ESO RIIO2 Business Plan 2 (2023-25)

April 2023 Incentives Report

25 May 2023

Contents

Introduction

As part of the RIIO-2 price control, we submitted a second Business Plan to Ofgem in August 2022. It sets out our proposed activities, deliverables, and investments for years three and four of RIIO-2 (2023-2025) as we respond to the rapidly changing external environment.

The ESO's Delivery Schedule sets out in more detail what the ESO will deliver, along with associated milestones and outputs, for the "Business Plan 2" period.

Ofgem, as part of its Final Determinations for the RIIO-2 price control, set out that the ESO would be subject to an evaluative incentive framework, assessing our performance in delivering the Business Plan.

The updated ESO Reporting and Incentives (ESORI) guidance sets out the process and criteria for assessing the performance of the ESO, and the reporting requirements which form part of the incentive scheme for the BP2 period. Every month, we report on a set of monthly performance measures; Performance Metrics (which have benchmarks) and Regularly Reported Evidence items (which do not have benchmarks). This report is published on the 17th working day of each month, covering the preceding month.

Every quarter, we report on a larger set of performance measures, and also provide an update on our progress against our Delivery Schedule in the RIIO-2 deliverables tracker. Our six-month and eighteen-month reports will broadly be similar to our usual quarterly report.

Our mid-scheme and end of scheme reports will be more detailed, covering all of the criteria used to assess our performance.

Please see our website for more information.

Summary of Notable Events

In April we have successfully delivered the following notable events and publications. We provide further detail on each of these under the role sections:

- We published our refreshed 2023-24 ESO Innovation Strategy. The strategy sets out how we plan to innovate in 2023-24 and where we need to focus our efforts to help achieve the ESO ambitions for 2025 and beyond.
- On 10 April we achieved a new low carbon intensity record of 33g/kWh due to high levels of wind and solar generation.
- We published our GB Grid Forming (GBGF) Best Practice Guide which aims to help stakeholders understand generic requirements for implementation of GBGF applications within the GB electricity system.
- In April we published the Triad dates for 2022-23. The Triads are used to determine Transmission Network Use of System (TNUoS) demand charges for customers with half hourly meters.
- We are now exploring the potential use of the Demand Flexibility Service (DFS) both as a winter contingency and a commercial service for the future, building on successes to date. In April, we ran three two-hour deep dive DFS workshops. Attendance, interaction, and feedback was good throughout the sessions. We are continuing engagement with industry and co-creating the DFS for Winter 23/24, looking at improvements that can be made to the service.
- We published our Summer Outlook Report on 13 April. The report presents our view of the electricity system for the summer ahead and is designed to support the industry in its preparations for the period.
- On 26 April, Ofgem published its decision to grant us an extension to its derogation from the requirements of Standard Licence Condition C28. The derogation enables the procurement of Net Transfer Capacity (NTC) through non-market-based procedures.
- Our Transmission Entry Capacity (TEC) amnesty ended on 30 April. The TEC Amnesty gave customers in the connections queue the opportunity to terminate or reduce TEC with little or no cost. The expression of interest window has now closed and we have received 8.1GW of applications.
- On 5 April, we announced the completion of the first phase of its Stability Pathfinder programme, which aimed to support the development and delivery of new technologies to generate important system characteristics, such as inertia. With the delivery of the final unit of this phase, the use of improved technology is expected to deliver up to £128m in consumer savings over their lifetime as well as reduce CO2 emissions by ~6mn tonnes.

Summary of Metrics and RREs

This table summarises our Metrics and Regularly Reported Evidence (RRE) performance for April 2023.

Metric/RRE		Performance	Status
Metric 1A	**Balancing Costs**	£200m. Awaiting benchmark methodology from Ofgem.	●
Metric 1B	**Demand Forecasting**	Forecasting error of 791MW vs indicative benchmark of 687MW	●
Metric 1C	**Wind Generation Forecasting**	Forecasting error of 4.69% vs indicative benchmark of 4.38%	●
Metric 1D	**Short Notice Changes to Planned Outages**	1.5 delays or cancellations per 1000 outages due to an ESO process failure (vs benchmark of 1 to 2.5).	●
RRE 1E	**Transparency of Operational Decision Making**	94.1 % of actions taken in merit order	N/A
RRE 1G	**Carbon intensity of ESO actions**	4.7gCO_2/kWh of actions taken by the ESO	N/A
RRE 1I	**Security of Supply**	0 instances where frequency was more than ±0.3Hz away from 50Hz for more than 60 seconds. 0 voltage excursions	N/A
RRE 1J	**CNI Outages**	0 planned and 0 unplanned system outages	N/A
RRE 2E	**Accuracy of Forecasts for Charge Setting**	Month ahead BSUoS forecasting accuracy (absolute percentage error) of 24.0%	N/A

Below expectations ● **Meeting expectations** ● **Exceeding expectations** ●

We welcome feedback on our performance reporting to box.soincentives.electricity@nationalgrideso.com

Gareth Davies

ESO Regulation Senior Manager

Role 1 (Control Centre operations)

ESO

Metric 1A Balancing cost management

This metric measures the ESO's outturn balancing costs (including Electricity System Restoration costs) against a balancing cost benchmark. The methodology includes the following elements:

1. Benchmark created using monthly data from the preceding 3 years.
2. A straight-line relationship established between historic constraint costs, outturn wind generation and the historic wholesale day ahead price of electricity.
3. A straight-line relationship established between historic non-constraint costs and the historic wholesale day ahead price of electricity.
4. Ex-post actual data inputted into the equation created by the historic relationships to create the monthly benchmarks.

ESO Operational Transparency Forum: The ESO hosts a weekly forum that provides additional transparency on operational actions taken in previous weeks. It also gives industry the opportunity to ask questions to our National Control panel. Details of how to sign up and recordings of previous meetings are available here.

April 2023 performance

Awaiting benchmark figures for 2023-24:	Please note that we are unable to report our actuals against a benchmark this month. Whilst the principles have been agreed for 2023-24, the final benchmark calculation method for 2023-24 has not yet been confirmed by Ofgem. We will update the April performance in subsequent reports once the benchmark has been finalised.

Figure 1: 2022-24 Monthly balancing cost outturn versus benchmark

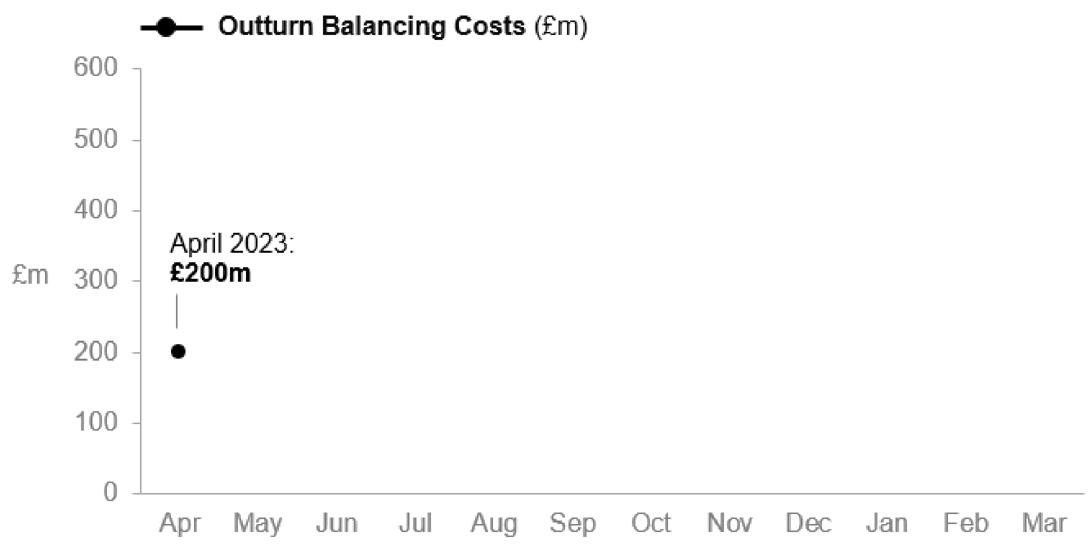


Table 1: 2023-24 Monthly balancing cost benchmark and outturn

All costs in £m	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	YTD
Outturn wind (TWh)	3.4												n/a
Average Day Ahead Baseload (£/MWh)	105												n/a
Benchmark	tbc												tbc
Outturn balancing costs (excluding Winter Contingency)[1]	**200**												**200**
Status	●												●

Previous months' outturn balancing costs are updated every month with reconciled values. Figures are rounded to the nearest whole number, except outturn wind which is rounded to one decimal place.

Performance benchmarks:

- **Exceeding expectations:** 10% lower than the annual balancing cost benchmark
- **Meeting expectations:** within ±10% of the annual balancing cost benchmark
- **Below expectations:** 10% higher than the annual balancing cost benchmark

Supporting information

ℹ	**Ongoing data issue:**	Please note that due to a data issue over the previous months, the Minor Components line in Non-Constraint Costs is capturing some costs which should be attributed to different categories. It has been identified that a significant portion of these costs should be allocated to the Operating Reserve Category. Although the categorisation of costs is not correct, we are confident that the total costs are correct in all months. We continue to investigate and will advise when we have a resolution.

The balancing costs for April 2023 were around £200m, which is a decrease of over £27m from the previous month, but slightly higher (£11m) from the same period last year.

As noted above, we will confirm whether this is below, meeting or exceeding expectations next month once the benchmark has been confirmed.

The main reason for costs being lower than the previous month (March 2023) is lower non-constraint costs. The non-constraint volume of actions was higher than the previous month, but the underlying non-constraint costs decreased significantly due to healthier margins driven by the wholesale electricity price being lower than the price in March.

This was partly offset by constraint costs being higher than the previous month, due to a higher volume of actions compared to the previous month (and compared to April 2022). This was due to periods when more wind had to be curtailed due to thermal constraints.

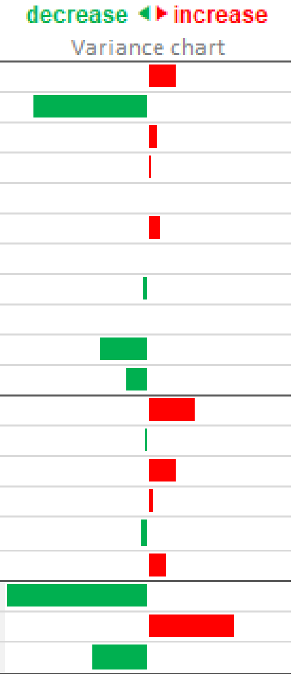
[1] Winter Contingency costs are excluded from the outturn balancing costs for comparison to the benchmark as agreed with Ofgem. However in the rest of this section we continue to include those costs for transparency and analysis purposes.

The total balancing cost slightly decreased compared to March 2023 and increased compared to the same period last year, however the total volume of actions significantly increased compared for both periods.

Breakdown of costs vs previous month

Balancing Costs variance (£m): April 2023 vs March 2023

		(a) Mar-23	(b) Apr-23	(b) - (a) Variance
Non-Constraint Costs	Energy Imbalance	-11.3	1.9	13.2
	Operating Reserve	73.5	17.0	(56.5)
	STOR	-1.0	3.0	4.0
	Negative Reserve	-0.0	1.0	1.0
	Fast Reserve	15.3	14.9	(0.4)
	Response	15.5	20.9	5.4
	Other Reserve	2.3	1.9	(0.5)
	Reactive	20.4	18.6	(1.7)
	Restoration	2.9	2.8	(0.1)
	Winter Contingency	23.7	0.0	(23.7)
	Minor Components	15.1	4.7	(10.4)
Constraint Costs	Constraints - E&W	37.7	60.1	22.4
	Constraints - Cheviot	0.6	0.0	(0.6)
	Constraints - Scotland	2.1	15.1	13.0
	Constraints - Ancillary	0.9	2.9	2.0
	ROCOF	6.1	3.3	(2.8)
	Constraints Sterilised HR	23.2	31.6	8.4
Totals	Non-Constraint Costs - TOTAL	156.3	86.8	(69.5)
	Constraint Costs - TOTAL	70.8	113.0	42.3
	Total Balancing Costs	**227.1**	**199.8**	**(27.3)**



As shown in the total rows from the table above, the non-constraint costs fell by almost £70m, which was partly offset by a £42m increase in non-constraint costs, resulting in an overall drop of £27m compared to March 2023.

Constraint costs: The main driver of the variances this month are detailed below:

- **Constraint-England & Wales**: £22.4m increase, due to higher volume of actions
- **Constraint-Scotland**: £13m increase, due to higher volume of actions.
- **Constraints Sterilised Headroom**: £8.4m increase. Cost increase is in line with the increasing of constraint actions because more headroom had to be replaced on the system outside the constraint through BM actions.

Non-constraint costs: The main drivers of the biggest variances this month are detailed below:

- **Operating Reserve**: £56.5m decrease. Healthier margins required less intervention to maintain reserve requirements.
- **Winter Contingency**: £23.7m decrease. The winter contingency contracts only covered the period between October 2022 and March 2023. There is no cost in this category for this month.

Constraint vs non-constraint costs and volumes

Please note that a portion of the **Minor Components** spend contributing to non-constraint cost and volume is Operating Reserve cost and volume. The narrative below discusses the broad themes of spend. The figures will be revised once the data issue is resolved.

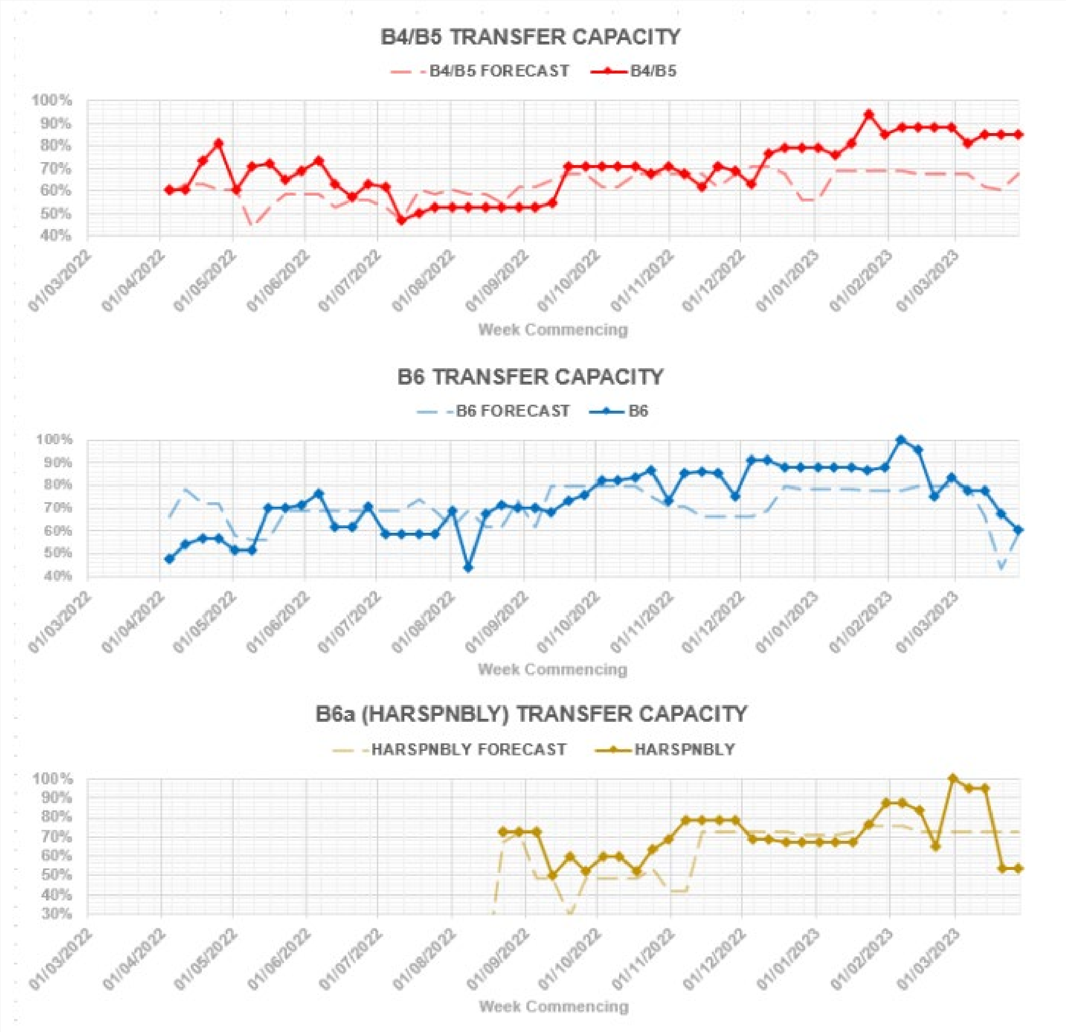
Constraint costs

Compared with the same month of the previous year:	Constraint costs were £41m higher than in April 2022 due to: • Higher volume of actions.
Compared with last month:	Constraint costs were £42m higher than in March 2023 due to: • Higher volume of actions.

Non-constraint costs

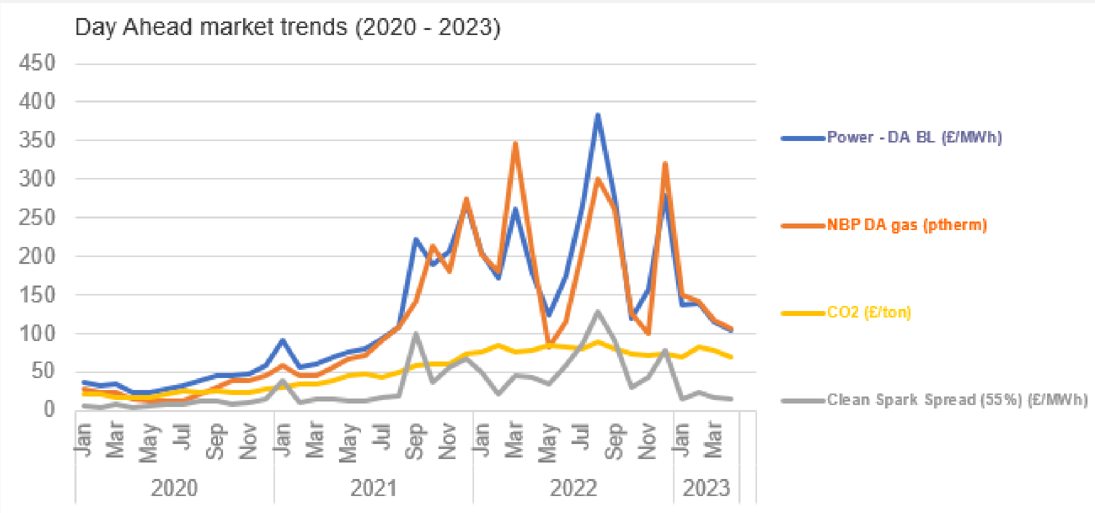
Compared with the same month of the previous year:	Non-constraint costs were £30m lower than in April 2022 mainly because healthier margins drove lower Operating reserve costs.
Compared with last month:	Non-constraint costs were £70m lower than in March 2023 due to: • Lower average wholesale prices. • No winter contingency contracts • Healthier margins

Network availability 2023-24



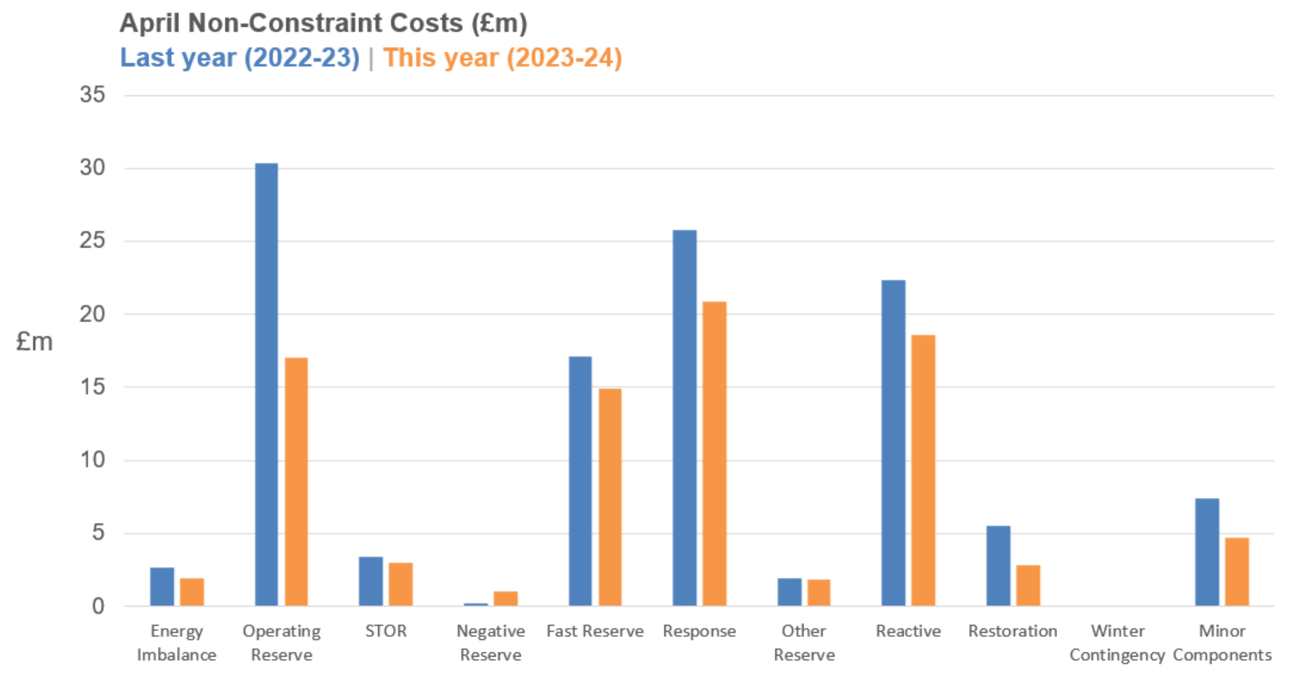
Please note that transfer capacity is discussed in more detail at each week's Operational Transparency Forum. Details of how to sign up, and recordings of previous meetings are available here.

Changes in energy balancing costs



DA BL: Day Ahead Baseload **NBP DA:** National Balancing Point Day Ahead

Power day ahead prices, day ahead Gas prices, Clean Spark Spread and Carbon prices decreased from last month and remain lower compared to the previous year.



Comparing the non-constraint costs of April 2023 with those of April 2022, all the categories showed a decrease or a small deviation from the previous month.

We do not cover the variation in Minor Components here as it is driven by the data issue referenced earlier.

- **Operating Reserve** £13.3m decrease because healthier margins required less intervention to maintain reserve requirements.
- **Response decreased** by £4.9m, due to significantly lower volume of actions

Drivers for unexpected cost increases/decreases

Margin prices (the amount paid for one MWh) have decreased significantly compared to March 2023 and the corresponding period of the previous year.

Daily Costs Trends

As discussed above, April's balancing costs were £27m lower than the previous month due to spending less on Operating Reserve due to healthier margins, no extra cost for winter contingency, and lower wholesale prices.

At this point we have recorded four days with a spend of more than £15m:

- On Wednesday 12 April when costs were around £22m, the major cost component was the constraints due to high wind speed resulting in more BM actions required to curtail generation in order to manage thermal constraints.
- There was a similar picture for the other expensive days, namely 09, 10 & 11 April, with thermal constraints being the main drivers behind costs.

The minimum cost of £1.9m was observed on 07 April.

The average daily spend for the month was 6.6m, a £0.7m decrease from the previous month.

High-cost days and balancing cost trends are discussed every week at the Operational Transparency Forum to give ongoing visibility of the operability challenges and the associated ESO control room actions.

Metric 1B Demand forecasting accuracy

This metric measures the average absolute MW error between day-ahead forecast demand (taken from Balancing Mechanism Report Service (BMRS19) as the National Demand Forecast published between 09:00 and 10:00) and outturn demand (taken from BMRS as the Initial National Demand Outturn) for each half hour period. The benchmarks are drawn from analysis of historical errors for the five years preceding the performance year.

A 5% improvement in historical 5-year average performance is required to exceed expectations, whilst coming with ±5% of that value is required to meet expectations.

In settlement periods where Optional Downward Flexibility Management (ODFM) and/or Demand Flexibility Service (DFS) are instructed by the ESO, this will be retrospectively accounted for in the data used to calculate performance. The ESO shall publish the volume of instructed ODFM to enable this to be done.

Performance will be assessed against the annual benchmark, but monthly benchmarks are also provided as a guide. The ESO will report against these each month to provide transparency of its performance through the year.

April 2023 performance

Indicative benchmark figures for 2023-24: Please note that the benchmark figures used below are indicative only. We have calculated these in line with the method specified by Ofgem, but we have not yet received the confirmed figures from Ofgem. We will update the April performance in subsequent reports once the benchmark has been finalised.

Figure 2: 2023-24 Monthly absolute MW error vs Indicative Benchmark

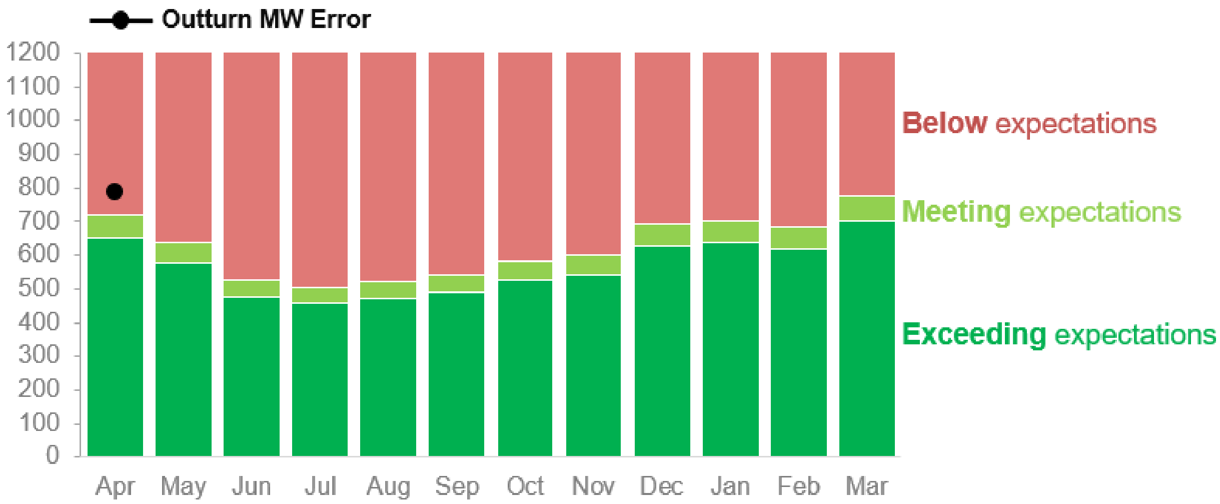


Table 2: 2023-24 Monthly absolute MW error vs Indicative Benchmark

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Indicative benchmark (MW)	687	606	503	481	497	516	554	571	659	669	651	738
Absolute error (MW)	**791**											
Status	●											

Performance benchmarks:

- **Exceeding expectations:** >5% lower than 95% of average value for previous 5 years
- **Meeting expectations:** ±5% window around 95% of average value for previous 5 years
- **Below expectations:** >5% higher than 95% of average value for previous 5 years

Supporting information

In April 2023, the average absolute error of our day ahead demand forecast was 791 MW compared to the indicative performance target of 687 MW, and therefore below expectations. As noted above, this is an indicative benchmark, and we will update the status for April once the benchmark has been confirmed by Ofgem.

According to the Met Office: "April was a predominantly unsettled month, with little in the way of consistent warmth, especially over England, and hence the advance of spring seemed to be rather slow, though it was more settled for a time around mid-month, this being followed by a return to rather chilly conditions." These weather behaviours were borne out in the demand forecast errors.

The monthly average was largely affected by a handful of difficult days – solar and weather uncertainty overlapped with the Easter weekend, causing larger errors on 7 and 9 May. Similar weather and solar errors occurred towards the end of the month, with additional wind errors on 28 May.

The remainder of the month was more settled, except for 12 May where Storm Noa caused larger errors due to difficult gusting winds. The Met office reports "It was an unusually severe storm for the time of year and the most significant April wind storm to affect England and Wales since April 2013. Some weather stations recorded new April wind gust records"

The distribution of settlement periods by error size is summarised in the table below:

Error greater than	Number of SPs	% out of the SPs in the month (1392)
1000 MW	435	31%
1500 MW	204	15%
2000 MW	101	7%
2500 MW	39	3%
3000 MW	13	1%

The days with largest MAE were April 7, 9, 12, 26 and 28.

Missed / late publications

There were 0 occasions of missed or late publications in April.

Triads

Triads only take place between November and February, and therefore did not impact on forecasting performance during April.

Metric 1C Wind forecasting accuracy

This metric measures the average absolute percentage error (APE) between day-ahead forecast (between 09:00 and 10:00, as published on ESO Data Portal here) and outturn wind generation (settlement metering as calculated by Elexon) for each half hour period as a percentage of capacity for BM wind units only. The data will only be taken for sites that did not have a bid-offer acceptance (BOA) during the relevant settlement period.

The ESO will publish this data on its Data Portal for transparency purposes. The benchmarks are drawn from analysis of historical errors of the five years preceding the performance year. 5% improvement in performance expected on the 5-year historical average, with range of ±5% used to set benchmark for meeting expectations.

April 2023 performance

Indicative benchmark figures for 2023-24:	Please note that the benchmark figures used below are indicative only. We have calculated these in line with the method specified by Ofgem, but we have not yet received the confirmed figures from Ofgem. We will update the April performance in subsequent reports once the benchmark has been finalised.

Figure 3: 2023-24 BMU Wind Generation Forecast APE vs Indicative Benchmark

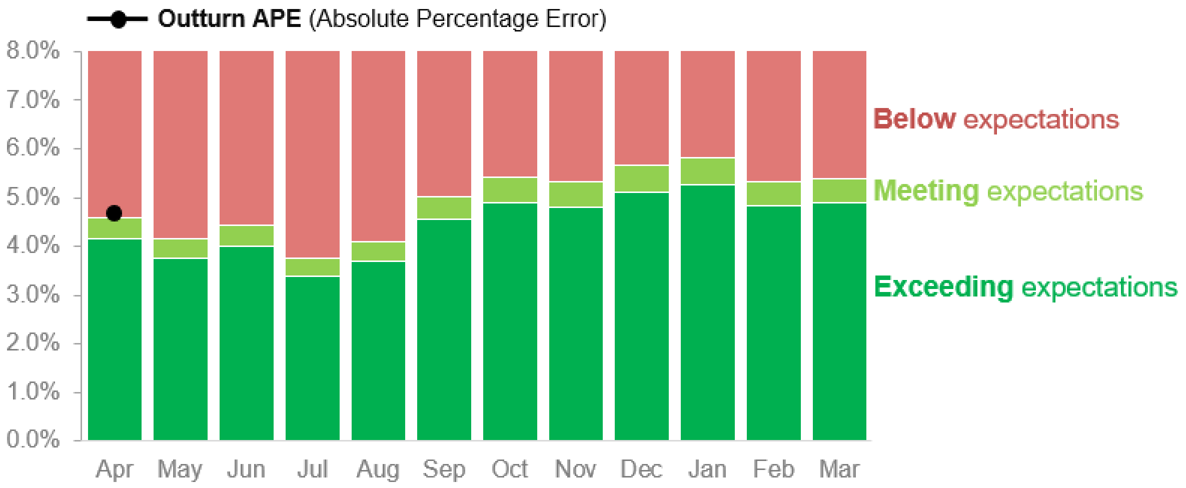


Table 3: 2023-24 BMU Wind Generation Forecast APE vs Indicative Benchmarks

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Indicative benchmark (%)	4.38	3.95	4.21	3.57	3.89	4.79	5.15	5.06	5.38	5.53	5.08	5.14
APE (%)	**4.69**											
Status	●											

Performance benchmarks:

- **Exceeding expectations:** < 5% lower than 95% of average value for previous 5 years
- **Meeting expectations:** ±5% window around 95% of average value for previous 5 years
- **Below expectations:** > 5% higher than 95% of average value for previous 5 years.

Supporting information

The weather in April was fairly unremarkable for the time of year and brought the typical April showers and bands of rain on some days. Wind speeds were light to moderate with very few low-pressure systems moving across the UK. One exception in the form of Storm Noa that travelled across on 12 April bringing wind to Southern areas. This brought Wind power forecast errors of 20% of installed capacity. On 14 April a low-pressure system travelled along the English Channel bringing bad weather to southern England bringing a similar level of forecast error.

Lightning activity is normally an indication of atmospheric instability and also increased risk of wind power forecast error. On 10 April there was significant lightning activity over Humberside, East Anglia and on into the North Sea. On 13 April there was lightning activity over Kent and the South coast of England. On 14 April lightning activity was seen along the East Coast from Edinburgh to Hull. On 22 April lightning developed on the continent and moved across the North Sea towards East Anglia. On 23 April lightning formed on the Midlands and developed through Oxfordshire and London throughout the day with further activity on the following day along the south coast.

Wind farms with CFD contractual arrangements switch off for commercial reasons while prices are negative for 6 hours or more. In April there were no occasions when the electricity price went negative.

Withdrawal of wind units

According to operational data there is no indication that any wind units withdrew their capacity in the month of April.

Missed / late publications

In April there were no occasions of late or missing publications of the forecast.

Metric 1D Short Notice Changes to Planned Outages

This metric measures the number of short notice outages delayed by > 1 hour or cancelled, per 1000 outages, due to ESO process failure.

April 2023 performance

Figure 4: 2023/24 Number of outages delayed by > 1 hour, or cancelled, per 1000 outages

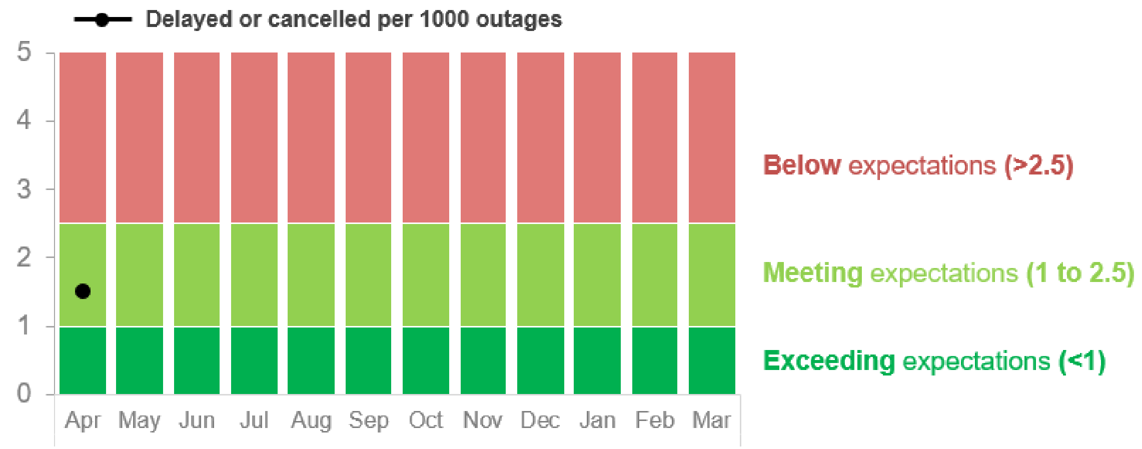


Table 4: Number of outages delayed by > 1 hour, or cancelled, per 1000 outages

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	YTD
Number of outages	664												664
Outages delayed/cancelled due to ESO process failure	1												1
Number of outages delayed or cancelled per 1000 outages	1.5												1.5
Status	●												●

Performance benchmarks:

- **Exceeding expectations:** Fewer than 1 outage delayed or cancelled per 1000 outages
- **Meeting expectations:** 1-2.5 outages delayed or cancelled per 1000 outages
- **Below expectations:** More than 2.5 outages delayed or cancelled per 1000 outages

Supporting information

For April, we successfully released 664 outages and there has been one delay or cancellation that occurred due to an ESO process failure. The number of stoppages or delays per 1000 outages is 1.5, which is within the ‘Meets Expectations’ target of less than 2.5 delays or cancellations per 1000 outages. The one event is summarized below:

- The delay occurred on an outage due to a fault level issue which was only identified by the control room prior to paralleling a 132kV substation to secure the DNO demand as a pre-fault action. As this fault level was not identified in planning timescales, the control room were required to simulate several different options to reduce the fault levels to an acceptable limit to allow the paralleling to commence. It was identified that the fault levels were mainly driven by the particular generation pattern on the system on the day and it was not a scenario the Planning department had considered.

Guidance has been shared back to the planning department and other control room teams on re-configuring the LV interconnectors, the 132kV substation running arrangement and specific generators to consider for fault level management on this outage. This will be written into an Operational Learning Note.

RRE 1E Transparency of operational decision making

This Regularly Reported Evidence (RRE) shows the percentage of balancing actions taken outside of the merit order in the Balancing Mechanism each month.

We publish the Dispatch Transparency dataset on our Data Portal every week on a Wednesday. This dataset details all the actions taken in the Balancing Mechanism (BM) for the previous week (Monday to Sunday). Categories and reason groups are allocated to each action to provide additional insight into why actions have been taken and ultimately derive the percentage of balancing actions taken outside of merit order in the BM.

Categories are applied to all actions where these are taken in merit order (Merit) or an electrical parameter drives that requirement. Reason groups are identified for any remaining actions where applicable. Additional information on these categories and reason groups can be found on our Data Portal in the Dispatch Transparency Methodology.

Categories include: System, Geometry, Loss Risk, Unit Commitment, Response, Merit

Reason groups include: Frequency, Flexibility, Incomplete, Zonal Management

The aim of this evidence is to highlight the efficient dispatch currently taking place within the BM while providing significant insight as to why actions are taken in the BM. Understanding the reasons behind actions being taken out of pure economic order allows us to focus our development and improvement work to ensure we are always making the best decisions and communicating this effectively to our customers and stakeholders.

We have been publishing the Dispatch Transparency dataset since March 2021, and it has sparked many conversations amongst market participants. As we continue to publish this dataset for BP2 we will also be providing additional narrative to help build trust by explaining:

- actions we are taking to increase understanding of the ESO's operational decision making
- insight into the reasons why actions are taken outside of merit order in the Balancing Mechanism
- activity planned and taken by the ESO to address and reduce the need for actions to be taken out of merit order.

April 2023 performance

Figure 5: 2023-24 Percentage of balancing actions taken in merit order in the BM

Table 5: Percentage of balancing actions taken outside of merit order in the BM

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Percentage of actions taken in merit order, or out of merit order due to electrical parameter (category applied)	94.1%											
Percentage of actions that have reason groups allocated (category applied, or reason group applied)	99.7%											
Percentage of actions with no category applied or reason group identified	0.3%											

Supporting information

This month 94.1% of actions were taken in merit order or taken out of merit order due to an electrical parameter. For the remaining actions, where possible, we allocate actions to reason groups for the purposes of our analysis.

During April 2023, we sent 55,957 BOAs (Bid Offer Acceptances) and of these, only 160 remain with no category or reason group identified, which is 0.3% of the total.

In April we began organising an online Dispatch Transparency event which will take place on 2 June. This is in response to customer feedback following the previous Dispatch Transparency event held in person on 5 December 2022. This event is in response to a number of requests for the event to be provided online in order to make it accessible to a wider range of our stakeholders. Attendee feedback from the previous event told us this event was informative and increased their understanding of the ESO dispatch decision making.

Content will be similar to the previous event, including:

- How the ESO currently dispatches – illustrating the cumulative challenges faced by our control engineers and explaining our approach to managing this
- The future of dispatch – overview of the Open Balancing Platform roadmap highlighting how progress will improve transparency and support the control room to manage the dispatch challenges
- Current ESO Dispatch Transparency methodology – explaining the reasons for accepting bids or offers which appear to be out of merit; or not accepting those which appear to be in merit. Including risk management actions

There will also be opportunity for a Q & A session and all materials, including the event recording will be shared.

RRE 1G Carbon intensity of ESO actions

This Regularly Reported Evidence (RRE) measures the difference between the carbon intensity of the combined Final Physical Notification (FPN) of machines in the Balancing Mechanism (BM) and the equivalent profile with balancing actions applied.

This takes account of both transmission and distribution connected generation and each fuel type has a Carbon Intensity in gCO2/kWh associated with it. For full details of the methodology please refer to the Carbon Intensity Balancing Actions Methodology document. The monthly data can also be accessed on the Data Portal here. Note that the generation mix measured by RRE 1F and RRE 1G differs.

It is often the case that balancing actions taken by the ESO for operability reasons increase the carbon intensity of the generation mix. More information about the ESO's operability challenges is provided in the Operability Strategy Report.

April 2023 performance

Figure 6: 2023-24 Average monthly gCO2/kWh of actions taken by the ESO (vs 2022-23)

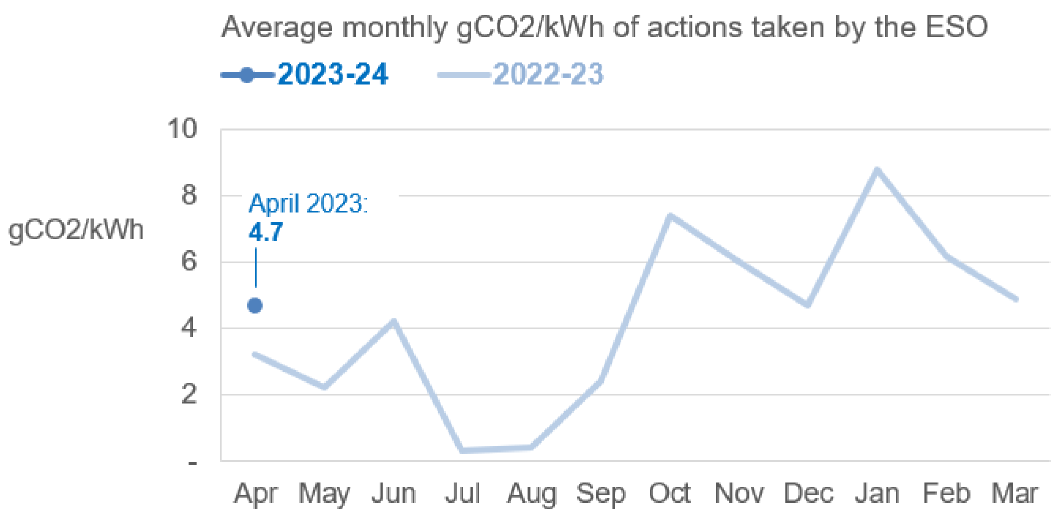


Table 6: Average monthly gCO2/kWh of actions taken by the ESO

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Carbon intensity (gCO2/kWh)	4.7											

Supporting information

In April 2023, the average carbon intensity of balancing actions was 4.7 gCO2/kWh. This is 1.5g higher than April 2022.

The average value of balancing actions was increased by a period of high wind in Scotland and North England following the Easter weekend, exacerbated by the unavailability of the Western HVDC Link. The need to constrain wind in Scotland, replace the energy in England and synchronise more gas fired generation to resolve voltage and inertia needs, resulted in many settlement periods with balancing actions contributing ~50gCO2/kWh. At times the interconnectors were exporting (particularly overnight), with the exception of NSL, requiring additional gas generation to meet demand.

Excluding 9-13 Apr would leave the average carbon intensity of balancing actions at 0.9 gCO2/kWh.

RRE 1I Security of Supply

This Regularly Reported Evidence (RRE) shows when the frequency of the electricity transmission system deviates more than ± 0.3Hz away from 50 Hz for more than 60 seconds, and where voltages are outside statutory limits. On a monthly basis we report instances where:

- The frequency is more than ± 0.3Hz away from 50 Hz for more than 60 seconds
- The frequency was 0.3Hz - 0.5Hz away from 50Hz for more than 60 seconds.
- There is a voltage excursion outside statutory limits. For nominal voltages of 132kV and above, a voltage excursion is defined as the voltage being more than 10% away from the nominal voltage for more than 15 minutes, although a stricter limit of 5% is applied for where voltages exceed 400kV.

For context, the **Frequency Risk and Control Report** defines the appropriate balance between cost and risk, and sets out tabulated risks of frequency deviation as below, where 'f' represents frequency:

Deviation (Hz)	**Duration**	**Likelihood**
f > 50.5	Any	1-in-1100 years
49.2 ≤ f < 49.5	up to 60 seconds	2 times per year
48.8 < f < 49.2	Any	1-in-22 years
47.75 < f ≤ 48.8	Any	1-in-270 years

At the end of the year, we will report on frequency deviations with respect to the above limits and communicate any plans for future changes to the methodology.

April 2023 performance

Table 7: Frequency and voltage excursions (2023-24)

	2023-24											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Frequency excursions (more than 0.5 Hz away from 50 Hz for over 60 seconds)	0											
Instances where frequency was 0.3 – 0.5 Hz away from 50Hz for over 60 seconds	0											
Voltage Excursions defined as per Transmission Performance Report[2]	0											

Supporting information

There were no reportable voltage or frequency excursions in April.

[2] https://www.nationalgrideso.com/research-publications/transmission-performance-reports

RRE 1J CNI Outages

This Regularly Reported Evidence (RRE) shows the number and length of planned and unplanned outages to Critical National Infrastructure (CNI) IT systems.

The term 'outage' is defined as the total loss of a system, which means the entire operational system is unavailable to all internal and external users.

April 2023 performance

Table 8: 2023-24 Unplanned CNI System Outages (Number and length of each outage)

	2023-24											
Unplanned	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Balancing Mechanism (BM)	0											
Integrated Energy Management System (IEMS)	0											

Table 9: 2023-24 Planned CNI System Outages (Number and length of each outage)

	2023-24											
Planned	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Balancing Mechanism (BM)	0											
Integrated Energy Management System (IEMS)	0											

Supporting information

There were no outages, either planned or unplanned, during April 2023.

Notable events during April 2023

We've published a refreshed Innovation Strategy (across all three roles)

In early April we published our 2023-24 ESO Innovation Strategy. The strategy sets out how we plan to innovate in 2023-24 and where we need to focus our efforts to help achieve the ESO ambitions for 2025 and beyond. These priorities have been developed in consultation with industry and our ESO subject matter experts. It has also been informed by other ESO strategies such as Future Energy Scenarios and Bridging the Gap, and our evolving understanding of changing energy system dynamics from the macro trends of Decarbonisation, Decentralisation, Digitalisation and Democratisation.

Our ESO Innovation priorities for 2023-24 are:

- Zero Carbon Transition
- Digital & Data Transformation
- Whole Energy System
- Future Markets
- Constraint Management
- System Stability & Resilience

The strategy document includes case studies of innovation projects relating to these areas, and tracks how our portfolio has performed against the previous year's priorities. Given our uniquely central position in industry, we also aim to facilitate innovation across the whole energy system and provide information on how to get more involved, particularly through collaborative projects and Open Innovation Events.

New carbon intensity record on 10th April

On Monday the 10 April, 65% of our energy demand was met with renewable sources, over 15GW of wind and 5GW of solar power. This combined with under 4GW of fossil sources meant we were able to set a new record for carbon intensity, with just 33g/kwh. The previous record was 36g/kWh set in April 2021.

This incredible record was due in part to the amazing work being done to find new, more efficient ways of meeting our energy needs. Resulting in lower amounts of fossil units required on the system. Projects like pathfinders and response reform have helped us reduce our reliance on fossil fuels.

Role 2 (Market developments and transactions)

ESO

RRE 2E Accuracy of Forecasts for Charge Setting – BSUoS

This Regularly Reported Evidence (RRE) shows the accuracy of Balancing Services Use of System (BSUoS) forecasts used to set industry charges against the actual outturn charges.

April 2023 performance

Figure 7: 2023-24 Monthly BSUoS forecasting performance (Absolute Percentage Error)

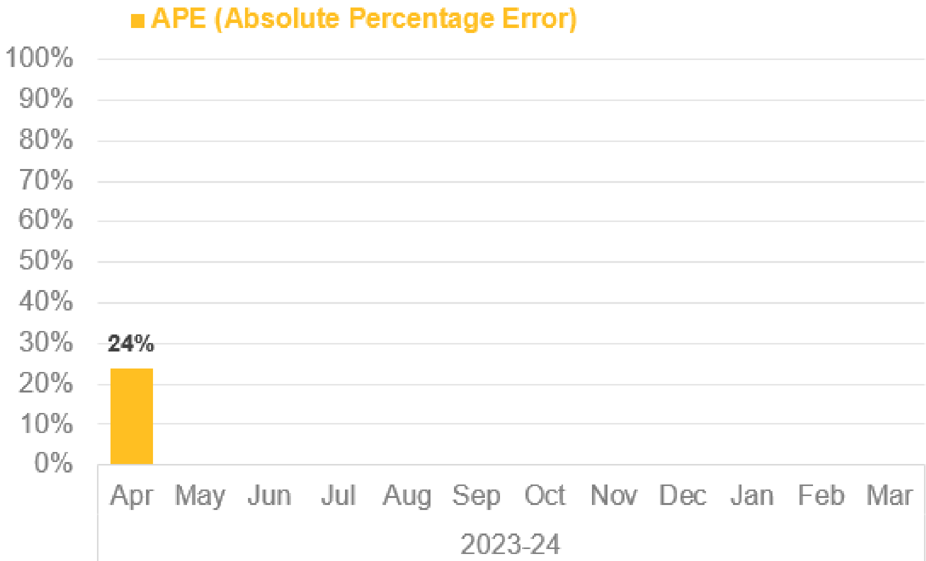


Table 10: Month ahead forecast vs. outturn BSUoS (£/MWh) Performance[3] - one-year view

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Actual	10.8											
Month-ahead forecast	13.4											
APE (Absolute Percentage Error)[4]	**24.0**											

Supporting information

The BSUoS charge (£/MWh) is now based upon a fixed tariff that was published in January 2023. Daily balancing costs (and other costs that ultimately make up the costs recovered through the BSUoS charge) were forecast for the year ahead and two 6-month tariffs were set to cover the 2023/24 charging year. We continue to forecast balancing costs monthly and measure our performance against this forecast as it remains an important metric to support the fixed tariff methodology. The BSUoS cost forecast (costs rather than what is charged against the fixed tariff) is probabilistic and therefore produces percentile values. The published forecast for each month is based on the central value of the BSUoS cost forecast (50th percentile). If the outturn BSUoS costs are below the 50th percentile of the cost forecast, then the actual costs for that month would be lower than the forecast predicted, provided the actual volume is at or above the estimate (and vice versa).

[4] Monthly APE% figures may change with updated settlements data at the end of each month. Therefore, subsequent settlement runs may impact the end of year outturn.

April Performance:

Absolute Percentage Error (APE) decreased from 52% in March 2023 to 24% in April 2023. The main driver of the variance was the outturn costs being lower than expected.

Costs:

April outturn costs were close to the 25th percentile of the forecast produced at the beginning of March.

This is firstly due to the wholesale electricity prices being 17% lower in outturn (£104/MWh) than the forward market prices available at the beginning of March (£126/MWh).

Secondly, the proportion of demand met by renewable generation was lower in outturn (20%) than the forecast at the beginning of March (29%).

Forecast for April made at the start of March: £245 million.

Outturn costs for April: £200m.

Volumes:

Estimated BSUoS volume (made at the start of March): 22.1 TWh

February actual BSUoS volume: 21.82 TWh (1.3% lower than estimate)

Please note, as a result of the approval of code modification CMP308, BSUoS charges have been removed from Generation from 1 April 2023. Therefore, the chargeable volume approximately halved from March 2023.

Notable events during April 2023

Grid Forming (GBGF) Best Practice Guide published

Historically, synchronous machines like coal and gas fired generators have supported the operation of the GB transmission system by providing system stabilising attributes that help the system operation.

Technologies including windfarms, solar plant, battery storage and interconnector differ from synchronous machines and rely upon an Invertors (Invertor Based Resources – IBR) to provide voltage and current.

These IBR can be categorised as Grid Following or Grid Forming - with the latter can be designed to have some of the system stabilising capabilities of synchronous machines to help the operation of the transmission system.

We have been working with wider stakeholders in developing the Grid Forming technology over the last 10 years. We have recently published The GB Grid Forming Best Practice Guide, details the standards to which we would like Grid Forming Plant to be developed. This in turn will allow for the mass deployment of these IBR applications, bring us one step closer to a fully decarbonised electricity system.

Triad dates for 2022-23 published

On 3 April we published the Triad dates for 2022-23 here. The Triads are the three half-hour settlement periods of highest net system demand on the GB electricity transmission system between November and February (inclusive) each year, separated by at least ten clear days. The Triads are used to determine TNUoS demand charges for customers with half hourly meters.

Demand Flexibility Service (DFS) - continued engagement with industry to deliver improvements to the service for next Winter

Following on from the success of the DFS for Winter 22/23 (delivery of just under 300MW of demand flexibility across 1.6million homes & businesses), we are now exploring the potential use of the DFS as a winter contingency and a commercial service for the future and to build on its past successes. We are actively consulting with industry and consumers to establish how this world leading service, or a similar flexibility product, can be developed further and support the continued evolution of consumer flexibility in the UK and its role in the power system of the future.

We have been collaborating with industry to develop the proposals for the continued use of the DFS for Winter 23/24. We ran three 2 hour deep dive DFS workshops, 2 of these were interactive sessions and we encouraged external participation using an interactive whiteboard tool.

- Deep dive 1 Role of the DFS – Attendance: 182 external participants, with nearly 60 questions answered during the webinar.
- Deep dive 2 DFS Commercials (interactive workshop) – Attendance: 88 external participants, with over 200 feedback points & questions posted on the interactive board during the webinar.
- Deep dive 3 DFS Process and operational delivery (interactive workshop) – Attendance: 76 external participants, with nearly 300 feedback points & questions posted on the interactive board during the webinar.

We are continuing engagement with industry and co-creating the DFS for Winter 23/24, looking at improvements that can be made to the service.

ESO’s derogation for procurement of NTC extended

On 26 April we received Ofgem’s decision letter on our request for a derogation against Standard Licence Condition C28 to continue to use Net Transfer Capacity (NTC) on interconnectors. The control room uses NTC when needed to restrict the import and/or export capacity of interconnectors to maintain security of supply (currently the NSL Interconnector represents our largest loss) or due to thermal constraints or system margins. Ofgem has granted us a derogation until 30 September 2023 to use NTCs. They have also requested that in advance of that date we;

(1) consult with stakeholders on the NTC commercial compensation methodology,

(2) provide more analysis on how NTCs have been used in the past,

(3) submit our plan to continue to reduce the use of NTCs (size and frequency). The NTC commercial compensation methodology consultation is due to take place in June 2023.

Role 3
(System insight, planning and network development)

ESO

Metrics and RREs: Please note there are no metrics or RREs for Role 3

Notable events during April 2023

End of Transmission Entry Capacity (TEC) Amnesty

TEC Amnesty was announced in September 2022. This is a process run by the ESO, in partnership with the Transmission Owners (TOs), whereby we invited all parties with Connections Agreements listed on the TEC register to confirm whether they would be willing to terminate their agreement at minimal or no cost, or reduce their TEC. This was the first TEC Amnesty since 2013. The window for parties to participate in the expression of interest window closed 30 April 2023, and we have received 8.1GW of applications. We are currently working with Ofgem to confirm how the costs associated with the projects to date will be recovered, before beginning next steps towards determining outcomes for each applicant.

First phase of stability pathfinders delivered

All 12 units that are contracted by the ESO under the first phase of the stability pathfinder are now live and operational. These units deliver inertia to the electricity network which allows it to operate securely and reduce the need to rely on fossil fuelled power stations. Inertia is a key technical characteristic which allows the network to withstand changes in system frequency.

The first phase is forecasted to save GB consumers up to £128 million and to reduce CO_2 emissions by around 6 million tonnes over the contract duration. This will also help deliver the ESO's ambition to operate a zero-carbon system by 2025 and will be supported by the contracts awarded under two further stability phases which will start delivering from early 2024.

2023 Summer Outlook Report published

We published our Summer Outlook Report on 13 April 2023. This is a report that we publish every year and sets out our view of the electricity system for the summer ahead to support industry preparations. We set out that we will meet our world-leading reliability standards and that we are confident we can use our existing tools to manage operability throughout summer. We also set out that we forecast balancing costs could be around 30% lower than last summer due to lower wholesale prices and activities we have undertaken to reduce costs to consumers.