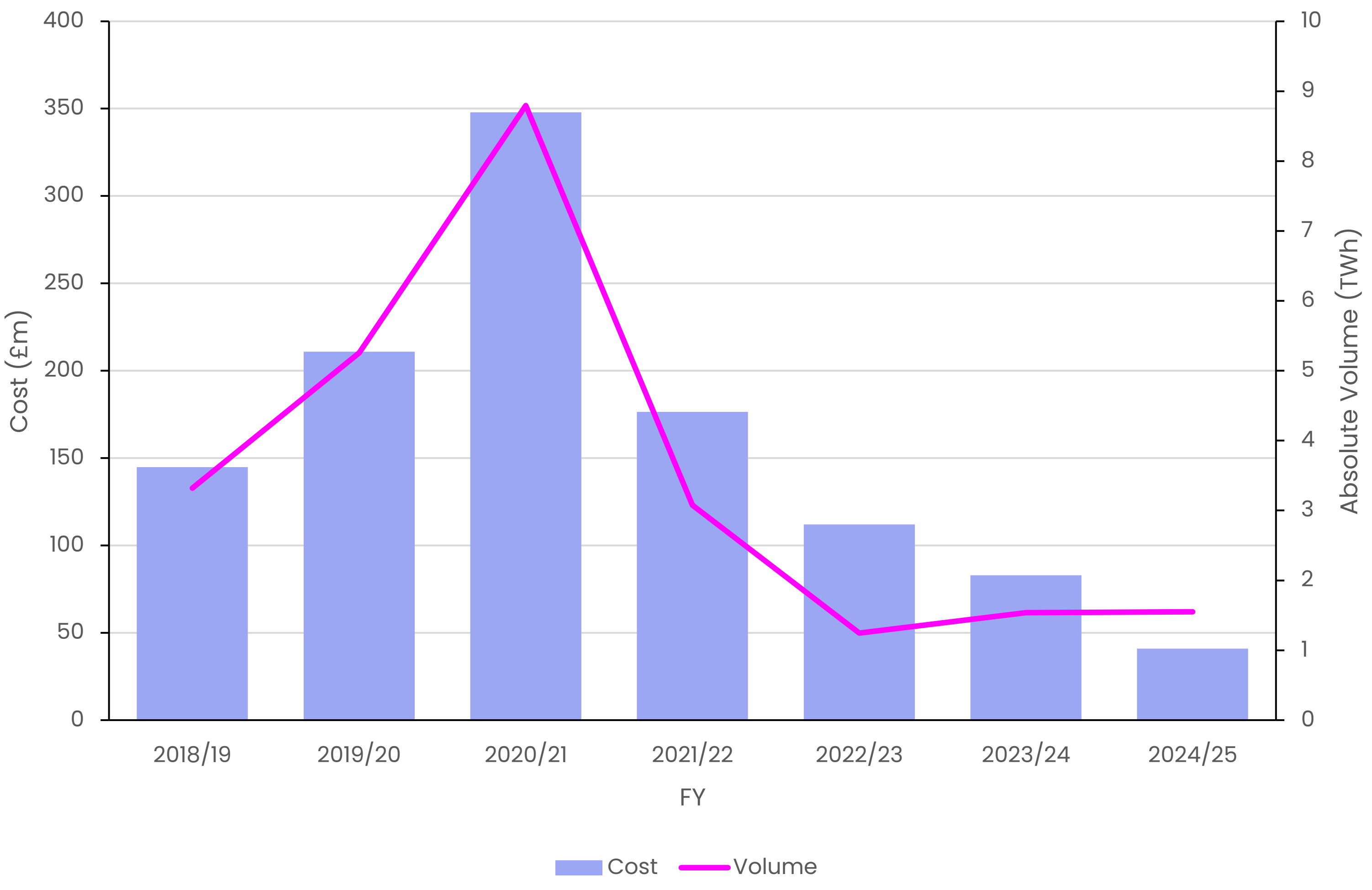
Outturn stability costs and volumes

Stability costs have lowered 51% to £41m in 2024/25, while volumes have seen a minor increase of 1% to 1.6TWh. Lower costs have been supported by a reduction in offer prices across 2024/25.

Stability costs also continue to see significant benefit from NESO initiatives, which have helped to substantially reduce costs since their peak in 2020/21. In 2024/25 this includes reductions to our inertia requirements from 140GVA.s to 120GVA.s which allows us to instruct fewer machines, and thus spend less, to meet system requirements. Phase 1 and 2 of our Stability Network Procurement Service have also been supporting lower costs for stability constraints across 2024/25.

Figure 16. Outturn stability costs and volumes 2018/19 – 2024/25



Looking Forward

Balancing costs are expected to rise in the short term, reaching a peak of ~£8bn in 2030. However, this peak in costs can be avoided, delivering savings of up to £4bn in 2030, if critical network projects are brought forward and delays to plans for wider network expansion are avoided, as outlined in our CP30 Advice.

Future cost drivers – Constraint costs

Constraints are contributing to rising balancing costs

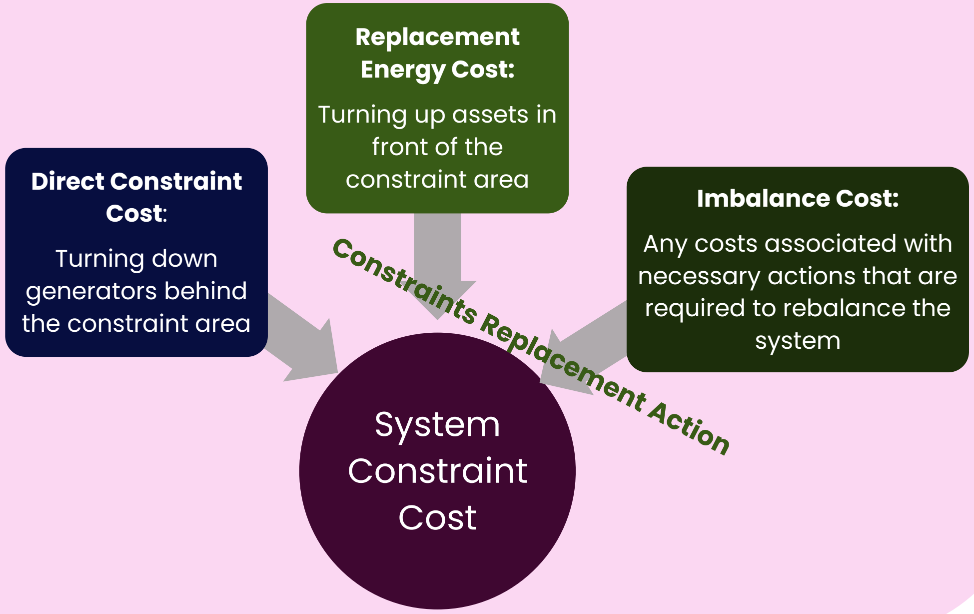
NESO manages the flow of energy on the transmission system. When the level of electricity being carried exceeds the capability of the network, we must take actions to protect it from damage and ensure that the power supply is secure. These events are known as system constraints and can be thought of in the same way as congestion on our roads which cause bottlenecks. Thermal, voltage, and stability constraints all require NESO to take action to manage. Thermal constraints are expected to be the most significant driver of costs over the next decade as large quantities of generation connects to the system.

To manage constraints, NESO will typically need to pay generators to stop generating electricity in constrained areas, while paying other generators to come online in areas that are free of constraints. This is known as a balancing action and forms part of the everyday running of the electricity system to help us reduce the strain on the network at certain times.

Government has endorsed our recommendations for accelerated network delivery set out in our CP30 Advice and this action, combined with the wide range of NESO led initiatives outlined in this report, will help manage congestion across the system and limit the number of balancing actions we will need to take, minimising the level of balancing costs faced by consumers. However, even with optimal reinforcement of the grid, annual constraint costs are expected to rise out to 2030 due to the lag between new generation connecting and transmission investment coming online.

Constraint Cost Elements

As well as direct turn down costs, system constraint costs also include costs associated with replacement energy (that must also provide access to an equivalent amount of reserve that was behind the constraint), and imbalance costs associated with necessary further actions to rebalance the system after turndown and replacement energy actions have taken place.



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Future cost drivers – Thermal & Reserve

Thermal Constraints

Where the amount of energy that would flow naturally from one region to another exceeds the physical capacity of the circuits connecting the two regions.

Why are thermal constraints changing?

- **New generation connections**: The rapidly changing generation mix, with high quantities of new generation connecting to the system outpacing network build is driving constraint costs up.
- **Location of connections:** Generation, flexibility and demand assets across the electricity system need effective locational signals, both in investment and dispatch timeframes. The current suite of signals sent through network charging and the balancing mechanism are proving insufficient and are resulting in inefficient investment and dispatch.
- **Outages:** Requests for network access are rising to facilitate the network development and new connections required for the net zero transition. Outages can result in short term increases in thermal constraints.

Reserve

At certain times of the day, we need access to sources of extra power in the form of either increased generation or demand reduction. This enables us to manage a greater (or less) than forecast electricity demand on Britain's transmission system.

Why are reserve costs changing?

- **Changing generation mix:** The growth in non-synchronous, renewable generation is expected to increase the speed and size of the energy swings which reserve services need to manage. The change in generation profile also affects the range of assets available to deliver reserve services, as traditional high-carbon assets are replaced with more renewable generation sources.
- **Size of largest loss:** We are expecting an increase in the size of the largest loss that we must secure with our frequency services.
- **Location of reserve:** Thermal constraints can limit access to reserve in certain locations. With constraints expected to rise over time, ensuring we have access to reserve in accessible locations will be increasingly important.

Future cost drivers (Thermal) – Network build

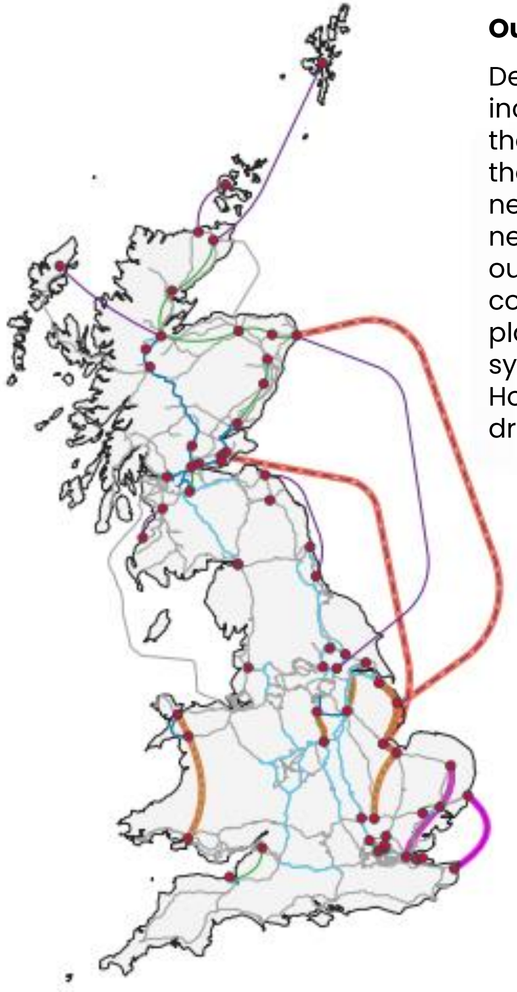
Investment in electricity transmission infrastructure will lower balancing costs

In December 2024, Government published its Clean Power 2030 Action Plan, which in line with our Clean Power 2030 Advice to Government sets out that a major expansion of the electricity networks is needed to facilitate clean power pathways. Current plans for network expansion are sufficient, but must overcome many barriers to deliver on time, and some vital projects need to be accelerated to deliver by 2030 (see page 33). A significant expansion of the transmission network is required over the next ten years, along with accompanying enabling works, connections and distribution network strengthening.

This rapid transformation of the electricity system will require significant levels of investment and the impact on consumer costs will vary across key components that make up energy bills. Accelerated network delivery is expected to significantly reduce balancing costs by alleviating network congestion and compounding delays of multiple projects can easily escalate thermal constraint costs by billions of pounds.

Investment in and timely optimisation of the national electricity network is consequently the most impactful lever available to minimise balancing costs as we progress with the energy transition.

Figure 17. **Map of 2030 transmission network reinforcements for a clean power system**



Outages

Development of the transmission system will require an increase in outages to enable access to the network. In the long-term, network upgrades will help to lower thermal constraints and facilitate net zero by increasing network capacity and supporting energy flows from newly connected generators, however, in the short-term, outages are expected to contribute to higher thermal constraint costs. NESO is optimising outage and project plans to facilitate additional outages while maintaining system security and limiting additional balancing costs. However, outages are expected to be a short-term driver of costs while network development is ongoing.

Category	Key
New offshore network infrastructure	
New onshore network infrastructure	
Voltage increase on network	
Existing network upgrade	
Substation upgrade or new substation	
HND wind farm	
Existing Network	

*Amber dashed lines represent reinforcements required for this blueprint, but current delivery date estimates sit beyond this.

Note: all routes and options shown on this map are for illustrative purposes only.

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Future cost drivers (Thermal) – Generation build

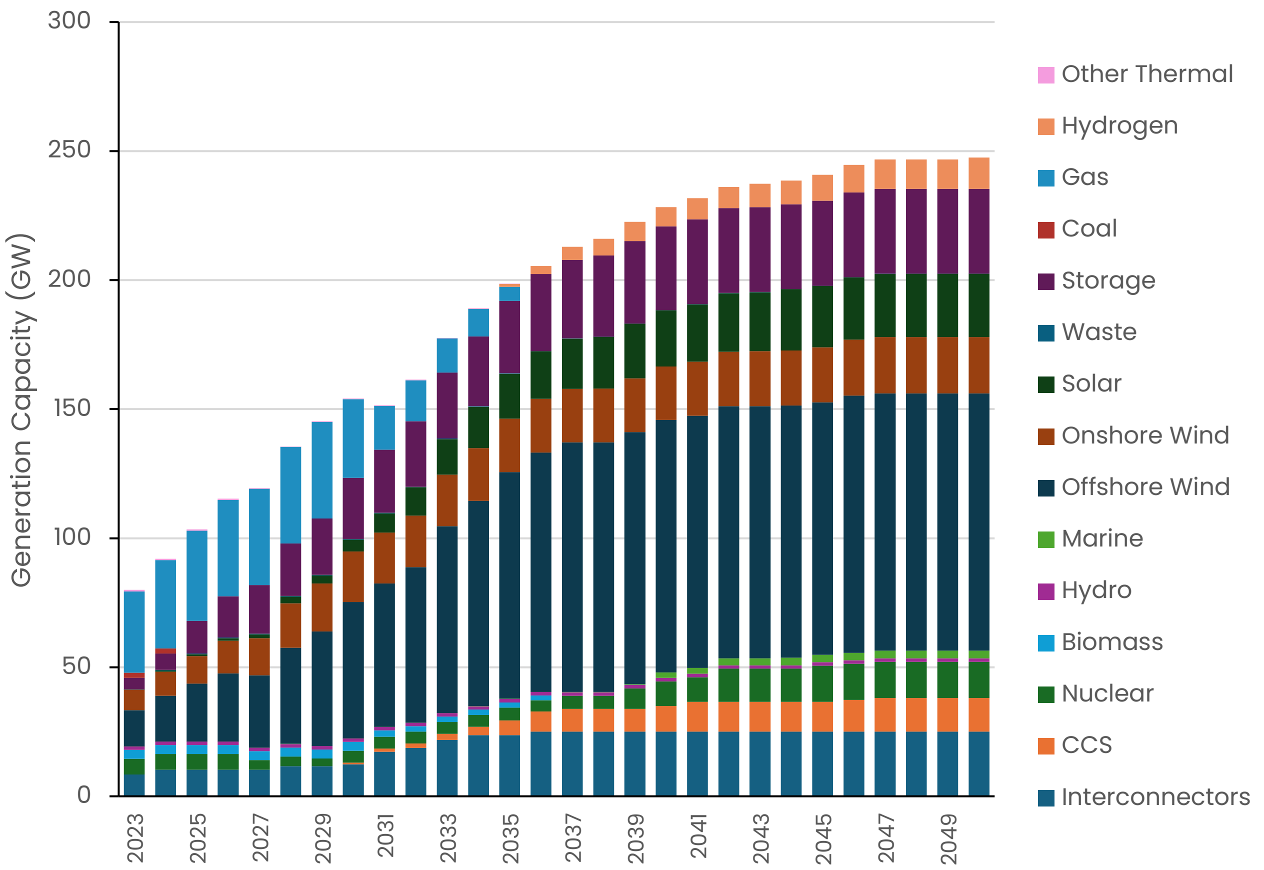
The changing generation mix is impacting balancing costs.

Our 2024 Future Energy Scenarios project a significant increase in generation capacity over the next two decades, including a sizable shift in the generation mix as we transition away from traditional fossil-fuel based sources to renewable, low carbon generation. Even with planned network build, this increase in capacity is expected to lead to growing network congestion over the next decade, as new connections will contribute to increased power flows that will outpace our ability to expand the capacity of the network. The location of these new generation connections, as well as their integration with proposed network development, will be important in determining the overall impact on balancing costs. Assessing the optimal locations, quantities and types of generation and storage infrastructure required to meet system needs will be a core focus of the Strategic Spatial Energy Plan (SSEP).

Of the numerous changes anticipated across the energy system, the expected increase in offshore wind remains the most notable with just over 50GW expected on our networks by 2030 under our most ambitious decarbonisation scenario.

The changing generation mix also poses further challenges to system operations due to reductions in synchronous generation and increased volatility in generation output which increases the need for NESO to manage voltage and stability requirements.

Figure 18. Transmission Generation Capacity – FES Holistic Transition



Future cost drivers – Voltage

Voltage Constraints

Voltage refers to the "pressure" or "driving force" that pushes electrical current through the transmission network. Voltage constraints occur when reactive power needs to be absorbed or injected in a particular area to support the local voltage.

Why are voltage constraints changing?

- **Equipment availability:** System spending in voltage management is mainly driven by a need of absorption capacity. Access to reactors or dynamic compensation in the right locations displaces the need to dispatch more expensive BMUs for voltage support.
- **Reactive spillage:** There is evidence of injection of MVArs from Grid Supply Points into the transmission system. This forces NESO to take additional actions to manage high voltages. This issue is mainly driven by the reactive gain of the distribution network plus an increasing capacity of Distributed Energy Resources.
- **Location of connections:** As our power system transitions away from fossil fuels, there are currently fewer dispatchable technologies located near to the areas of reactive power needs. Therefore, the location of new investment is key.
- **Low demand:** Low demand days, particularly during summer periods, are reflected in high spending on voltage management. This is driven by less synchronous units (typically CCGTs) being dispatch to meet the demand. These not only provide active power but voltage support and inertia as by-products. A lightly loaded grid also contributes to the issue.

Access to reactive equipment is important for minimising voltage synchronisation costs.

Voltage synchronisation costs are associated with specific actions required to support voltage in the system. These actions involve units that are instructed to provide MVArs and maintain voltages within SQSS limits.

During the last few years, costs for voltage management have increased dramatically, reaching a record high of £270m in FY2023/24. Although these costs have decreased compared to the previous year, spending in FY2024/25 remains significant at approximately £154m

Voltage management is a highly location dependent issue, so only a limited set of assets are effective in voltage support. High costs are linked to BMUs that are required to be instructed (synchronised) on a regular basis during overnight periods to maintain voltage under SQSS limits.

Access to sufficient reactive equipment at key locations on the network will help to displace the need to dispatch more expensive plant through the BM for voltage management. We are therefore working with Transmission Owners to enhance access to reactors.

We estimate this work can deliver savings worth millions of pounds each year for balancing costs. There is consequently a significant opportunity cost if reactors are not commissioned in time and highlights the need to accelerate this delivery where possible.

Future cost drivers – Stability and Response

Stability Constraints

Stability is the inherent ability of the system to quickly return to acceptable operation following a disturbance. To maintain power system stability, we need sufficient amounts of inertia, short circuit levels (SCL) and dynamic voltage support.

Why are stability constraints changing?

- **Changing generation mix:** As more non-synchronous generation connects to the network and displaces synchronous generation, stability requirement are expected to increase throughout this decade. Our inertia requirements are also becoming more dynamic as they fluctuate according to weather-driven generation and demand.
- **Locational stability requirements:** We are required to ensure the system remains strong and resilient to disturbances which can impact SCL and dynamic voltage by maintaining fault levels. The reduction of non-synchronous generation is increasing the requirement to manage stability levels.

Response

As part of our licensing obligations, we control system frequency at 50Hz plus or minus 1%. Frequency response services react in real-time to automatically balance supply and demand and maintain frequency on the grid

Why are response costs changing?

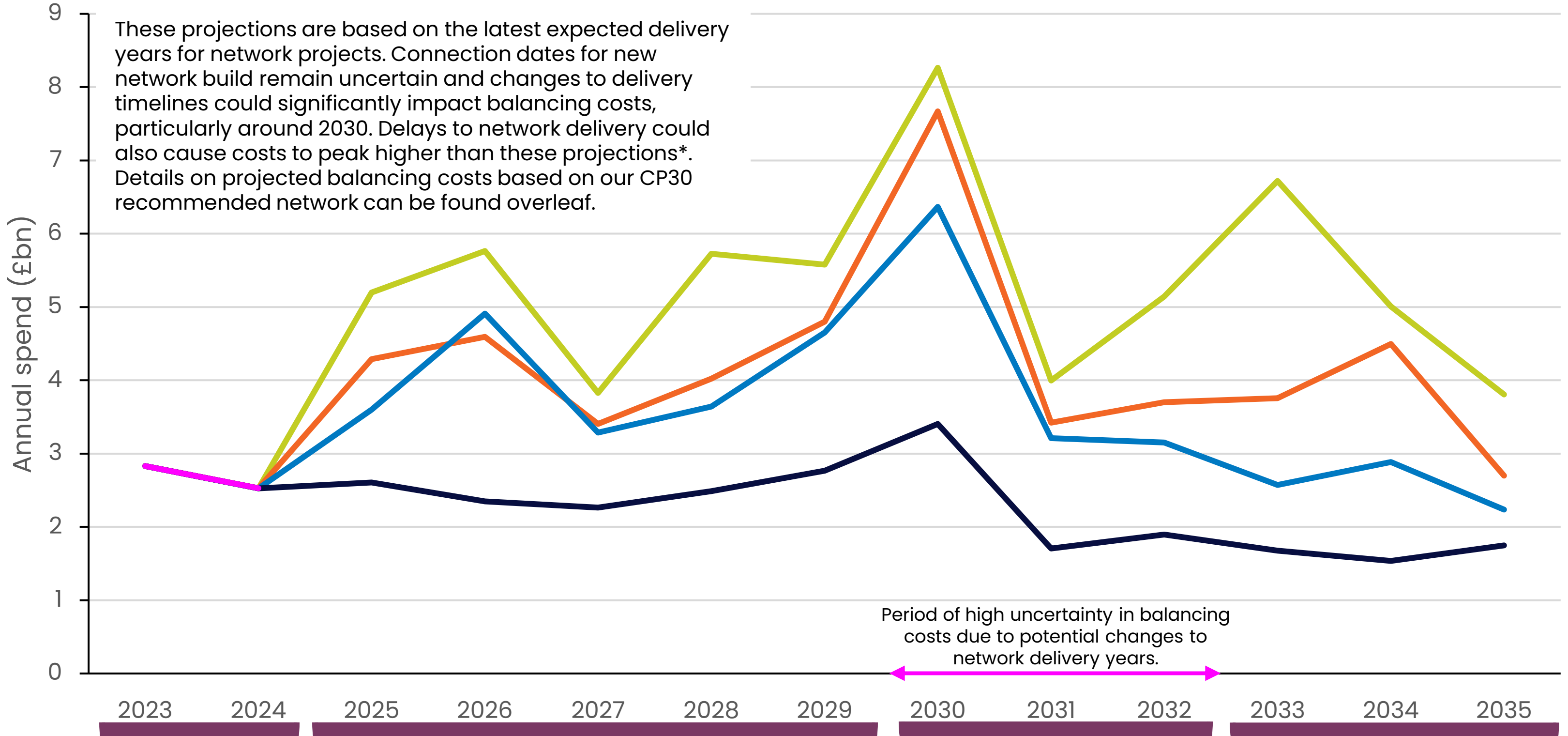
- **Lower levels of inertia:** As we continue our transition to net zero, we must move away from using fossil-fuel based sources of generation, which tend to provide inertia and dampen frequency changes, and rely more on non-synchronous energy sources such as wind and solar. This increases the need for response services.
- **Frequency variations:** Increased variable renewable generation on the system creates more volatility with frequency variation faster, more significant and harder to predict. Volumes of responsive assets such as interconnectors, Battery Energy Storage Systems (BESS) and flexible, electrified demand can also drive frequency changes as they respond to price signals.

Balancing Cost Projections

Details on FES pathways

Changes since last report

Figure 19. Projection of total balancing costs extrapolated from NOA7 and TCSNP2



Overall balancing costs fell in CY 2024 despite higher thermal constraint costs due to reductions in other cost components.

Balancing costs are expected to increase out to 2030 driven by increased thermal constraint costs due to a rapidly changing generation mix, with significant quantities of new generation connecting.

Constraint costs will fall significantly after 2030 following the delivery of network reinforcement.

Constraint costs rise again in some scenarios beyond 2030, as further generation connects to the system, which is later balanced by additional network build. Post-2030 thermal constraints also rely on effective policy decisions that deliver the right siting of electrolysers, new nuclear SMRs, wind, and demand.

Holistic Transition | Electric Engagement | Hydrogen Evolution | Counterfactual | Outturn balancing costs

Note: Outturn costs are for calendar years

These projections show potential future pathways for balancing costs only. It is important to recognise that balancing costs are just one of many components making up energy bills. For example, the reduction in balancing costs post-2030 is supported by significant investment in the transmission network, worth ~£118bn over the assessed period. The energy transition and potential market reforms will have variable impacts on all consumer cost elements.

Our projections currently extend to 2035 as **beyond 2035 balancing costs remain highly uncertain**. A key area of uncertainty includes the potential transition to a zonal market design which is currently under consideration as part of the REMA programme. While this decision process is underway speculation of future costs remains difficult as market reform and the nature of any potential reform is yet to be confirmed. For example, if a zonal market were to be implemented assumptions of the implementation dates for reform, number of zones, and possible grandfathering arrangements for generation assets would all have an impact on costs over this period. **An accurate projection of costs post-2035 therefore remains dependent on many factors such as network build and the nature of reform. A decision on REMA is expected to be announced later this year.**

*If no further network reinforcement takes place (current transmission network remains unchanged) constraint costs could peak at £12.7bn in 2030.

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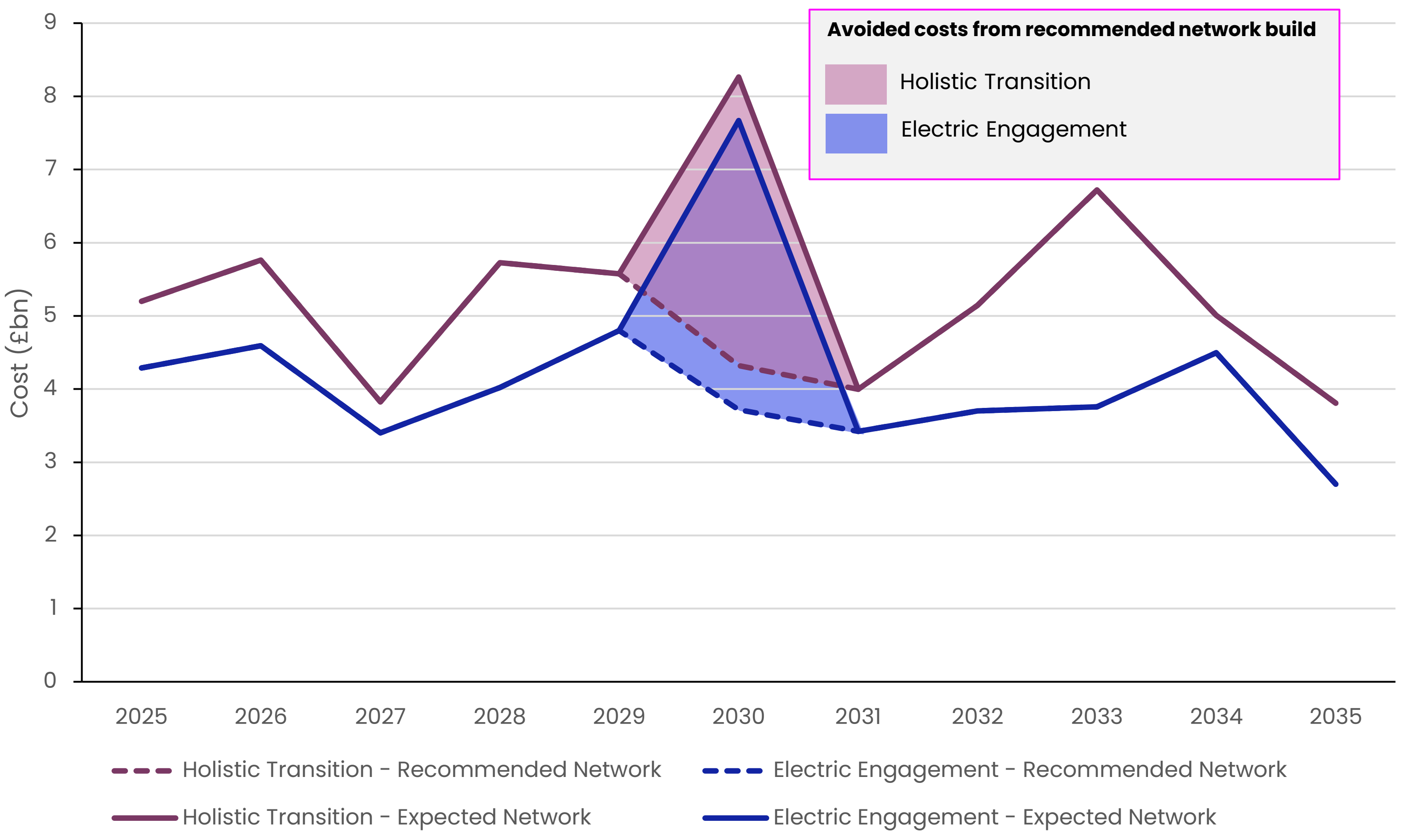
Balancing Cost Projections – Recommended Network

We have identified three network projects as critical to delivering a network which supports the Clean Power 2030, but at present have delivery dates after 2030. Support is therefore needed to bring these projects forward for 2030 delivery. These are projects in East Anglia and in the southeast that are critical for connecting offshore wind in the North Sea and supporting the flow of clean power. Our assessment suggests that without these projects, the clean power objective would not be achieved, leaving the clean power target short by around 1.6% in 2030 (assuming a typical weather year) and consumers could face extra constraint costs of ~£4 billion in 2030. Following the publication of the CP30 report, the Transmission Owners (TOs) are considering various ways to accelerate these projects.

CP30 Constraints Projections

Constraint costs have been extracted for both the recommended network and the expected network in our CP30 analysis. The recommended network includes three projects identified as critical to delivering a network which supports the clean power pathways, but at present have delivery dates after 2030. These projects are Norwich to Tilbury (AENC and ATNC) and Sea-Link (SCD1). After 2030, the recommended and expected network are identical. Our CP30 analysis has been combined with our FES projections to provide the balancing cost projections under the recommended network shown on this page.

Figure 20. **Balancing cost projections with CP30 recommended network (combined FES and CP30 scenarios)**



For more information on our CP30 Advice see our Clean Power 2030 Report

Balancing costs and Clean Power 2030

In December 2024, Government released its Clean Power 2030 Action Plan. This plan builds on advice published by NESO earlier in the year that was commissioned by the Secretary of State for Energy Security and Net Zero to provide independent expert advice on delivering clean power by 2030.

Our analysis concludes that Clean Power is a huge challenge but is achievable for Great Britain by 2030. This will require changes to the whole energy system at significant pace which will have multiple effects on wider system costs. In this report we focus specifically on balancing costs, but it is important to recognise that balancing costs are just one of many components making up energy bills for which the energy transition will have variable impacts. For example, our CP30 analysis concludes that the cost of generation is likely to reduce due to lower contract prices associated with wind and solar compared to existing gas-fired power stations.

Balancing costs are however one component of energy costs that are expected to rise in the short term under the clean power pathways. This is due mainly to increased constraint costs linked to the accelerated roll out of renewable generation. In order to minimise constraint costs, our CP30 advice recommends a major expansion of the transmission network. Current planned investment for 2030 will help to efficiently transmit clean power from where it is generated to where the demand is highest.

Based on expected delivery dates, in addition to the critical projects outlined on the previous page, we recommend bringing forward 8 additional projects, which would bring further benefit in reducing the use of unabated gas and a further reduction in constraint costs. Six of these projects (Figure 21), we understand from TOs, could be accelerated towards 2030 and any acceleration would bring reduced constraint costs. However, accelerating them to 2030 is likely to be extremely difficult. Two projects (Figure 22) are at an earlier phase of development and, we understand from TOs, cannot be brought forward from their existing post-2035 delivery dates, although any acceleration will bring benefits.

Figure 21. Projects due after 2030 assessed for potential to accelerate

Code	Description	Latest Delivery Year
CGNC	New circuit between Creyke Beck and High Marnham	2031
E4L5	New offshore HVDC link between Peterhead and the East Coast of England (Eastern Green Link 3)	2033
EDN2	New circuit between Chesterfield and Ratcliffe-on-Soar	2031
GWNC	New circuit between North Lincolnshire and South Lincolnshire border	2033
SHNS	New substation in the South Humber area	2033
TGDC	New offshore HVDC link between East Scotland and the East of England (Eastern Green Link 4)	2034

Figure 22. Projects at an earlier stage of development, which cannot be accelerated to 2030

Code	Description	Latest Delivery Year
PSNC	New double circuit from Pentir to Swansea North	2037
LRN6	New double circuit from South Lincolnshire to Hertfordshire	2034

For more information on our CP30 Advice see our Clean Power 2030 Report

NESO Balancing Cost Strategy and Delivered Savings

We are tracking savings from key balancing cost initiatives which saved over £1bn across the BP2 period (and represents just part of the range of initiatives currently delivering savings). This analysis is supporting evidence-based decisions for the development and prioritisation of current and future initiatives.

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Balancing Cost Strategy Roadmap

Our Balancing Cost Strategy will need to adapt over time to meet the needs of an evolving energy landscape. We are now coming to the end of Phase 1 of the strategy (Development Phase) where we have mapped the balancing costs landscape and built NESO capabilities to deliver cost reductions.

Phase 1 is now complete

Phase 1

2023 – 2025

Development Phase / Understanding the Balancing Cost Landscape

Phase 2

2025 – 2029

Monitoring / Implementation Phase

Our 2025 strategy covers Phase 2 We will closely monitor balancing costs and savings and implement evidence-based decisions on the development and prioritisation of initiatives in collaboration with industry.

The energy landscape of 2030 will be significantly different from today. A reassessment of our strategy at this time will allow us to revaluate the cost landscape and re-focus our strategy as needed.

Phase 3

2030

Reassessment Phase

Phase 4

2031 - 2040

New World / Monitoring & Implementation Phase

We still need to monitor and reduce costs over the 2030s. This will continue following our 2030 strategy reset.

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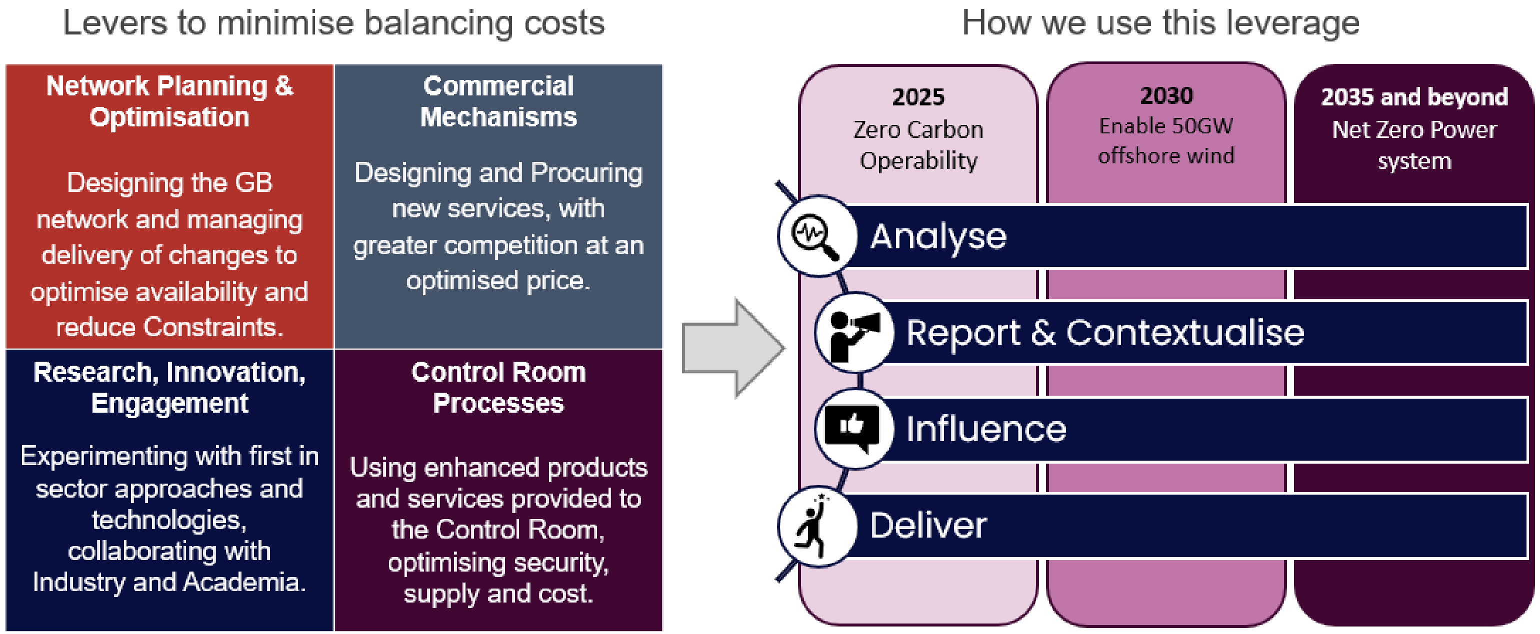
NESO 2023 Balancing Costs Strategy Recap

In 2023 we set out our first dedicated Balancing Costs Strategy. This outlined four key levers to minimise balancing costs and plans to utilise this leverage to deliver cost savings across a strategic timeline, while also increasing visibility of balancing costs through enhanced reporting and analysis.

Since this strategy was developed, we have made significant progress towards these goals, having established a dedicated Balancing Costs Team within NESO that provides a voice and advocacy to spearhead cost initiatives and contextualise balancing cost. Over the BP2 period we have progressed a significant number of initiatives, some of which are already delivering large savings in balancing costs. Through our enhanced analysis capabilities, we are now also able to more closely track savings delivered by these initiatives, providing strategic insight for further savings development.

2023 Balancing Costs Strategy



See the full 2023 strategy here.

How have we delivered change across BP2?

Our work on PN Inaccuracy improvements provides an example of how we have progressed change for balancing costs:

(PN Inaccuracy causes significant operational risk and adds to balancing costs due to BM payments being misaligned to delivered output)

Analysis

Analysis of FPN data to quantify misalignment and associated impact on balancing costs

Engagement

Discussions with Ofgem and DESNZ, and engagement with industry via OTF and WAG on issue and proposed solutions

Solution development

Establish acceptable threshold for PN Inaccuracy based on Control Room needs and generator capabilities

Change

Guidance Note published on 'Good Industry Practice' in August 2024 in relation to FPN accuracy in accordance with the Grid Code

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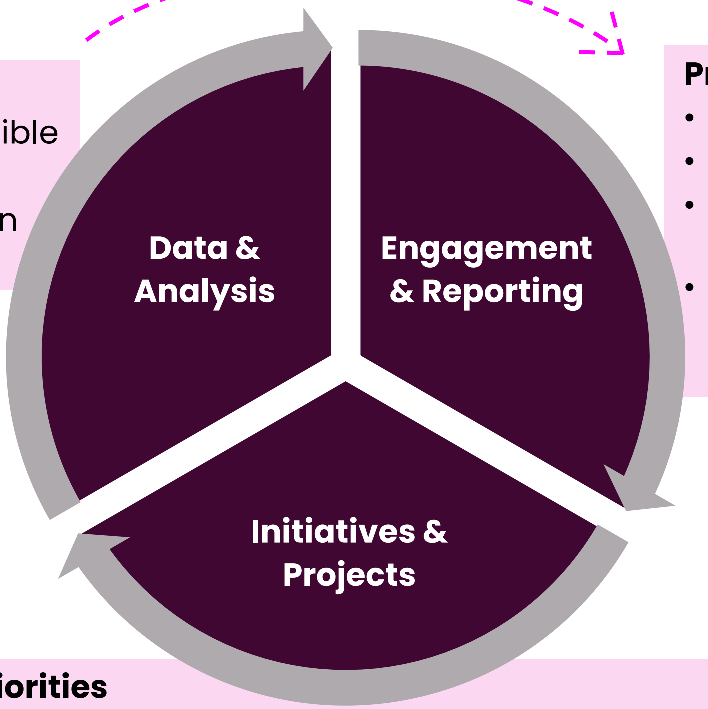
2025 Balancing Costs Strategy

We have identified three key delivery commitments to our 2025 Strategy: **Data & Analysis**; **Engagement & Reporting**; and **Initiatives & Projects**. These components naturally support each other, providing flows of information and feedback to support ongoing improvements and adjustments to our delivery to meet evolving strategic needs.

See the full 2025 strategy here.

Cost & savings insights shared with industry

Priorities
- Making cost data more accessible
- Providing insights on £ saved
- Defining the cost categorisation scheme



Priorities
- Regular industry updates
- Yearly cost projections
- Regular reporting on outturn balancing costs and drivers
- Contextualising trade-offs (i.e. other system benefits such as CO_2 savings)

Evidence-based decisions on the development and prioritisation of initiatives in collaboration with industry

Analysis of implemented initiatives to quantify delivered savings

Priorities

Implementation and development of:
- Industry-wide initiatives
- NESO initiatives

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Calculated savings

We are now tracking the savings delivered by several NESO initiatives. This includes savings for Network Services (NS) projects, Demand Flexibility Service (DFS), reductions to inertia requirements, and trading.

Savings are calculated by comparing the cost of actions taken through these initiatives with known counterfactuals (which in most cases would be taking equivalent actions in the BM).

These initiatives are currently delivering savings worth millions of pounds each month as well as supporting system security. We are in the process of expanding our tracking of savings and will add to this view over time, with the aim that this analysis will support evidence-based decisions for the development and prioritisation of current and future initiatives.

For more details on these initiatives see section 6 of this report.

Network Services Savings

We are using Network Services (NS) to implement solutions to operability challenges in the electricity system.

This includes the Constraint Management Intertrip Service, and Voltage & Stability Network Services which are delivering savings compared to taking counterfactual actions in the BM.

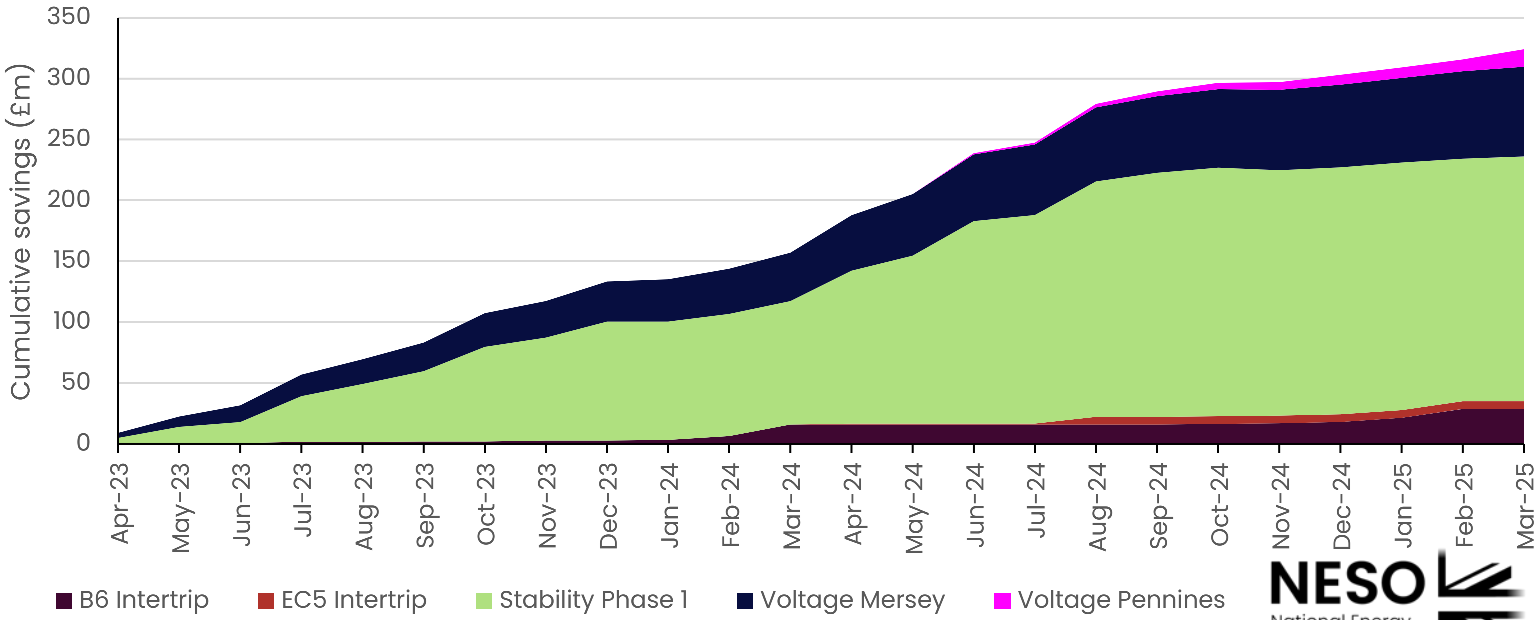
We have calculated that the B6 and EC5 Constraint Management Intertrip Services, Voltage Mersey, Voltage Pennines, and Stability Phase 1 have delivered approximately £324m in savings across BP2. This represents the first set of live NS projects. Other projects are currently undergoing development and implementation, such as Stability Phase 2 and 3.

B6 Intertrip Service Savings

During BP2, the main region of constraints in Scotland has moved north of the B6 boundary to the B4/B5 boundaries due to planned long-term outages. This has limited the amount of savings delivered by the B6 Intertrip Service over this period.

We are currently considering options for extending this service to additional boundaries in Scotland and Cheviot, and GB more generally, to support constraint savings through varying system conditions.

Figure 23. **Cumulative NSP Savings (BP2 period)**



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For more details on these initiatives see section 6 of this report.

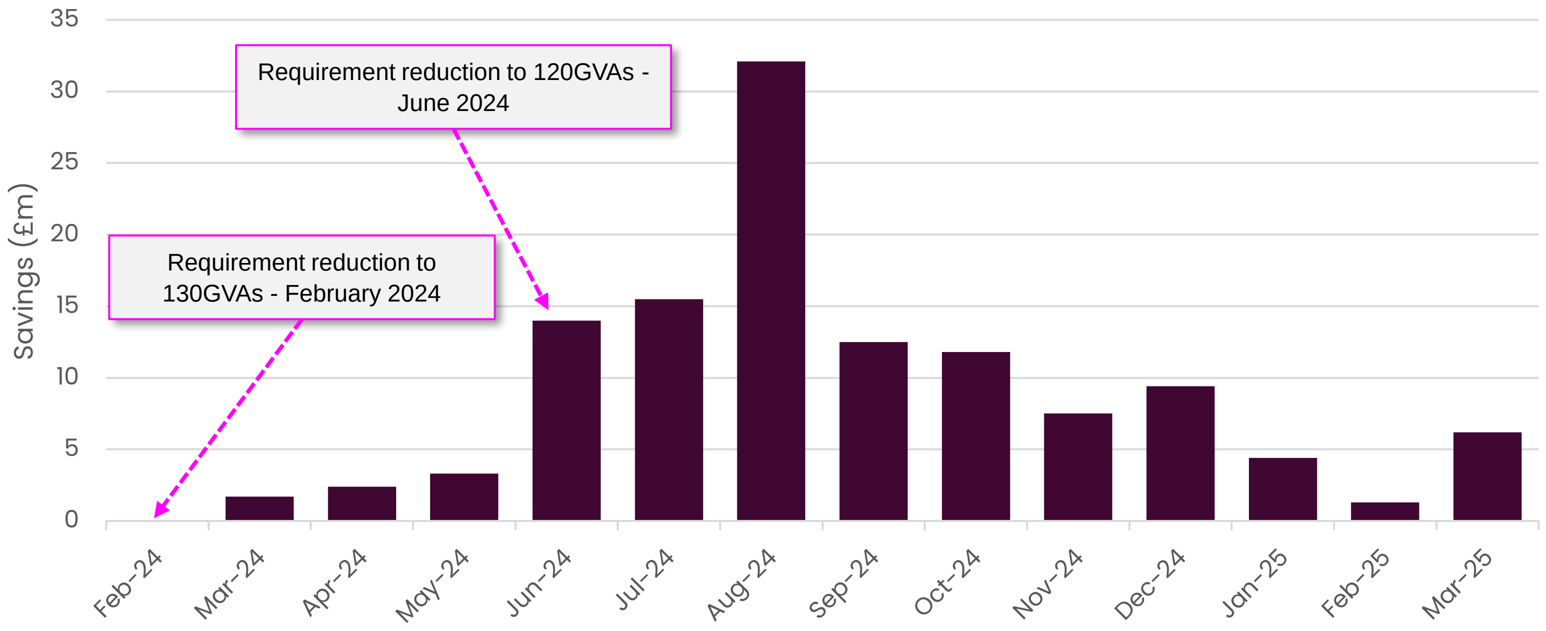
FRCR Inertia Requirement Reduction Savings

In 2024 significant reductions have been made to the system's inertia requirements, including a reduction on 28th February from 140 GVA.s to 130 GVA.s and a further reduction on 19th June to 120 GVA.s.

These reductions allow the system to operate with 20 GVA.s less without an increased risk of frequency deviations. As a result, fewer machines need to be instructed to meet the reduced inertia requirement, which has delivered a total saving of £122m since implementation (February 2024 – March 2025).

Proposals have been raised through the Frequency Risk and Control Report process to lower the requirement further to 102 GVA.s which should further reduce the volume of actions required to manage system stability.

Figure 24. Savings – Inertia requirement reduction from 140 GVA.s. to 120 GVA.s.



Please note that these are preliminary calculations and may be subject to change

Calculated savings

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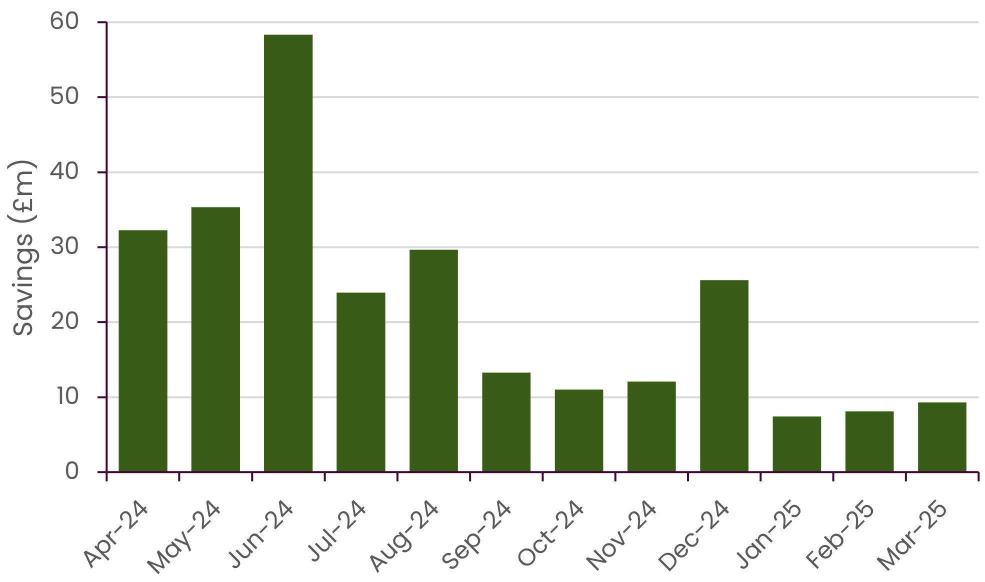
Savings are calculated by comparing the cost of actions taken through these initiatives with known counterfactuals (which in most cases would be taking equivalent actions in the BM).

These initiatives are currently delivering savings worth millions of pounds each month as well as supporting system security. We are in the process of expanding our tracking of savings and will add to this view over time, with the aim that this analysis will support evidence-based decisions for the development and prioritisation of current and future initiatives.

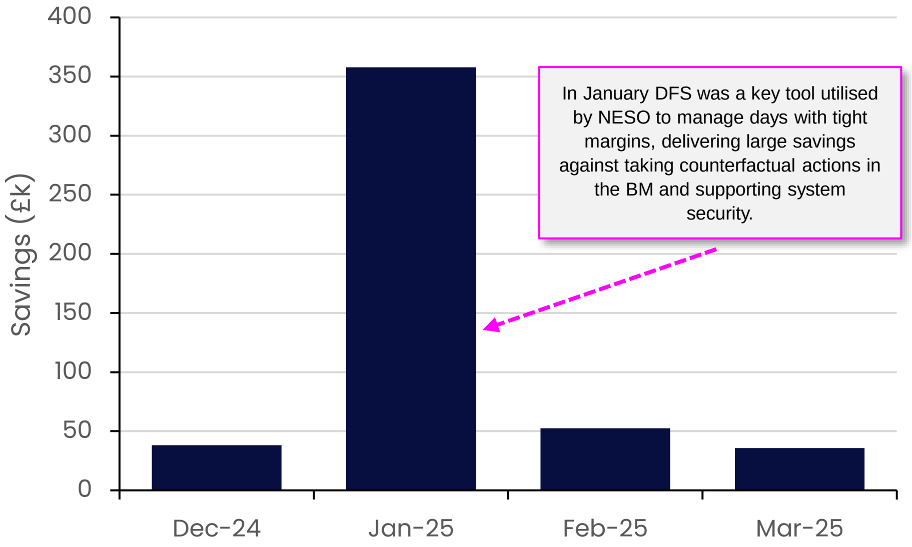
For more details on these initiatives see *section 6 of this report.*

Figure 25. Trading Savings



NESO undertakes trading actions with interconnectors and generators outside the BM to provide GB with access to generation both domestically and internationally, with prices that can be used for balancing at lower cost than BM actions. The Trading team have a licence obligation to conduct trades to balance the system in the most economic way, replacing more expensive BM actions. Across 2024/2025 trading has delivered £266m savings as opposed to alternative BM actions.

Figure 26. Demand Flexibility Service Savings (Winter 24/25)



In 2024, the Demand Flexibility Service (DFS) was transitioned from an enhanced action service to an in-merit based margin tool and the service went live on 27 November 2024.

Since going live, the cost of accessing volume through DFS has reduced significantly and often provides a cheaper alternative to equivalent actions in the BM. DFS is only procured where it demonstrates economic value against alternative actions at the time of assessment. DFS has been utilised consistently over winter 2024/25 period and has contributed to £484k savings over this period.

Key actions required across industry

NESO has varying levels of control over factors that impact balancing costs. Actions are also required across industry to minimise costs. We have identified four key areas where industry action is expected to have the largest impact on balancing costs:

Network Build

- Network build is the most impactful lever available to minimise balancing costs as we progress with the energy transition.
- Industry must work to ensure current plans for network expansion are delivered on time.
- Some critical network projects should also be accelerated to deliver by 2030 to support clean power pathways and avoid peak constraint costs (see p31 - 33).
- The development of supporting network infrastructure, including reactive power equipment, will also be crucial for supporting the requirements of the future energy system.

Market Reform

- Market reforms such as REMA have the potential to significantly impact balancing costs, such as zonal pricing, dispatch arrangements, and reforms to CfD.
- The next few years will be pivotal for setting the direction of balancing costs over the 2030s and beyond.
- We are also developing our NESO markets to enable lower costs and maintain security of supply. We will need support from industry to progress this market reform through supporting consultations and bring assets to market.

Connections

- The location of new generation connections, as well as their integration with proposed network development, will be important in determining future balancing costs.
- It is important that the correct locational signals are sent to generators to support efficient investment decisions and dispatch.

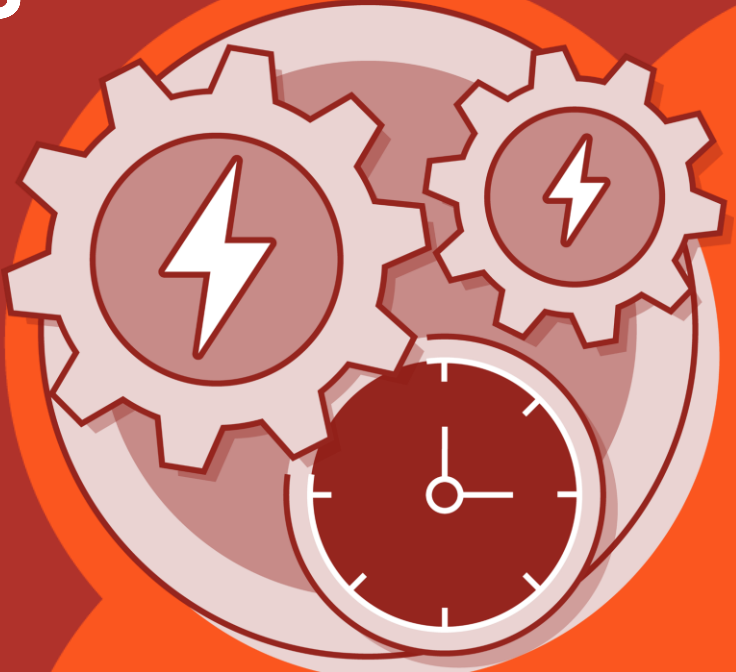
Flexibility

- System conditions are expected to change as the generation mix changes. Access to flexible assets such as batteries, demand response, and interconnectors will help us respond quickly to changes and meet system needs.
- Stability and voltage requirements are becoming larger and more dynamic. Flexible assets that resolve specific system needs as well as provide energy will be crucial for supporting the future energy system.

Initiatives to reduce Balancing Costs

Future balancing costs are not fixed and can still be influenced by proactive initiatives from NESO and industry to reduce costs. We are undertaking a wide range of initiatives within our balancing costs strategy that are aimed at minimising balancing costs.

Our Markets Roadmap also details our forward-looking view of our markets, our market design principles and plans to reform and evolve our markets.



Factors that impact Balancing Costs with influence level NESO has over these factors

- These 15 factors are not mutually exclusive; they directly or indirectly influence each other
- NESO has different levels of influence on these factors
- The level of influence may change as NESO develops into new roles

UK Government Policy
CP30 Action Plan
e.g. Connections reform, pathways to clean power

EU Policy
e.g. Clean Energy Package, Cannot buy more than 30% reserve and response at day ahead

Grid code changes
FRCR, Grid Forming, Fixed BSUoS

Interconnectors
New interconnectors imminent, flow on interconnectors depends on market price

Wholesale electricity prices
Set entirely by wholesale market but directly drives BM prices

Network outages
We optimise when outage take place but still has a significant impact on balancing costs

Generator Outages
Balancing options more limited when these are significant

Transmission Network build
What, where and when new transmission networks coming online alleviates constraints

New Products and Services
NESO can design new ancillary services and procure them according to our license conditions.

New Generator Connections
When and where new generators connect to the transmission network

Electricity Market Design
REMA: Incentives on market actors to schedule and trade in a way that respects system security

Operating Margin
The level of operating margin required to cover demand changes or generation breakdowns is defined by NESO

Market Monitoring
NESO will notify Ofgem of potential market misuse or identify potential market changes required

System Modelling and Data
We build system models that result in published data e.g. demand forecasting and transmission constraints

Control Room/BM
Balance supply and demand at lowest costs whilst meeting security standards

Very little influence | Some influence | Strong influence

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Thermal constraints

Network Reinforcement

In our Clean Power 2030 report we outlined that a major network expansion will be required to operate a clean power system for Great Britain by 2030. This involves twice as much transmission build in the next five years as was built in total over the last decade.

Current plans for network expansion are sufficient to meet the Clean Power target, but must overcome many barriers to deliver on time, and some vital projects need to be accelerated to deliver by 2030.

Network reinforcement will also be crucial for minimising thermal constraint costs. The network currently expected for 2030 is expected to reduce constraint costs by £4-5bn compared to a transmission network with no further development. This reduction increases to £9-11bn if all further projects identified for acceleration in our CP30 assessment are delivered by 2030.

Compounding delays of multiple projects can therefore easily escalate thermal constraint costs by billions of pounds, while acceleration of network projects is the most significant lever available to reduce balancing costs over the long-term.

Network Planning

The Network Planning Review (NPR) has been established by NESO to ensure that network design and investment processes in GB are fit for the future. The Pathway to 2030 Holistic Network Design (HND) and the recommendations set out in the Network Options Assessment (NOA) were the first steps towards a more centralised, strategic network planning approach. We're building on this long-term, strategic approach through the development of a Centralised Strategic Network Plan (CSNP). The CSNP will take a broad, whole energy system view to transforming the pace and scale of our planning.

Steps have been taken to accelerate the delivery of strategic electricity transmission network upgrades through The Accelerated Strategic Transmission Investment (ASTI) framework. Informed by the Holistic Network Design (HND), an initial list of ASTI projects have been set out for delivery by 2030.

The combined effect of a new offshore transmission system and the acceleration of onshore reinforcement projects is expected to contribute to significant reductions in thermal constraint costs following delivery.

Eastern Green Link

Underwater links between Scotland and England on the East coast that are undergoing the project assessment process under ASTI.

In 2024, Ofgem confirmed final approval on the costs associated with the delivery of Eastern Green Link 1 and 2. These projects are expected to alleviate Scottish constraints, with operational dates currently targeted for 2029/2030.

Outage Optimisation

NESO is optimising outage and project plans to minimise their impact on system constraints. NESO identify constraints ahead of time and agree enhanced services with TOs to mitigate impacts. Requests for network access have risen significantly in recent years and will continue to increase to facilitate the large amount of network development and new connections required for the net zero transition, so the need for outage optimisation will grow.

Enhanced outage optimisation will facilitate additional outages while maintaining system security. This also has a significant benefit for balancing costs by reducing thermal constraints.

Thermal constraints

Short Term Market Reform

Due to a long lead time for network reinforcement, and fundamental market reform under consideration by the government's Review of Electricity Market Arrangements (REMA), thermal constraints are currently being managed through short-term reforms.

Constraints Collaboration Project

The Constraints Collaboration Project is bringing NESO and industry together to find solutions for thermal constraints, which can be implemented in the short term.

Proposed solutions from industry fell into two broad categories: the development of Constraints Management Markets (CMM) outside the BM; and increasing flow over boundaries through pre- and post-fault services or technical solutions.

After assessing the consumer and system benefits of the different options, the focus is now on progressing an innovation project relating to smoothing boundary flow, developing our battery storage strategy, and a long-term CMM to incentivise flexible demand in constrained areas.

Constraint Management Intertrip Service

The Constraint Management Intertrip Service (CMIS) looks for ways to reduce the cost of managing constraints at various locations on the electricity system. Intertrip schemes enable the Control Room to facilitate more power to flow on the existing transmission infrastructure pre-fault, thus reducing the amount of generation being curtailed pre-emptively when the expected flow exceeds the current capability of the circuits.

At present two Intertrip services have been implemented and are helping to manage network congestion at the B6 and EC5 boundaries. This has contributed to total constraint savings of ~£119m since implementation.

The Constraint Collaboration Project is currently considering options for enhancing the existing Intertrip Service by securing the boundaries with more assets and intertrip connections. Additional boundaries may also be able to benefit from an extension of the Intertrip Service which is also under consideration by NESO.

Regional Development Programmes (RDP)

RDPs are designed to address areas of the network challenged by large volumes of Distributed Energy Resources (DER). They aim to improve transmission and distribution system coordination to unlock network capacity, reduce constraints and open new revenue streams for market participants.

A number of RDPs are under development and at varying stages of progression. This includes Megawatt Dispatch (MWD), an RDP analysing what requirements and capabilities are needed in the south west of England to manage power flows from high levels of renewable solar and wind energy at the least cost to consumers. MWD is now active in the Southwest and Southeast of England

Auto Switching Software

Auto switching software can be used to increase pre-fault flows on the network by allowing control engineers to use automated circuit switching.

NESO is currently undertaking a trial of this software, and following successful completion, further schemes are to be considered.

Thermal constraints

Long Term Market Reform

Over the long-term thermal constraints will be largely determined by the balance between new generation connections, pushing costs up, and the development of new network, bringing costs back down. Market reforms will also be significant over the long-term and as they have the potential to influence the locational and operational signals sent to generators which will have knock-on consequences for the volume and cost of actions we need to take to manage constraints.

There is currently a high level of uncertainty regarding final decisions impacting long-term market reforms, and we expect the next few years to be highly influential for determining the long-term outlook for thermal constraint costs. Key workstreams we are tracking that are expected to have a high level of influence on thermal constraints include network delivery timelines, connections reform, REMA, and policy for new generation.

Connections Reform

The Connections Reform project forms part of NESO's long-term vision for change to the connections process. In 2024, we set out our proposed way forward for connections reform (referred to as TMO4+), that will seek to align the connections process with strategic energy and network plans.

Connections Reform will look to speed up grid connections which will support faster decarbonisation of the energy system and is expected to contribute to cheaper electricity generation. The acceleration of generation connections is also likely to add to network congestion and increase constraint costs. However, the proposed options will provide connection offers based on a co-ordinated network design which is expected to create significant savings in capital and constraint costs compared to the status quo. In April 2025, Ofgem published its Final Decision to approve the TMO4+ Connections Reform Proposals.

In November 2024, Ofgem additionally published a consultation on proposed changes to the regulatory framework around electricity grid connections, as part of its connections end-to-end review.

REMA

The fact that thermal constraint costs are rising forms an important part of the case for change for the Government's ongoing Review of Electricity Market Arrangements (REMA), which – among other objectives – seeks to ensure that our future renewables-dominated system can be operated safely and cost-effectively.

There are several changes under consideration that have the potential to impact balancing costs:

- **Zonal pricing:** Strengthening locational signals in the wholesale market. This could be achieved through making changes to the existing national pricing framework, such as by strengthening TNUoS, or by introducing zonal pricing. These reforms would reduce thermal constraint costs by incentivising market participants to operate and locate in a way that aligns with the physical needs of the system.
- **Dispatch arrangements:** Changes to dispatch arrangements could reduce the need for re-dispatch which would help to lower consumer costs.
- **Reforms to CfD:** Contracts for Difference (CfD) payments currently cause some distortions in the BM. Reforms to CfD arrangements could support better cost reflectivity in bid prices.

In December 2024, DESNZ provided an update on the REMA programme, setting out that REMA reforms will to work alongside the Clean Power 2030 Action Plan.

Thermal constraints

Long Term Market Reform – Policy for new generation

Government policy for wind, hydrogen, and nuclear is developing and will have an impact on future generation connections. In December 2024, Government set out its Clean Power 2030 Action Plan which included ambitions for new generation pathways out to 2030.

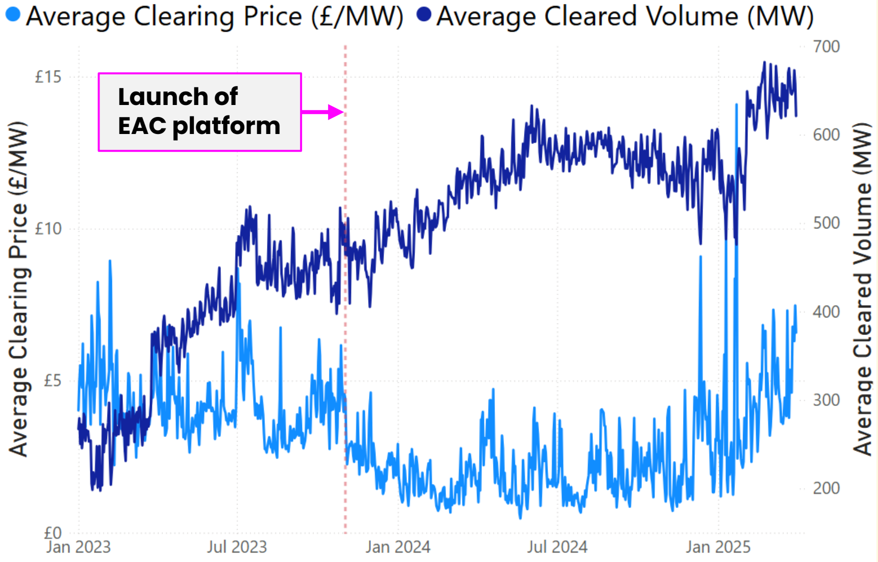
Technology	Description	Impact on balancing costs	Key Points from Government's CP30 Action Plan
Wind	Wind has a particularly important role in decarbonising the GB power system. However, wind curtailment is increasing balancing costs, particularly in regions north of the B6 boundary and in the EC5 region.	Increased wind generation is expected to drive up balancing costs out to 2030. This will need to be supported by a range of initiatives to manage constraint costs and facilitate new connections that are integrated with proposed network development.	• Ambitions for 43-50 GW of offshore wind and 27-29 GW of onshore wind by 2030. • Onshore wind brought back into the Nationally Significant Infrastructure Project (NSIP) regime and consultation response published confirming changes to the National Planning Policy Framework (NPPF). • Reforms to the Contracts for Difference (CfD) mechanism to ensure it can support the volume of new capacity needed to deliver the renewable contribution to the CP30 target whilst continuing to minimise the costs of doing so to consumers.
Nuclear	As baseload capacity shrinks with the phase out of conventional generators, nuclear will become increasingly important in maintaining grid stability. SMR is likely to play an important role in the future of nuclear generation (circa. 2035).	Location will be key in reducing balancing costs. Government is consulting on its proposed approach for determining how new nuclear developments could be sited beyond 2025 and will designate a new nuclear NPS in 2025.	• Ambition for 3-4 GW nuclear capacity by 2030. • Government is progressing post-2030 generation interventions, with final decisions on Sizewell C and the Great British Nuclear-led Small Modular Reactor programme to be taken at the Spending Review. • Nuclear power is expected to play a key role in achieving Clean Power 2030 and beyond by providing low-carbon, baseload generation on the system.
Storage/ flexible capacity	Increased system flexibility is necessary to facilitate an energy system more reliant on variable renewables. This includes long-duration storage, which can support security of supply during longer periods of low renewable output.	Access to flexible assets will help us respond quickly to increased volatility on the system at lower cost than alternatives. Long-term storage could be used to relieve grid constraints, particularly north of B6. However, the benefit will be highly dependent on siting location, with demand needing to be incentivised in congested regions.	• Ambitions for 23-27 GW of battery capacity, 4-6 GW of long-duration energy storage, and development of flexibility technologies including gas carbon capture utilisation & storage, hydrogen, and substantial opportunity for consumer-led flexibility. • DESNZ to publish with Ofgem and NESO a joint Low Carbon Flexibility Roadmap in 2025. The Flexibility Roadmap will set out clear short and long-duration flexibility milestones and measures required for both clean power in 2030 and net zero by 2050. • Government developing a hydrogen to power (H2P), carbon capture usage and storage (CCUS) and long-duration electricity storage (LDES) business models to de-risk investment and bring forward capacity at an accelerated rate.

Response

Response Market

We are seeking to enhance our within-day service options with some of the benefits we have seen in our Dynamic Services. This could include updated technical requirements to ensure the service is effective at managing frequency and the opportunity for commercial participation which could deliver cost savings similar to those we have seen in our day-ahead services.

Figure 27. Average clearing price and average cleared volume for Dynamic Services (January 2023 – March 2025)



Dynamic Services (DC/DM/DR)

In recent years we have transitioned to a new set of frequency response products that we are able to procure via the Enduring Auction Capability (EAC) platform. This has features such as co-optimisation of auction products, splitting of bids across multiple products and negative price clearing leading to an increase in market liquidity and has greatly reduced the cost of procuring frequency response.

We are currently considering options for further efficiency improvements to the Dynamic Services and expanding these benefits to other response services which is expected to deliver further cost benefits over time:

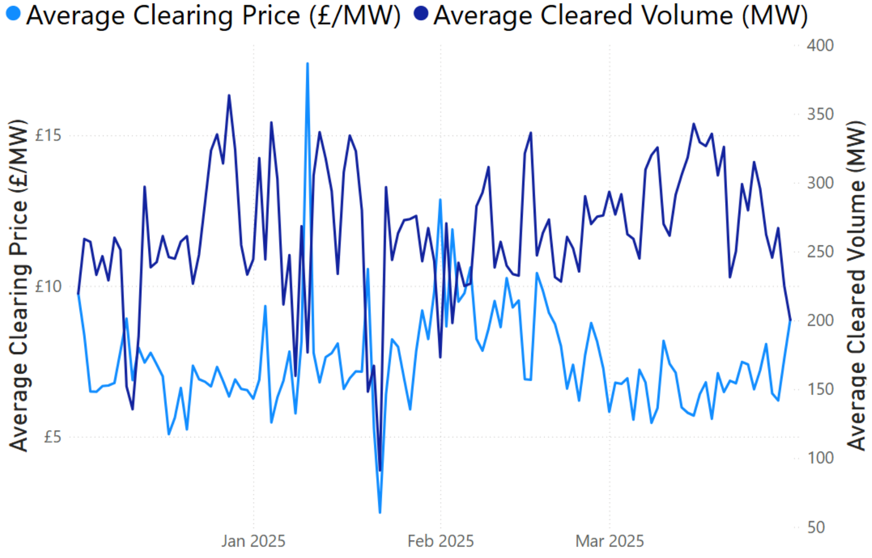
- **Locational procurement:** As network constraints become more variable, the proportion of units which are effectively sterilised represent a growing inefficiency of procurement. We are considering processes and options available to better align procurement with regions for which response delivery will be effective which should reduce costs and risks to system security for under delivery. We aim to consult on locational procurement of Dynamic Response in late 2025 or 2026.
- **Stacking and co-optimisation:** We are continuing to progress options to allow increased stacking and co-optimisation of Dynamic Services with other response and reserve services. This should improve the efficiency of our auction clearing and reduce costs. We aim to consult on Stacking Dynamic Response with Quick Reserve in late 2025 or 2026 following the establishment of the Quick and Slow Reserve products.
- **30 minute contracted windows:** We seek to reduce barriers to entry and allow assets to provide accurate and reflective prices in our auctions as well as to improve access for other asset types such as demand side flexibility. We are investigating transitioning from using four hour EFA block service windows to 30 minute Settlement Period contracted windows which could support this goal and align providers bidding granularity with that of our day-ahead reserve services.
- **Instructible Dynamic Response:** We are looking to develop a within-day commercial service with both non-mandatory and mandatory elements to replace our primary within-day service, Mandatory Frequency Response. This should provide significant cost savings whilst maintaining system security. We are aiming to consult on this topic in late 2025 or early 2026.
- **Static Response:** We are considering changes to Static Firm Frequency Response including updated metering requirements, co-optimised procurement with dynamic services, improved visibility and control of units, and some adjustments to delivery parameters. The first round of changes are likely to be consulted on in late 2025.

Reserve

Reserve Market

We are designing a new suite of reserve services to enable us to more effectively manage the system and minimise balancing costs as we transition to net zero. We have delivered Balancing Reserve and Quick Reserve in 2024 and are planning to launch Slow Reserve in 2025. We are also continuing to optimise our reserve requirement setting and considering opportunities for introducing locational procurement of reserve to improve the efficiency of our procured reserve volumes.

Figure 28. Average clearing price and average cleared volume for Quick Reserve (December 2024 – March 2025)



Balancing Reserve

Balancing Reserve (BR) allows NESO to procure Regulating Reserve on a firm basis at day ahead through auctions in the morning, using a pay-as-clear pricing structure.

Balancing reserve is acting to reduce balancing costs and improve system security as the reserve capacity is guaranteed for the Control Room to access when they need it, reducing the need for potentially expensive real-time balancing actions. NESO held the first auction for the BR service on 12 March 2024.

Quick Reserve

Quick Reserve (QR) is a new reserve service, procured at the day-ahead stage through an auction in the afternoon. The service is aimed primarily for reacting to pre-fault disturbances to restore the energy imbalance quickly and return the frequency close to 50.0 Hz. The first auction took place on 3 December 2024.

We are now developing the proposed service and procurement design for the enduring (Phase 2) Quick Reserve service, incorporating both BM (Balancing Mechanism) and non-BM (non-Balancing Mechanism) market participants, with the service design currently undergoing consultation.

Slow Reserve

Slow Reserve (SR) is primarily aimed at reacting to post-fault disturbances to restore energy imbalances within 15 minutes of a loss event. Slow Reserve is due to be delivered in 2025 in line with the OBP release plan and will ultimately replace the legacy Short Term Operating Reserve (STOR) service. Unlike STOR, Slow Reserve will be bi-directional and will secure against both losses of generation and demand.

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Voltage

Voltage Market

The evolving generation landscape is changing reactive power requirements. Increasing locational requirements, paired with the drive for greater competition, more transparency and lower system costs, provides a clear case for change and the need for coherent market and code reforms.

Enduring Voltage Markets

The Future of Reactive Power Market project has recommended the implementation of a long-term reactive power market. At the time of writing this publication, NESO has completed system studies and has launched the first long-term market procurement process, the Long-term 2029 tender. This network services tender is seeking provision of reactive power services across England & Wales from 2029 onwards.

Throughout 2024, we have also explored a mid-term reactive power market in more detail resulting in a decision in early 2025 to progress with its implementation. We will continue to assess the feasibility of a short-term market, which will also consider the output from the review of the Obligatory Reactive Payment Service (ORPS).

Voltage Network Services

Voltage NS identifies the most cost-effective ways to address high voltage system issues. It was developed through the Pathfinder programme with the first solutions delivering reactive power from April 2022.

The Mersey Voltage NS was the first voltage project to deliver and provides access to 240 MVAr of reactive power volume, reducing our reliance on a CCGT unit in the area. Successful units from the Pennines long-term NS also became operational in 2024, providing 700 MVar of effective reactive power volume to the North region. Both projects are currently delivering savings on voltage spending and included in our assessment on page 38.

Through the most recently completed Network Services tender known as ‘Voltage 2026’, we have contracted a further 200 MVar in London and 446 MVar in the North England of effective absorption contribution from a combination of shunt reactor and Battery Energy Storage System (BESS) units on 10-year contracts. These contracts will deliver a forecasted consumer saving of £318m across the 10-year period.

The Long-term 2029 tender is the most recently launched Network Services tender, representing the first Network Services tender through the Long-term Voltage Market.

ORPS Reform

NESO is reviewing its Obligatory Reactive Power Service (ORPS) with the aim of deriving value for consumers through potential reforms to how reactive services are designed, calculated and paid.

The core objective of the project is to review the existing methodology and, if suitable, to develop a new methodology for ORPS that accurately and fairly compensates reactive power service providers now and in the future. The project is expected to result in a code modification that could take between 6 months to 2 years to implement.

Asset Investment

National Grid Electricity Transmission (NGET) are working towards delivering new reactors in Melksham and Taunton by mid 2025 and early 2026 respectively. We have worked closely with NGET to prioritise the right locations on the network for compliance, economic and zero carbon reasons.

In 2024/25 we have also undertaken analysis to quantify the benefits of new reactors with the aim of supporting future investment decisions.

Stability

Stability Market

We are committed to procuring stability services more competitively and transparently versus the Balancing Mechanism counterfactual. To meet ongoing stability requirements, we must ensure that sufficient capability is accessible to provide these services on a high-availability basis.

Enduring Stability Markets

In 2023, we launched our first stability market – the mid-term (Y-1) market – for delivery from October 2025. In 2024 it was announced that this first tender procured 5 GVA.s inertia in total from five providers and is estimated to deliver consumer savings in excess of £47m throughout the first delivery year. We have kicked-off the second delivery year (for delivery from October 2026).

NESO has completed system studies and has launched the first long-term stability market procurement process, the Long-term 2029 tender. This network services tender is seeking provision of stability services across Great Britain from 2029 onwards.

Stability Network Services

Stability Network Services Procurement look for the most cost-effective way to address stability issues in the electricity system. Contracts signed under Phase 1 started delivering in April 2020. Phase 2 and 3 have awarded contracts and the first assets have started to go live.

Units commissioned under Stability Pathfinder Phase 1 remained operational throughout 2024 and were utilised significantly to reduce actions required in the Balancing Mechanism. Stability savings delivered by these units are included in our assessment on page 38.

New assets contracted under Stability Pathfinder Phase 2 have also successfully commissioned during 2024. This includes the first ever grid-forming battery energy storage system at Blackhillock which will provide valuable inertia and SCL support in Scotland.

In 2022, agreements were signed as part of Stability Pathfinder Phase 3, which are due to start delivering in 2025.

Frequency Risk and Control Report (FRCR)

Our FRCR dynamically assesses the magnitude, duration, and likelihood of transient frequency deviations, the forecast impact and the cost of securing the system. It allows us to change the system's inertia requirements to suit the system conditions.

In 2024, we made significant reductions to the system's inertia requirements, including a reduction from 28th February from 140 GVAs to 130 GVA.s and a further reduction from 19th June to 120 GVA.s. These reductions allow the system to operate with 20 GVA.s less without an increased risk of frequency deviations. As a result, fewer machines need to be instructed to meet the reduced inertia requirement. The FRCR requirement reduction to from 140 to 120 GVA.s has contributed to £122m in savings across 2024/25.

Additionally, proposals have been made through the Frequency Risk and Control Report process to lower this further to 102 GVA.s which should reduce the volume of actions required to manage system stability.

Improving system operation

System operations

We are continuously making improvements to system operations through the implementation of enhanced products and services provided to the Control Room to optimise security, supply and cost.

Single Markets Platform

The Single Markets Platform (SMP) is supporting NESO become a better buyer of ancillary services by providing users frictionless access to NESO markets.

The SMP had its foundational release of functionality on 10 February 2022. There have since been continuous monthly releases to add new functionality for the Market.

Savings achieved through SMP are indirectly realised through enhanced market entry for new and enduring day-ahead Frequency Response markets.

Open Balancing Platform (OBP)

The OBP, part of our Balancing Programme, introduces a new real-time balancing capability to replace legacy NESO balancing systems and processes and support zero carbon grid operations. OBP allows increased use of flexible assets (bulk dispatch), improved situational awareness and will help to facilitate other initiatives.

The first stage of our new platform to support the bulk dispatch of battery storage and small Balancing Mechanism Units (BMUs), the OBP went live on 12 December 2023. Since then, our ability to dispatch a greater number of typically smaller BMUs within a settlement period has increased. This has unlocked greater capability to dispatch batteries in the Balancing Mechanism. Several further releases have since increase capabilities.

We are committed to maximising the flexibility of energy offered by battery storage and expect the utilisation of battery dispatches in the BM to provide substantial environmental and financial benefits.

Demand Flexibility Service

The Demand Flexibility Service (DFS) helps households and businesses participate in the electricity market by providing incentives, through suppliers and aggregators, for reducing or shifting demand.

DFS was introduced during the winter of 22/23 as part of the winter contingency toolkit. In 2024, DFS was transitioned from an enhanced action service to an in-merit based margin tool and the service went live on 27 November 2024.

Since going live, the cost of accessing volume through DFS has reduced significantly and often provides a cheaper alternative to equivalent actions in the BM. DFS is only procured where it demonstrates economic value against alternative actions at the time of assessment. DFS has been utilised consistently over winter 2024/25 period and has contributed to £484k savings over this period. This includes the largest daily saving of £285k on 8th January, where we utilised the DFS service to secure demand turn down across the evening peak to alleviate tight margins.

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Improving system operation

Trading Activity

NESO undertake trading actions with interconnectors and generators outside the BM to provide GB with access to generation both domestically and internationally, with prices that can be used for balancing at lower cost than BM actions. The Trading team have a licence obligation to conduct trades to balance the system in the most economic way, replacing more expensive BM actions.

NESO carries out trades with parties for three key purposes: to balance the system where there is a foreseen energy requirement; to ensure system security where there may be a constraint; and to meet forecast NESO balancing requirements at minimum cost. We primarily focus on short term intra-day trades. During 2024/25 trading was predominantly utilised to support constraint management, particularly in south east England, and to support voltage and margin requirements.

Across 2024/25 trading has delivered £266m savings as opposed to alternative BM actions.

Visibility of DER

As we transition to Net Zero, we are seeing a proliferation in the volume of generation technologies such as wind and solar connecting to distribution networks. We need greater visibility of Distributed Energy Resource (DER) and Consumer Energy Resources (CER) assets to better plan, connect, and operate networks, increase market liquidity and maintain system resilience through greater co-ordination between NESO and DSO operational activities. The Transformation to Integrate Distribution Energy (TIDE) will aim to do this via a long-term, cross-industry programme extending beyond the end of the BP2 period.

A roadmap is being co-created with industry, setting out 5 DER visibility programme phases, with full implementation by 2030.

Initial work has identified consumer benefits of up to £150m / year from greater DER Visibility to NESO alone. Delivery of the programme as a whole will deliver significant industry benefit in addition to this.

TO:SO Optimisation

SO:TO Optimisation is a trial Output Delivery Incentive (ODI) to encourage the TOs to proactively identify and provide solutions to NESO to help reduce constraint costs (STCP 11-4). The trial initially applied to the first two years of RIIO-2 and was then retained for years 3-5 with some modifications to the incentive reward paid to TOs.

The trial was found to contribute to a £33m net consumer benefit in the first year of the trial, scaling to a £268m benefit by the second year.

Platform for Energy Forecasting

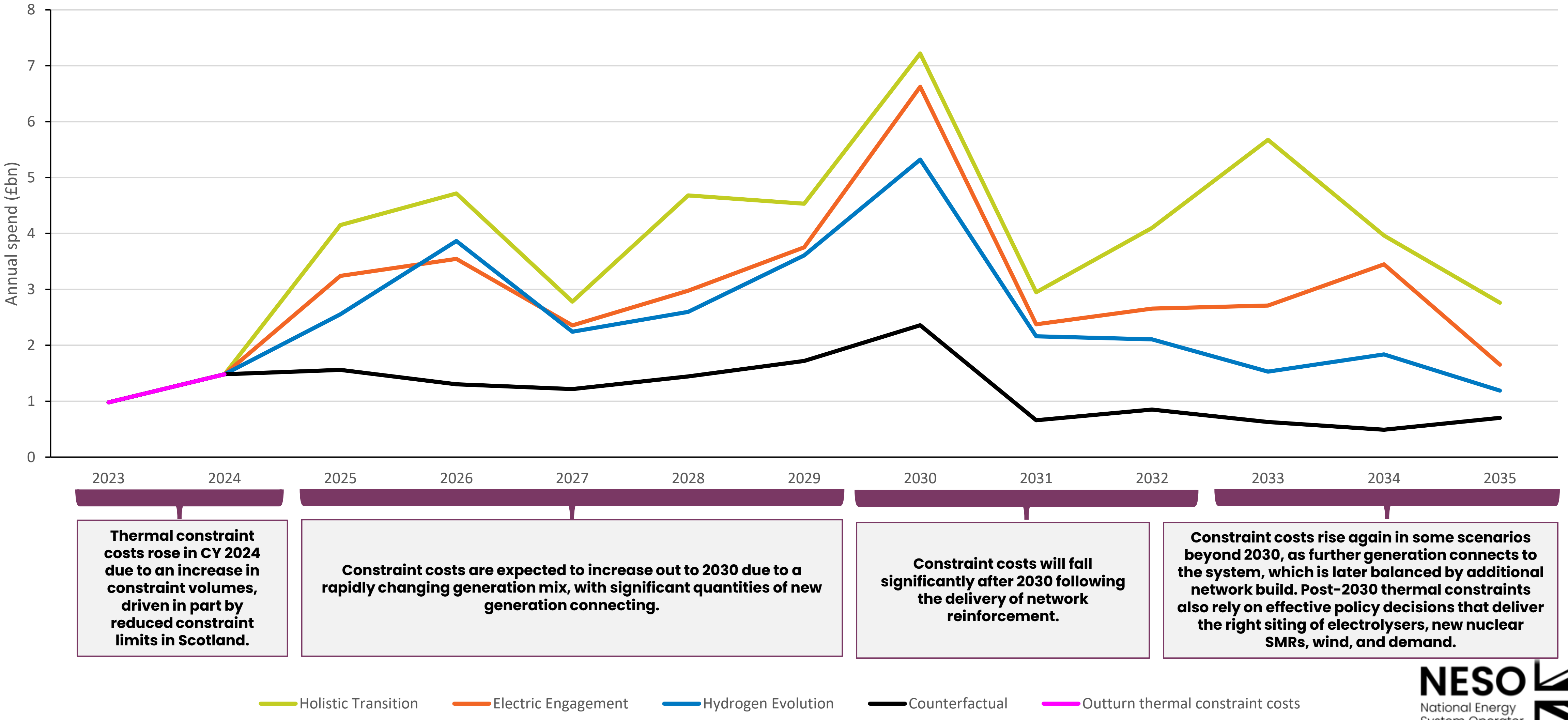
Improved forecasting methodology incorporated into our control room. PEF supports the delivery of efficient system balancing decisions ahead of real time to deliver value to consumers.

PEF is currently undergoing implementation which is partially complete.

Appendix

Thermal Constraint Projections

Figure 29. Projection of thermal constraint costs extrapolated from NOA7 and TCSNP2



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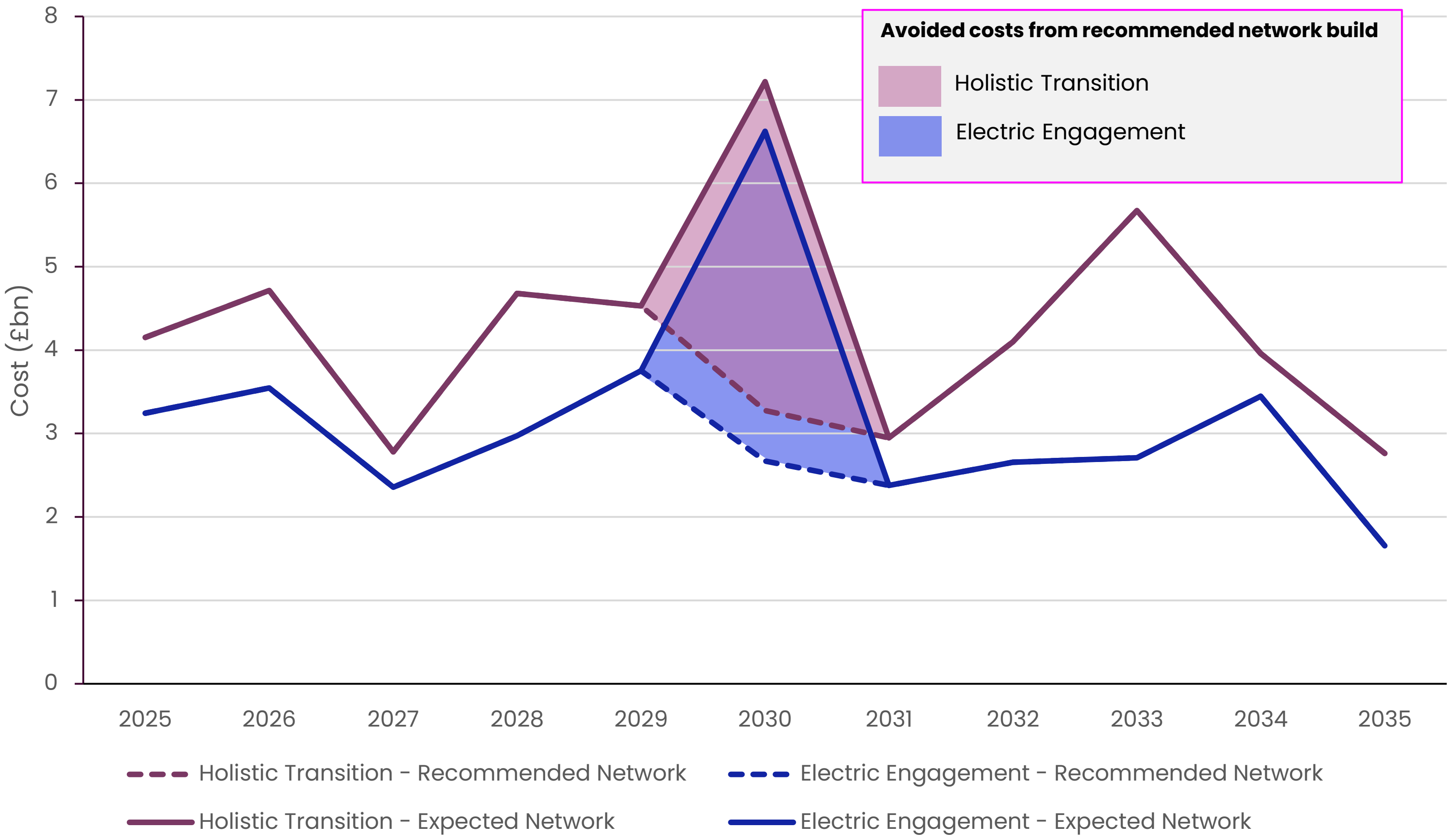
Thermal Constraint Projections – Recommended Network

We have identified three network projects as critical to delivering a network which supports the Clean Power 2030, but at present have delivery dates after 2030. Support is therefore needed to bring these projects forward for 2030 delivery. These are projects in East Anglia and in the southeast that are critical for connecting offshore wind in the North Sea and supporting the flow of clean power. Our assessment suggests that without these projects, the clean power objective would not be achieved, leaving the clean power target short by around 1.6% in 2030 (assuming a typical weather year) and consumers could face extra constraint costs of ~£4 billion in 2030. Following the publication of the CP30 report, the Transmission Owners (TOs) are considering various ways to accelerate these projects.

CP30 Constraints Projections

Constraint costs have been extracted for both the recommended network and the expected network in our CP30 analysis. The recommended network includes three projects identified as critical to delivering a network which supports the clean power pathways, but at present have delivery dates after 2030. These projects are Norwich to Tilbury (AENC and ATNC) and Sea-Link (SCD1). After 2030, the recommended and expected network are identical. Our CP30 analysis has been combined with our FES projections to provide the balancing cost projections under the recommended network shown on this page.

Figure 30. Thermal constraint projections with CP30 recommended network (combined FES and CP30 scenarios)



For more information on our CP30 Advice see our [Clean Power 2030 Report]

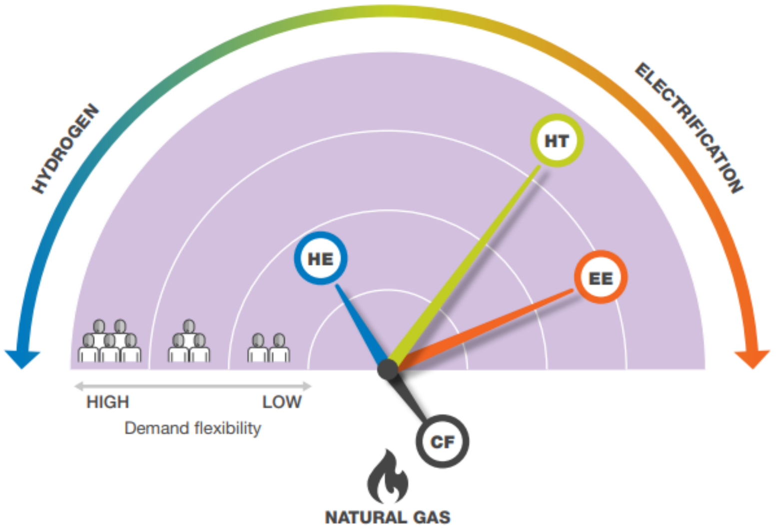
Balancing Cost Projections

Balancing costs and Future Energy Scenarios

Future Energy Scenarios (FES) represent different, credible ways to decarbonise our energy system as we strive towards the 2050 target.

Our balancing cost projections have been updated to reflect the 2024 FES framework. Balancing cost scenarios have therefore been aligned to our new pathways: Holistic Transition (HT), Electric Engagement (EE), and Hydrogen Evolution (HE), which explore strategic routes to net zero based on our extensive stakeholder engagement, research and analysis; and Counterfactual (CF), which is used to understand the gap between successful tracking of the pathways versus enabling change too slowly and missing targets.

Pathways framework 2024



Holistic Transition

Net zero met through a mix of electrification and hydrogen, with hydrogen mainly around industrial clusters. Consumer engagement in the transition is very strong with demand shifting, with smart homes and electric vehicles providing flexibility to the grid.

Electric Engagement

Net zero met through mainly electrified demand. Consumers are highly engaged in the energy transition through smart technologies that reduce energy demands, utilising technologies such as electric heat pumps and electric vehicles.

Hydrogen Evolution

Net zero met through fast progress for hydrogen in industry and heat. Many consumers will have hydrogen boilers, though energy efficiency will be key to reducing cost. There are low levels of consumer engagement. Hydrogen will be prevalent for heavy goods vehicles but electric car uptake is strong.

Counterfactual

Net zero missed, though some progress is made for decarbonisation compared to today. While home insulation improves, there is still a heavy reliance on gas across all sectors, particularly power and space heating. Electric vehicle uptake is slower than the net zero pathways, but still displaces petrol and diesel.

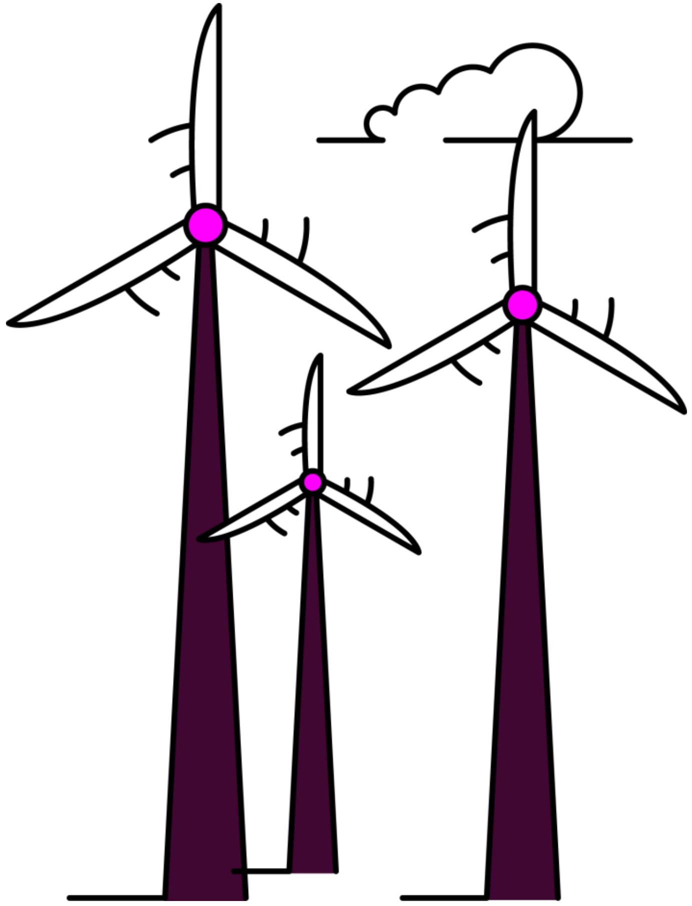
For more information on pathways see our latest Future Energy Scenarios (FES) report

NESO National Energy System Operator

Changes to projections since the last report

Our balancing cost projections have been updated to reflect the latest available information:

- Projections have been updated to reflect the 2024 FES framework.
- Balancing cost projections have increased since last year due to accelerated connection of renewables.
- Based on the latest expected delivery years for network projects we expect costs to peak in 2030. The CP30 analysis identified three network projects in East Anglia and in the southeast that need to be accelerated back on track to 2030 which could avoid this peak. In our CP30 Advice, we therefore recommend accelerating these projects to support clean power pathways and reduce constraint costs (see pages 32 & 33).
- Variations between scenarios since the last report are driven by a range of factors, including changes in the generation and demand backgrounds in the FES models.
- Constraint costs are expected to decrease as recommended reinforcements are delivered through the 2030's.

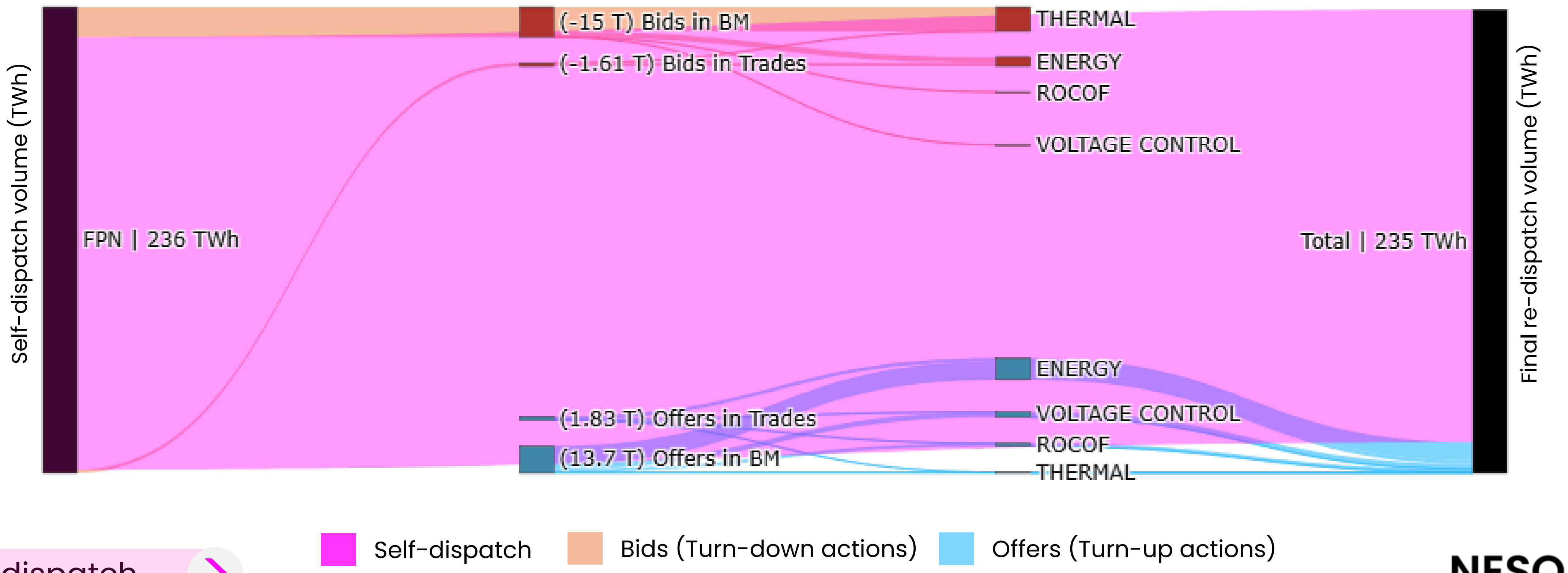


Re-dispatch volumes

Whole system re-dispatch

The figure below shows NESO redispatch volumes by action reason in proportion to volumes of self-dispatch in 2024/25.

Bid volumes (in orange) are turn-down actions by NESO, while Offer volumes (in blue) are turn-up actions. When considering the whole market absolute Bid volumes broadly equal Offer volumes as the overall system needs to be kept in balance, however when looking at individual fuel types more variability is observed as certain fuel types are more predisposed to certain types of actions (please see the following pages for more detail on re-dispatch for specific fuel types).

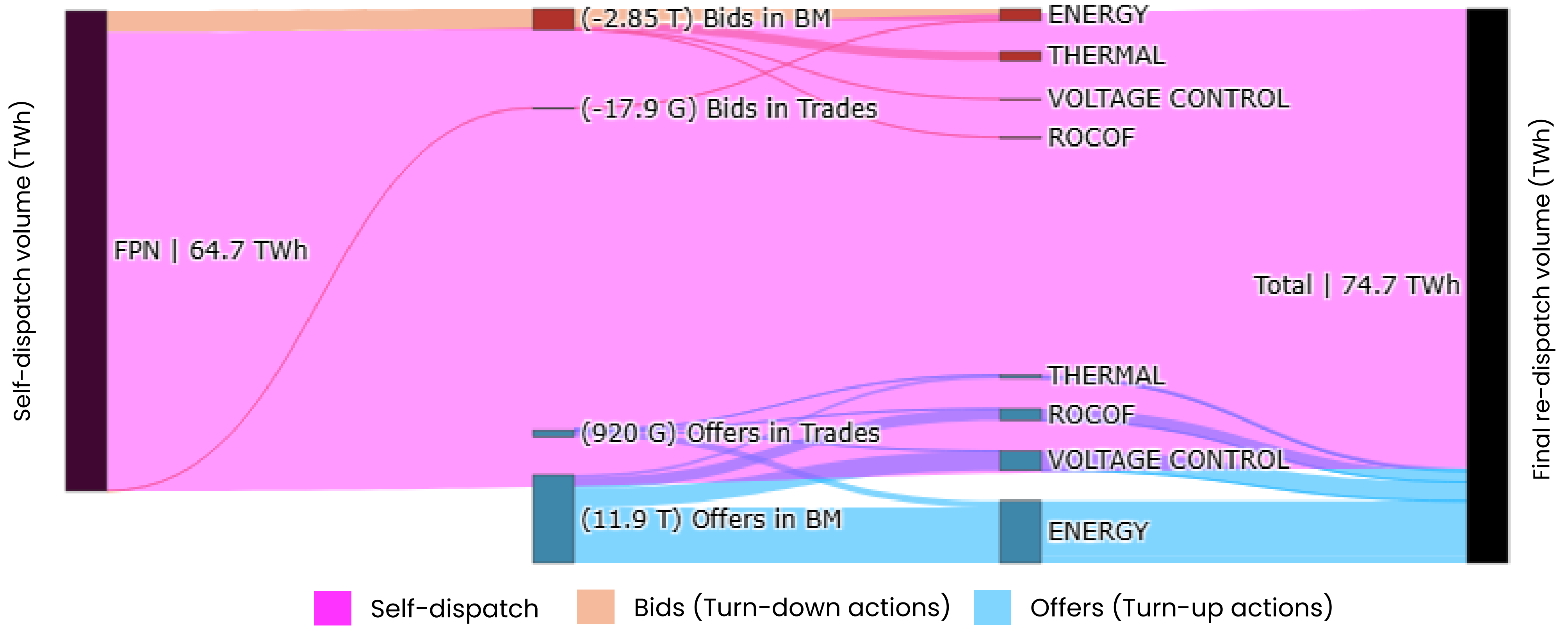


Gas redispatch

Re-dispatch volumes

Gas redispatch

In 2024/25, 4.4% of self-dispatch volumes were bid down, and offer actions contributed to 17.2% of the final re-dispatched volume for gas.



Whole system redispatch

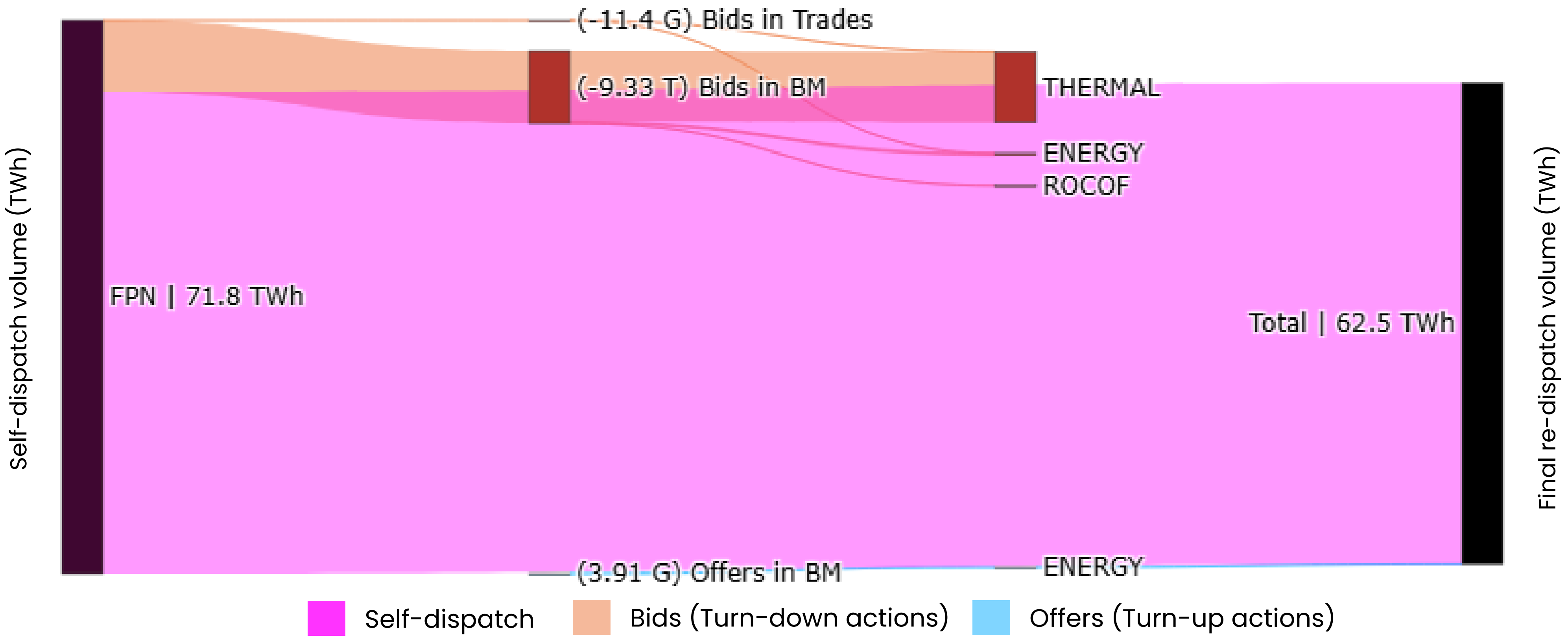
Wind redispatch

NESO National Energy System Operator

Re-dispatch volumes

Wind redispatch

In 2024/25, 13.0% of self-dispatch volumes were bid down, and offer actions contributed to <1% of the final re-dispatched volume for wind.



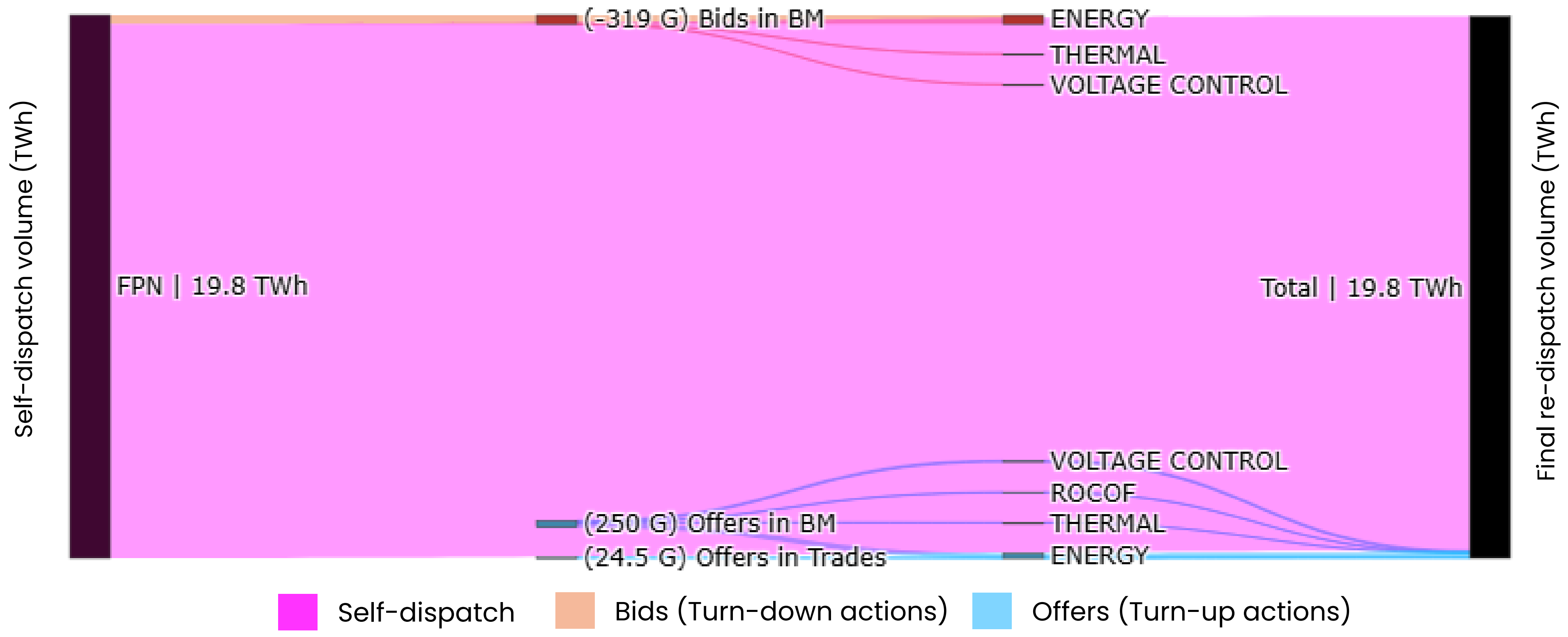
Gas redispatch

Biomass redispatch

Re-dispatch volumes

Biomass redispatch

In 2024/25, 1.6% of self-dispatch volumes were bid down, and offer actions contributed to 1.4% of the final re-dispatched volume for biomass.



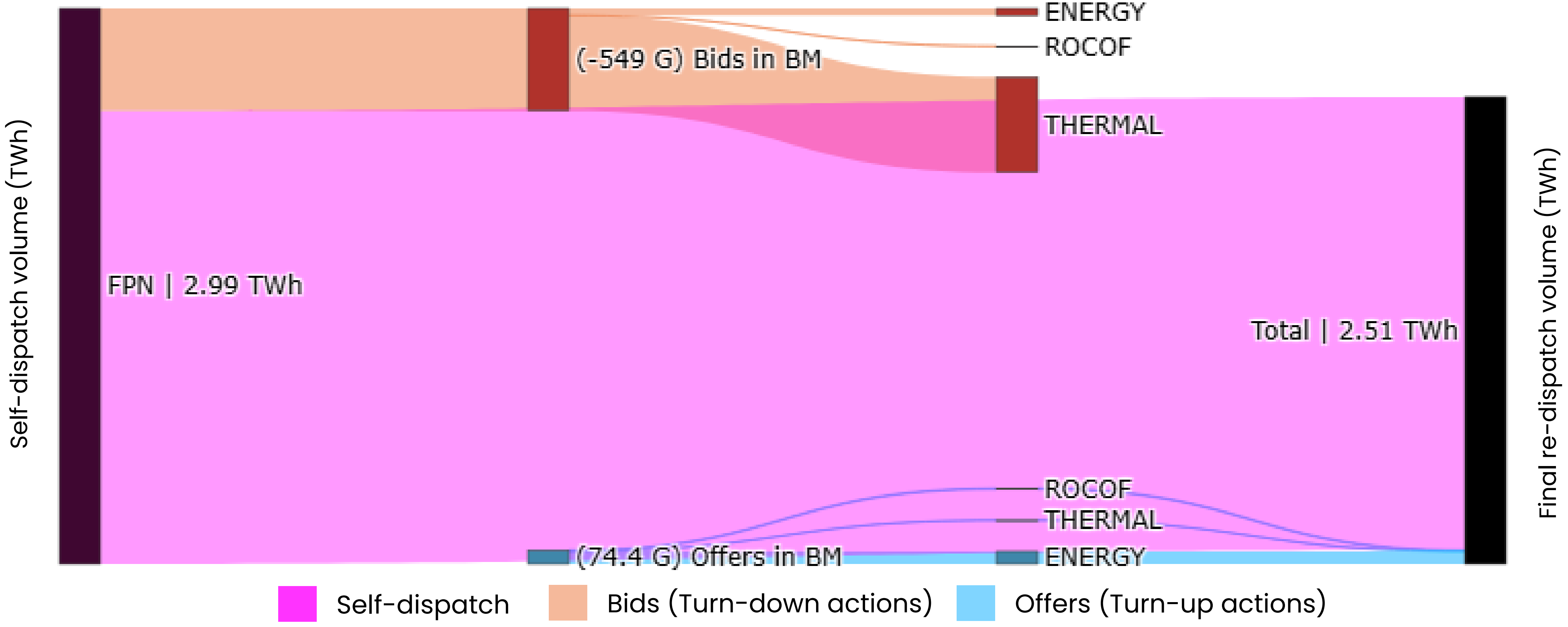
Wind redispatch
Hydro redispatch

NESO National Energy System Operator

Re-dispatch volumes

Hydro redispatch

In 2024/25, 18.4% of self-dispatch volumes were bid down, and offer actions contributed to 3.0% of the final re-dispatched volume for hydro.

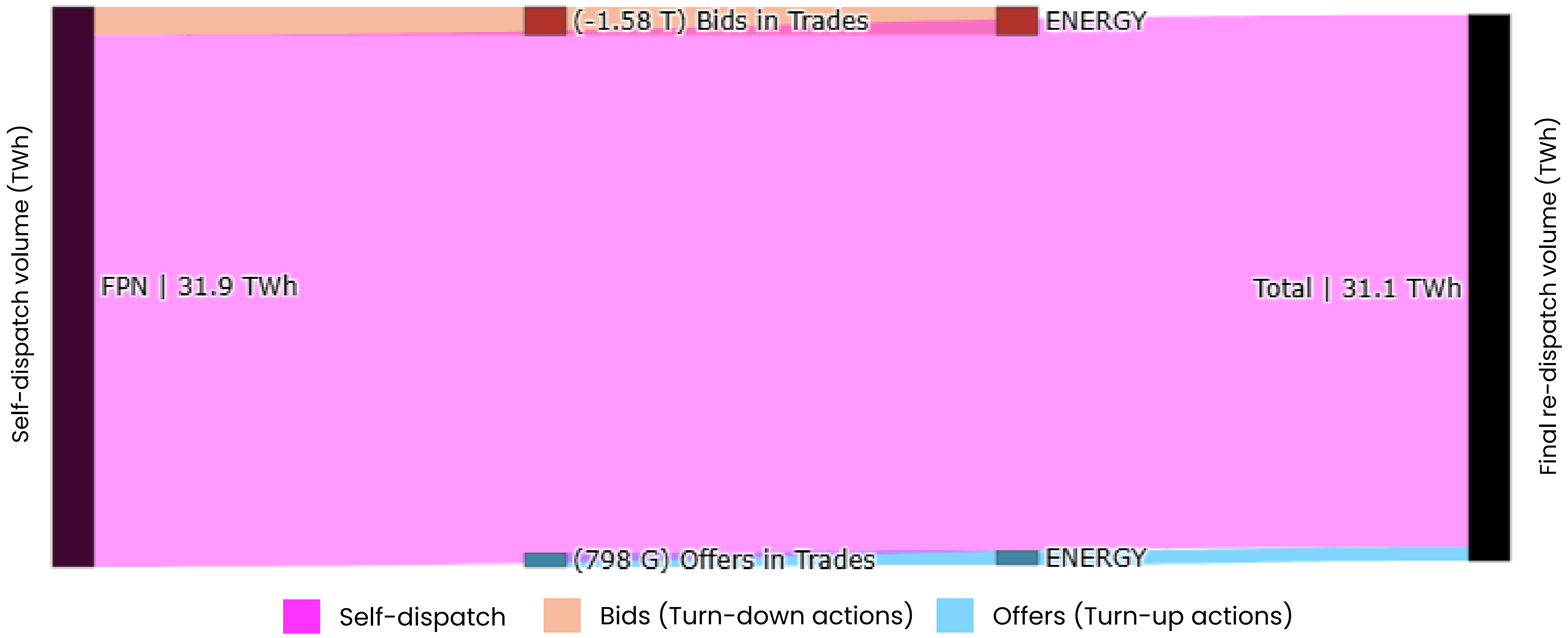


Biomass redispatch
Interconnector redispatch

Re-dispatch volumes

Interconnector redispatch

In 2024/25, 5.0% of self-dispatch of self-dispatch volumes were bid down, and offer actions contributed to 2.6% of the final re-dispatched volume for interconnectors.



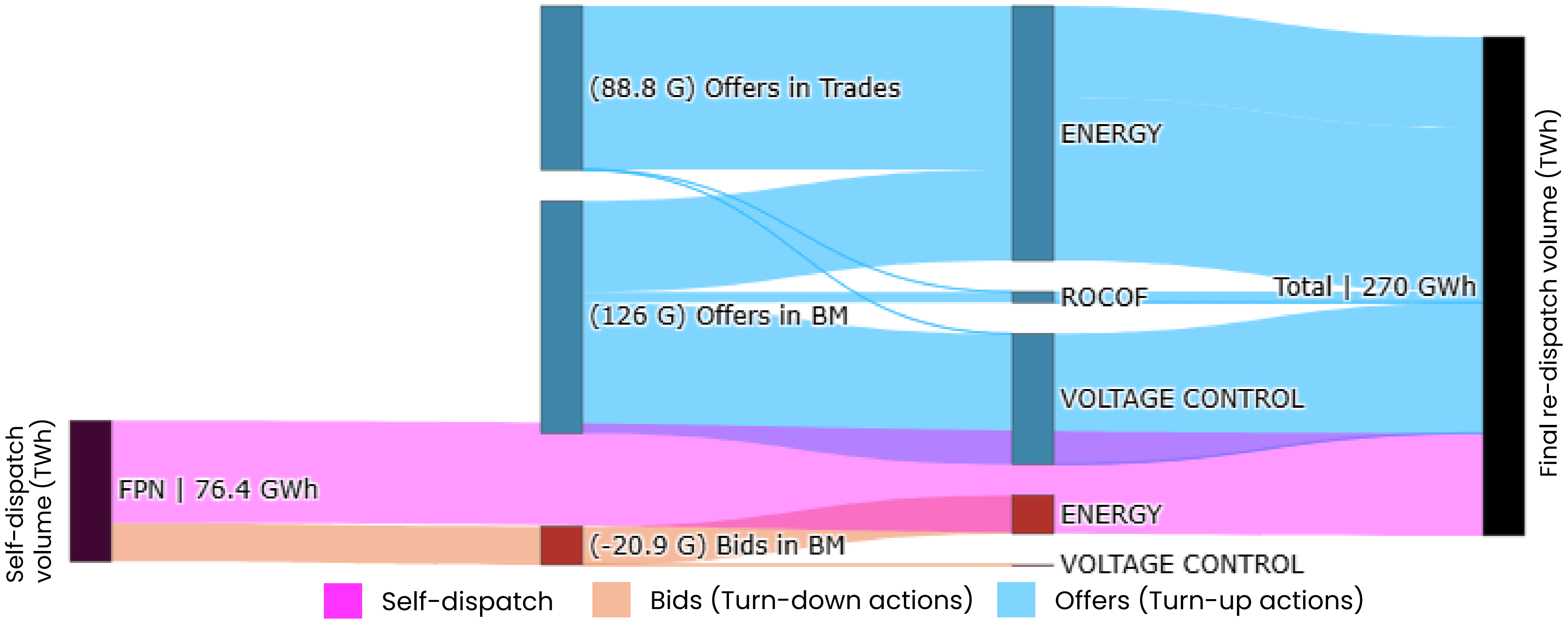
Hydro redispatch

Coal redispatch

NESO
National Energy System Operator

Coal redispatch

In 2024/25, 27% of self-dispatch of self-dispatch volumes were bid down, and offer actions contributed to 80% of the final re-dispatched volume for coal.



Interconnector redispatch

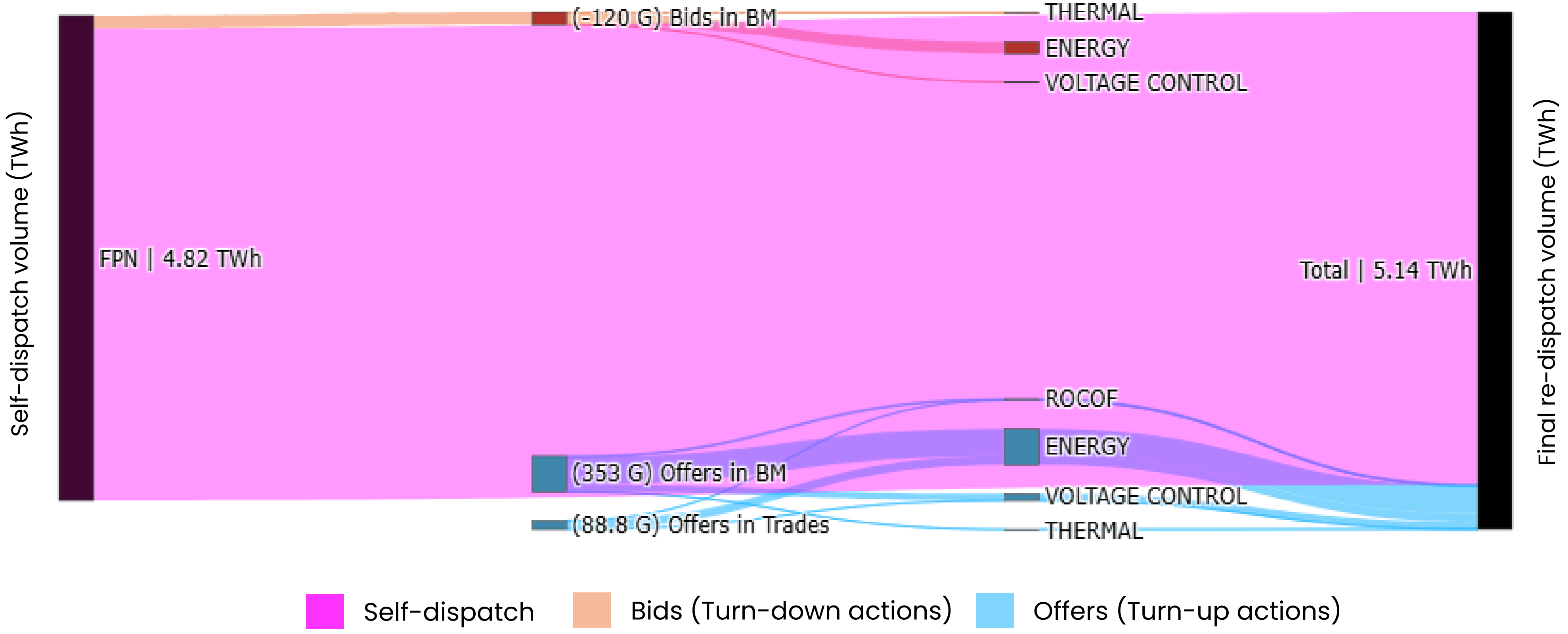
Other redispatch

Note: Coal generation ended in GB on 30 September 2024 data therefore covers March – September 2024 only.

Re-dispatch volumes

Other redispatch

In 2024/25, 2.5% of self-dispatch of self-dispatch volumes were bid down, and offer actions contributed to 8.6% of the final re-dispatched volume for other generation.



Coal redispatch
Battery redispatch

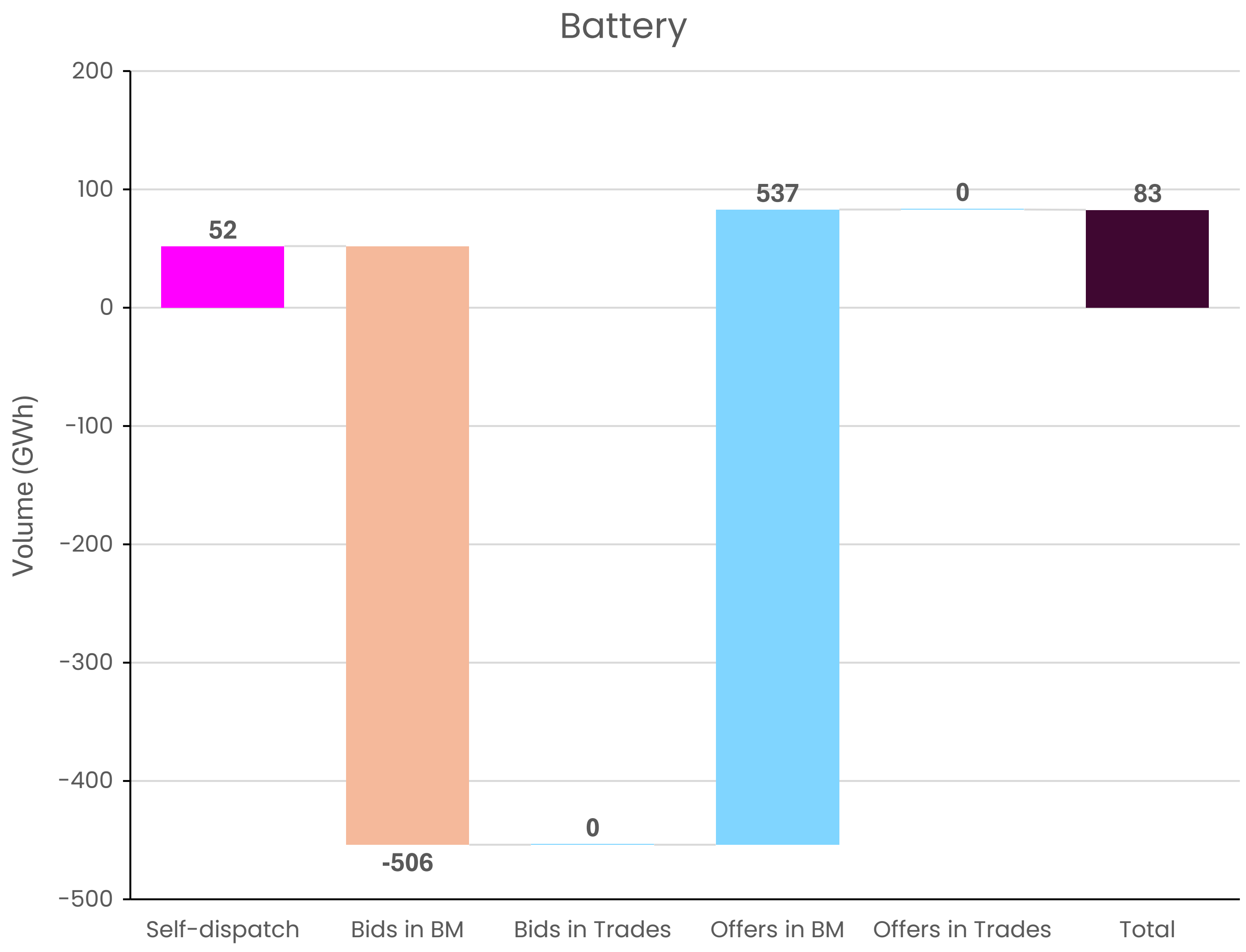
Re-dispatch volumes

Battery redispatch

Battery units provide both energy imports and exports meaning re-dispatch can have a large impact on the net position of battery volumes.

In 2024/25, 506GWh of bids and 537GWh of offers were taken on batteries in the BM.

Battery volumes dispatched through the BM have grown significantly following the launch on the Open Balancing Platform (OBP) in December 2023.



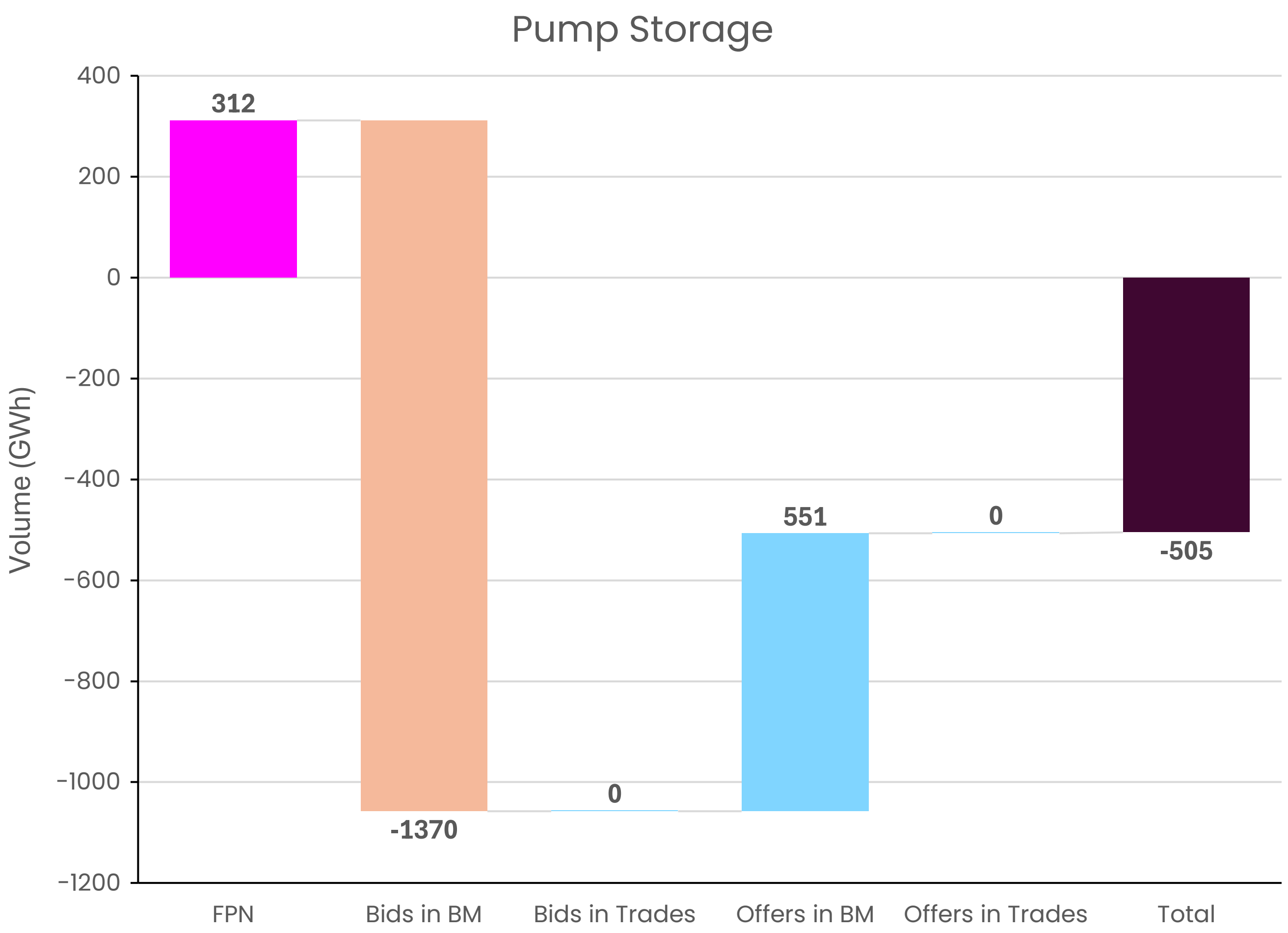
Coal redispatch
Pumped Storage redispatch

Re-dispatch volumes

Pumped storage redispatch

Pumped storage units provide both energy imports and exports meaning re-dispatch can have a large impact on the net position of pumped storage volumes.

In 2024/25, 1,370GWh of bids and 551GWh of offers were taken on pumped storage in the BM.



Battery redispatch

If you have any questions or queries relating to Balancing Costs, please reach out to box.nc.customer@neso.energy

For further information on NESO publications please visit: neso.energy.com