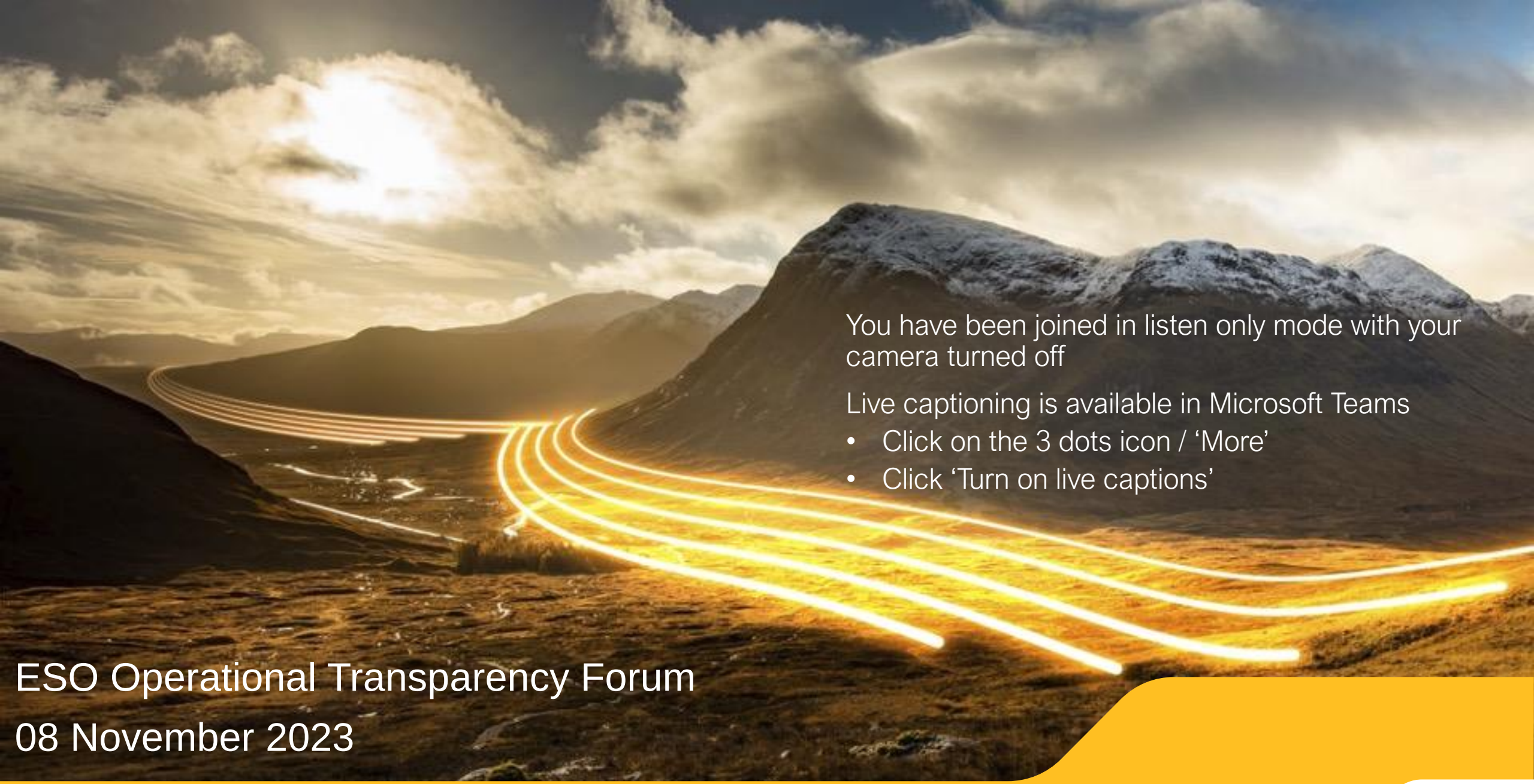


You have been joined in listen only mode with your camera turned off

Live captioning is available in Microsoft Teams

- Click on the 3 dots icon / ‘More’
- Click ‘Turn on live captions’

ESO Operational Transparency Forum

08 November 2023

Introduction | Sli.do code #OTF

To ask questions live and provide us with post event feedback go to Sli.do and join event code #OTF.

- **Ask your questions as early as possible** as our experts may need time to ensure a correct answer can be given live.
- **Please provide your name or organisation**. This is an operational forum for industry participants therefore questions from unidentified parties will not be answered live. If you have reasons to remain anonymous to the wider forum please use the advance question or email options given on the slide.
- **Questions will be answered in the upvoted order whenever possible**. We will take questions from further down the list when: the answer is not ready; we need to take the question away or the topic is outside of the scope of the OTF.
- **Sli.do will remain open until 12:00**, even when the call closes earlier, to provide the maximum opportunity for you to ask questions.
- **All questions will be recorded and published.** Questions which are not answered on the day will be included, with answers, in the slide pack for the next OTF.

Stay up to date on our webpage: https://www.nationalgrideso.com/OTF

Future deep dive / focus topics

Today

Scottish Oscillations

Future

If you have suggestions for future deep dives or focus topics please send them to us at: .box.NC.customer@nationalgrideso.com and we will consider including them in a future forum

You can ask questions in advance (before 12:00 on Monday) at: https://forms.office.com/r/k0AEfKnai3

Balancing Reserve Webinar: Post Industry Consultation

Please join us for the Balancing Reserve Webinar on **16th November 2023 at 10:00 am**.

The purpose of this webinar is to review stakeholder feedback from our EBR Article 18 consultation prior submission to Ofgem, and to provide further information on timelines and next steps. The EBR Article 18 consultation closed on 26th October 17:00 but the documents are still available on our website.

We will also hold a Q&A session at the end of the presentation for any questions that you may have. The session will be recorded and shared on our website along with a Q&A document.

Register for Balancing Reserve Webinar here

If you have any further questions, please contact the team at:
box.futureofbalancingservices@nationalgrideso.com

Electricity System Restoration Engagement Webinar – 22 November 2023

Are you based in the UK's South West & Midlands region and interested in providing restoration services? If so, then our upcoming stakeholder engagement webinar will be very useful for you.

The South West & Midlands tender for restoration services includes the East Midlands, West Midlands, Southern England, South Wales and South West England which will be launching in early 2024. This tender is designed to follow on from the contracts awarded during our previous tender for this region and closes out this round of regional restoration tenders.

Our stakeholder webinar on **22nd November 2023 11.00am - 12.00pm** will provide an overview of the tender timescales, technical requirements, the process through to service go-live and what's different this time round with the ESR procurement. We welcome all technology types to take part in the restoration tenders, including Distributed ReStart services to supplement any full service provisions for the SW & Midlands region.

This webinar will be a great opportunity for you to come along and ask any questions ahead of the expression of interest (EOI) stage in early 2024. During the webinar we will also be seeking feedback on our proposed steps.

Please register your details *HERE* and we will send you a placeholder for the session.

ESR Market Engagement Webinar for the SW & Midlands ESR Tender 2024 - Event Registration (office.com)

Balancing Programme Engagement Event

This event has been postponed until **Tuesday 28th November**.

Further information can be found here.

Please note that the wrong date was published in PluggedIn.

Sub-Synchronous Oscillation Events in June and July 2023

Operational Transparency Forum

8th November 2023

ESO

Aims for the presentation

- To provide some background on power system oscillations for non-engineers
- To present basic details of what happened during the oscillation events centred in Scotland in June and July 2023.
- To explain how the conditions leading to the oscillations were resolved.
- To present conclusions and next steps.
- Please remember that ESO is bound by confidentiality restrictions - we will not be naming any of the parties involved and request that any questions do not name or speculate on any users.

Overview

- During June and July 2023, 8Hz Sub-synchronous Oscillation (SSO) occurred on five separate days, all centred in the Scottish network
- The SSO events caused disturbances on the power system which included the tripping of assets – no demand was lost at any time
- The ESO initiated defensive measures and set up an investigation team after the first event
- The ESO worked closely with relevant parties to gather and analyse data, and propose, implement and test changes
- There have been no further SSO events
- The ESO has identified further work to reduce the likelihood of SSO
- No link to inertia, short-circuit levels, high wind levels, high transfers across the B6 boundary or decarbonisation in general

What is a Sub-synchronous Oscillation (SSO)?

- SSOs are power system oscillations at frequencies that are less than the power system frequency. They can occur under normal system conditions due to system disturbances, these oscillations are normally damped quickly and resolved.
- An SSO event can occur when there is an undamped or amplification of normal background low magnitude oscillations.
- What does this mean in practice?

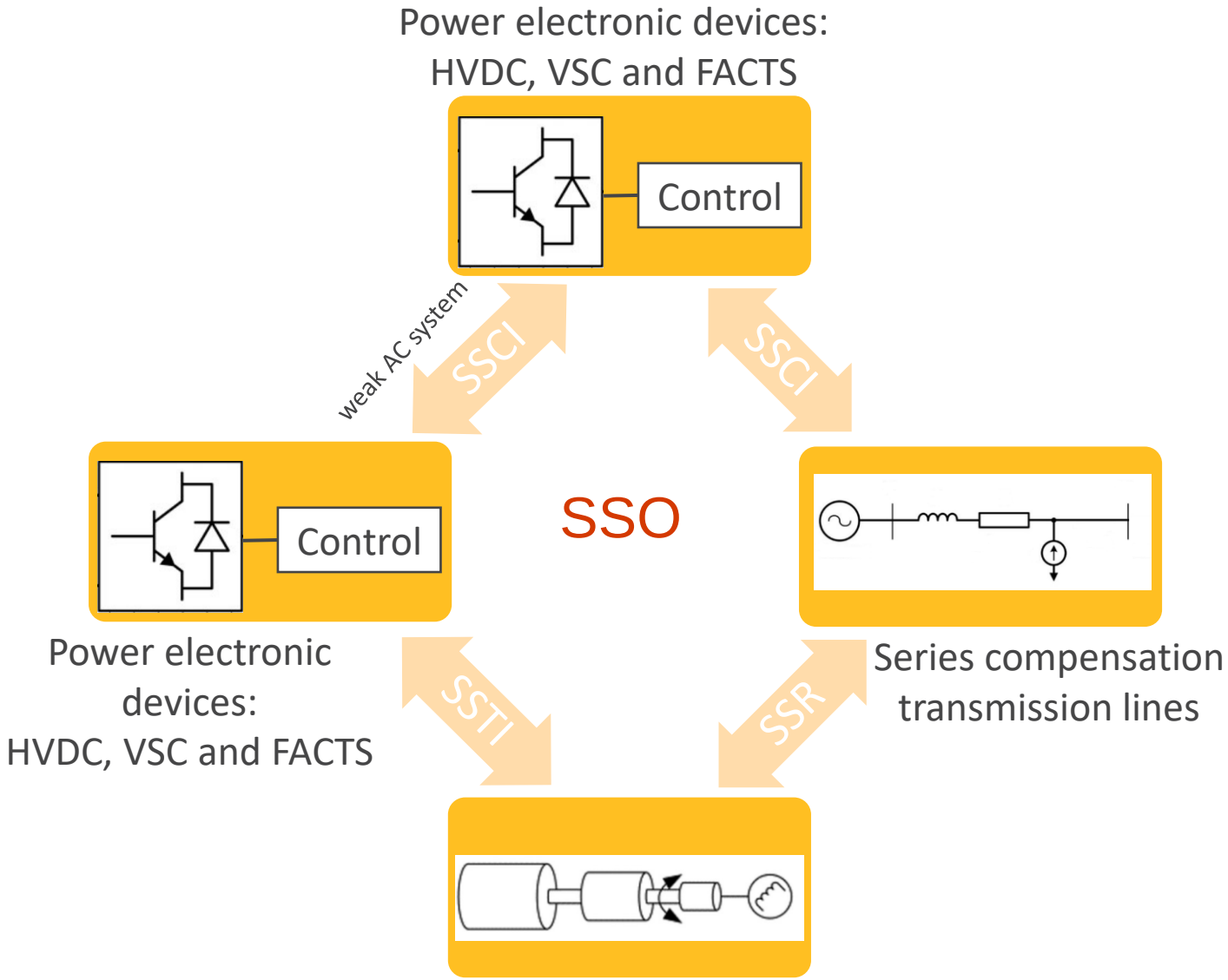


Figure 1. Classification of SSOs [1]

[1] Gu, K., Wu, F. and Zhang, X. (2018). Sub-synchronous interactions in power systems with wind turbines: a review. IET Renewable Power Generation, 13(1), pp.4–15. doi:https://doi.org/10.1049/iet-rpg.2018.5199.

What happened?

During June and July 2023, 8Hz Sub-synchronous Oscillation (SSO) occurred on five separate days, all centred in the Scottish network. The SSO was in the range 5 – 9Hz, mainly at about 8Hz (approximately 1/6th of 50Hz nominal frequency)

The SSO events caused disturbances on the power system which included the tripping of generation, tripping of an interconnector and HVDC link, and in one case a transmission circuit trip.

The ESO initiated defensive measures and started an investigation after the first event. A dedicated project team was established after the second event.

The project team led the investigation, co-ordinated the response across ESO and managed communication with relevant parties.

The most likely cause of the SSO was identified in mid-July.

The project team was stood down on 24th July 2023 and responsibility for concluding work transferred back to the relevant teams.

Changes have been made and there have been no further SSO events.

Defensive measures

Immediately after the first event the Control Room initiated defensive measures

The defensive measures were refined and expanded during June and July before being withdrawn in mid-August

Reduce the likelihood of SSO occurring:

- Maximise the Short-Circuit Level (SCL) in Scotland
- Restrict planned switching in Scotland at times of low demand
- Increase the inertia in Scotland at times of low demand
- Manage the voltage to maximise stability of synchronous generators in Scotland at times of low demand

Manage the impact of SSO:

- To secure against the absolute worst-case loss of generation the ESO determined that it was necessary to increase the response and reserve holding
- Between 3rd July and 14th August, the ESO updated the response policy with increased DC-L requirement and procurement to cover a largest loss up to 1800MW. If the SSO loss risk was greater than 1800MW, actions could be taken in control timescales to procure additional Mandatory Frequency Response (MFR), curtail wind or reposition the Moyle interconnector.
- The ESO also reviewed reserve policy and agreed to hold additional reserve during SSO investigation. The increased reserve requirement would be covered by procuring additional short term operating reserve (STOR).

How it was resolved

- The ESO worked closely with relevant parties to gather data, particularly from Phasor Measurement Units (PMUs)
- The ESO worked closely with asset owners to help model and analyse the behaviour of the power system during SSO
- This analysis and other investigations identified the asset that contributed most to the SSO and helped to rule out causal behaviour of others
- Further modelling and analysis of some equipment was undertaken by asset owners which identified control system changes which would significantly reduce the likelihood of SSO
- The relevant equipment owner made changes to controller settings and the assets were brought back into service in a controlled process
- Close monitoring of the power system has shown that the changes had the intended effect and no further SSO events have been observed.

Conclusions

- The ESO analysed a large data set including plant status and system conditions across all the events:
  - This data showed no link between the oscillations and system conditions (system inertia, short circuit levels or any specific type of generation) and therefore no specific link to decarbonisation
  - No SSO has been observed since the relevant assets returned to service after making changes to their configuration
  - Based on all of the analysis and actions taken, the ESO is confident that the main contributory factor has been removed.
- Post-event, multiple lessons learnt and recommendations have been identified which can be broken into the below categories:
  - Improvements to electromagnetic transient (EMT) modelling
  - Real time monitoring and alarms in the frequency domain
  - Review of the compliance processes

How common is SSO?

Sub-synchronous modes always exist in a power system but, in most cases, the oscillations arising from these modes are of low magnitude and are adequately damped.

The academic paper listed below gives 19 examples of SSO across the world 2007 – 2021.

‘Real-World Subsynchronous Oscillation Events in Power Grids with High Penetrations of Inverter-Based Resources’ https://www.osti.gov/pages/servlets/purl/1862948

Reminder about answering questions at the ESO OTF

- **Questions from unidentified parties will not be answered live**. If you have reasons to remain anonymous to the wider forum please use the advance question or email options. Details in the appendix to the pack.
- **Questions will be answered in the upvoted order whenever possible**. We will take questions from further down the list when: the answer is not ready; we need to take the question away or the topic is outside of the scope of the OTF.
- **Sli.do will remain open until 12:00**, even when the call closes earlier, to provide the maximum opportunity for you to ask questions.
- **All questions will be recorded and published** All questions asked through Sli.do will be recorded and published, with answers, in the Operational Transparency Forum Q&A on the webpage: https://www.nationalgrideso.com/what-we-do/electricity-national-control-centre/operational-transparency-forum
- **Takeaway questions** – these questions will be included in the pack for the next OTF, we may ask you to contact us by email in order to clarify or confirm details for the question.
- **Out of scope questions** will be forwarded to the appropriate ESO expert or team for a direct response. We may ask you to contact us by email to ensure we have the correct contact details for the response. These questions will not be managed through the OTF, and we are unable to forward questions without correct contact details. Information about the OTF purpose and scope can be found in the appendix of this slide pack

slido

Audience Q&A Session

ⓘ Start presenting to display the audience questions on this slide.

Feedback

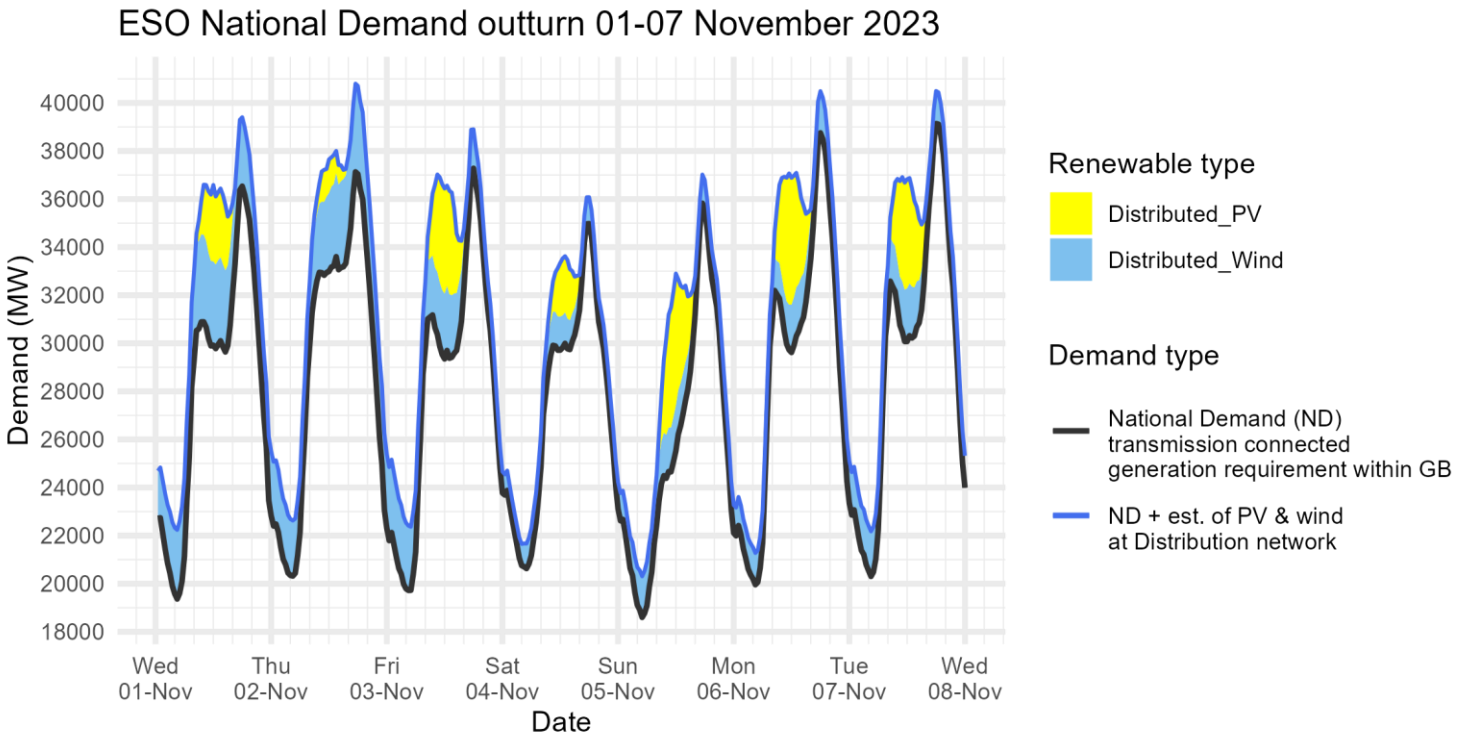
Please remember to use the feedback poll in sli.do after the event.

We welcome feedback to understand what we are doing well and how we can improve the event for the future.

If you have any questions after the event, please contact the following email address:
box.NC.Customer@nationalgrideso.com

Appendix

Demand | Last week demand out-turn



The black line (National Demand ND) is the measure of portion of total GB customer demand that is supplied by the transmission network.

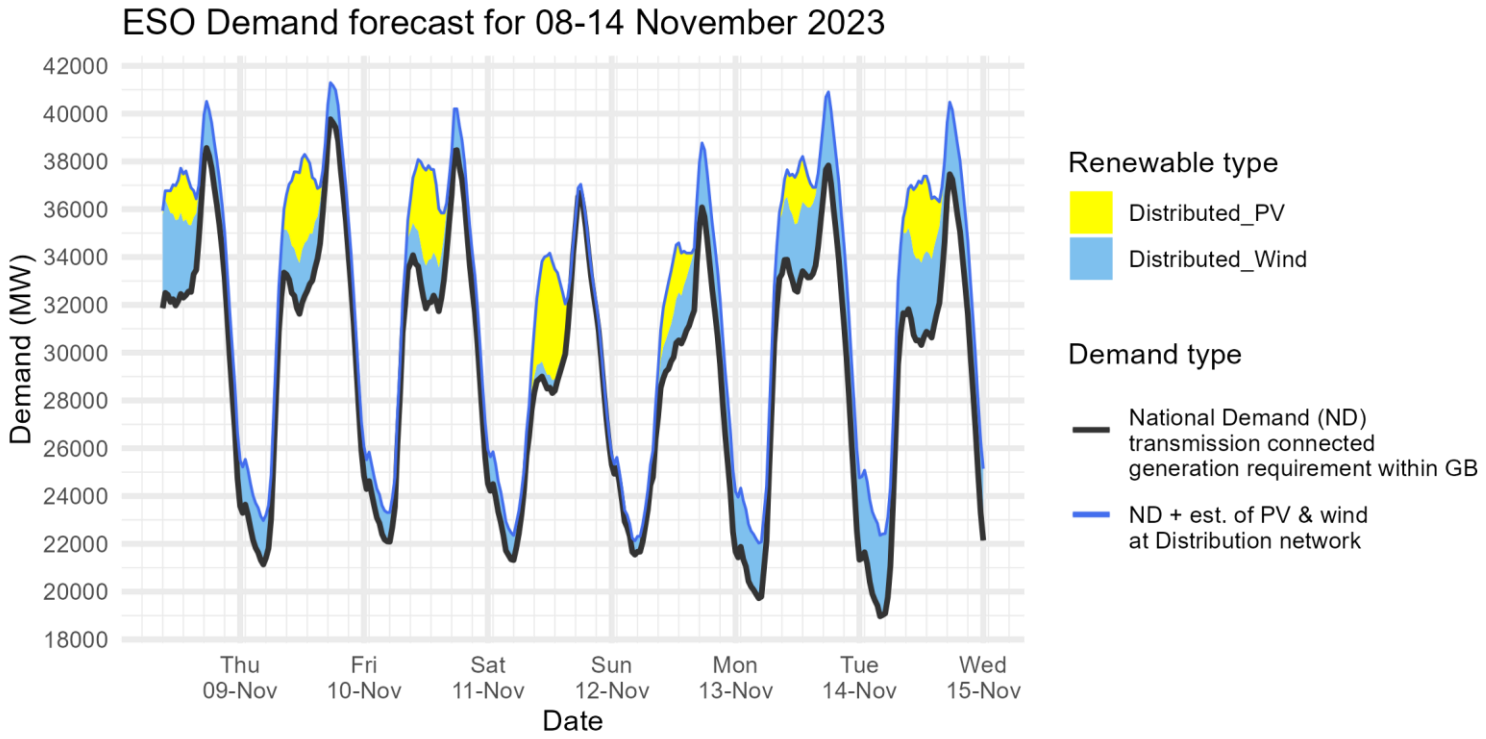
ND values **do not include** export on interconnectors or pumping or station load

Blue line serves as a proxy for total GB customer demand. It includes demand supplied by the distributed wind and solar sources, but it does not include demand supplied by non-weather driven sources at the distributed network for which ESO has no real time data.

Historic out-turn data can be found on the ESO Data Portal in the following data sets: Historic Demand Data & Demand Data Update

		FORECAST (Wed 01		OUTTURN		
Date	Forecasting Point	National Demand (GW)	Dist. wind (GW)	National Demand (GW)	Triad Avoidance est. (GW)	Dist. wind (GW)
01 Nov 2023	Evening Peak	36.5	2.6	36.5	0.0	2.9
02 Nov 2023	Overnight Min	19.3	2.7	20.3	0.0	2.3
02 Nov 2023	Evening Peak	35.7	3.9	37.1	0.0	3.7
03 Nov 2023	Overnight Min	18.6	3.5	19.7	0.0	2.7
03 Nov 2023	Evening Peak	36.4	2.5	37.3	0.0	1.6
04 Nov 2023	Overnight Min	20.0	1.1	20.6	0.0	1.0
04 Nov 2023	Evening Peak	34.7	1.4	35.0	0.0	1.1
05 Nov 2023	Overnight Min	19.3	1.2	18.6	0.0	1.7
05 Nov 2023	Evening Peak	35.3	2.0	35.8	0.0	1.2
06 Nov 2023	Overnight Min	19.3	2.2	20.0	0.0	1.3
06 Nov 2023	Evening Peak	38.5	2.4	38.8	0.0	1.7
07 Nov 2023	Overnight Min	20.0	2.4	20.3	0.0	1.9
07 Nov 2023	Evening Peak	39.0	2.1	39.1	0.0	1.4

Demand | Week Ahead



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ND values **do not include** export on interconnectors or pumping or station load

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Historic out-turn data can be found on the ESO Data Portal in the following data sets: Historic Demand Data & Demand Data Update

		FORECAST (Wed 08 Nov)	
Date	Forecasting Point	National Demand (GW)	Dist. wind (GW)
08 Nov 2023	Evening Peak	38.6	1.9
09 Nov 2023	Overnight Min	21.1	1.8
09 Nov 2023	Evening Peak	39.8	1.5
10 Nov 2023	Overnight Min	22.1	1.2
10 Nov 2023	Evening Peak	38.5	1.7
11 Nov 2023	Overnight Min	21.3	1.0
11 Nov 2023	Evening Peak	36.7	0.4
12 Nov 2023	Overnight Min	21.5	0.6
12 Nov 2023	Evening Peak	36.1	2.7
13 Nov 2023	Overnight Min	19.7	2.3
13 Nov 2023	Evening Peak	37.8	3.1
14 Nov 2023	Overnight Min	19.0	3.4
14 Nov 2023	Evening Peak	37.5	3.0

Operational margins | Week Ahead

How to interpret this information

This slide sets out our view of operational margins for the next week. We are providing this information to help market participants identify when tighter periods are more likely to occur such that they can plan to respond accordingly.

The table provides our current view on the operational surplus based on expected levels of generation, wind and peak demand. This is based on information available to National Grid ESO as of 8 November and is subject to change. It represents a view of what the market is currently intending to provide before we take any actions. The interconnector flows are equal to those in the Base case presented in the Winter Outlook.

The indicative surplus is a measure of how tight we expect margins to be and the likelihood of the ESO needing to use its operational tools.

For higher surplus values, margins are expected to be adequate and there is a low likelihood of the ESO needing to use its tools. In such cases, we may even experience exports to Europe on the interconnectors over the peak depending on market prices.

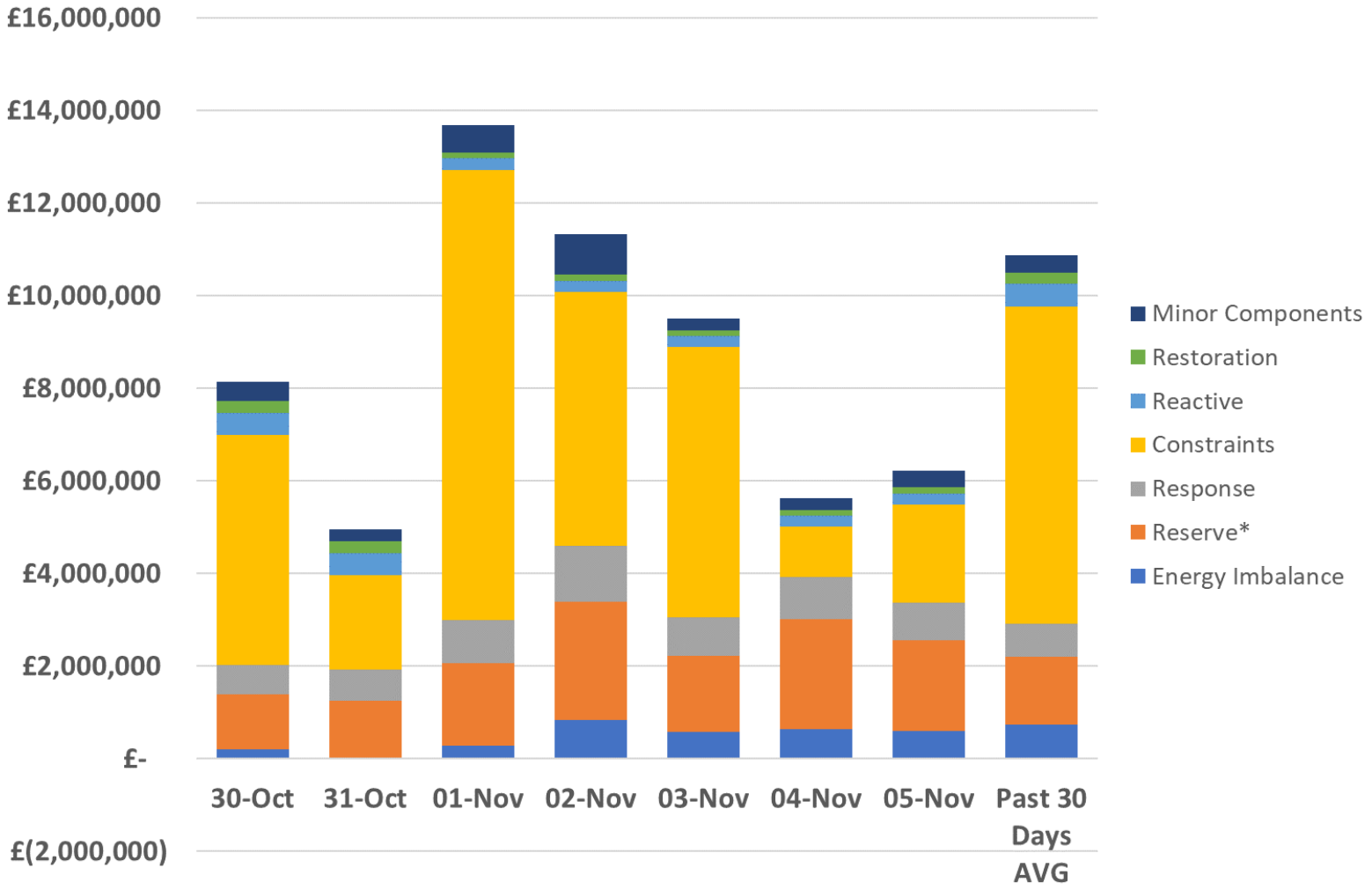
For lower (and potentially negative) surplus values, then this indicates operational margins could be tight and that there is a higher likelihood of the ESO needing to use its tools, such as issuing margins notices. We expect there to be sufficient supply available to respond to these signals to meet demand.

Margins are adequate for the next week.

Day	Date	Notified Generation (MW)	Wind (MW)	IC Flows* (MW)	Peak demand (MW)	Indicative surplus (MW)
Thu	09/11/2023	41655	7270	4080	39690	9150
Fri	10/11/2023	41257	8940	4080	38660	11410
Sat	11/11/2023	40697	1710	4080	37020	5560
Sun	12/11/2023	40090	12990	4080	35250	17510
Mon	13/11/2023	41300	14630	4080	38120	17430
Tue	14/11/2023	41300	14580	4080	37370	18130
Wed	15/11/2023	42140	13370	4080	38880	16170

*Interconnector flow in line with the Winter Outlook Report Base Case but will ultimately flow to market price

ESO Actions | Category costs breakdown for the last week



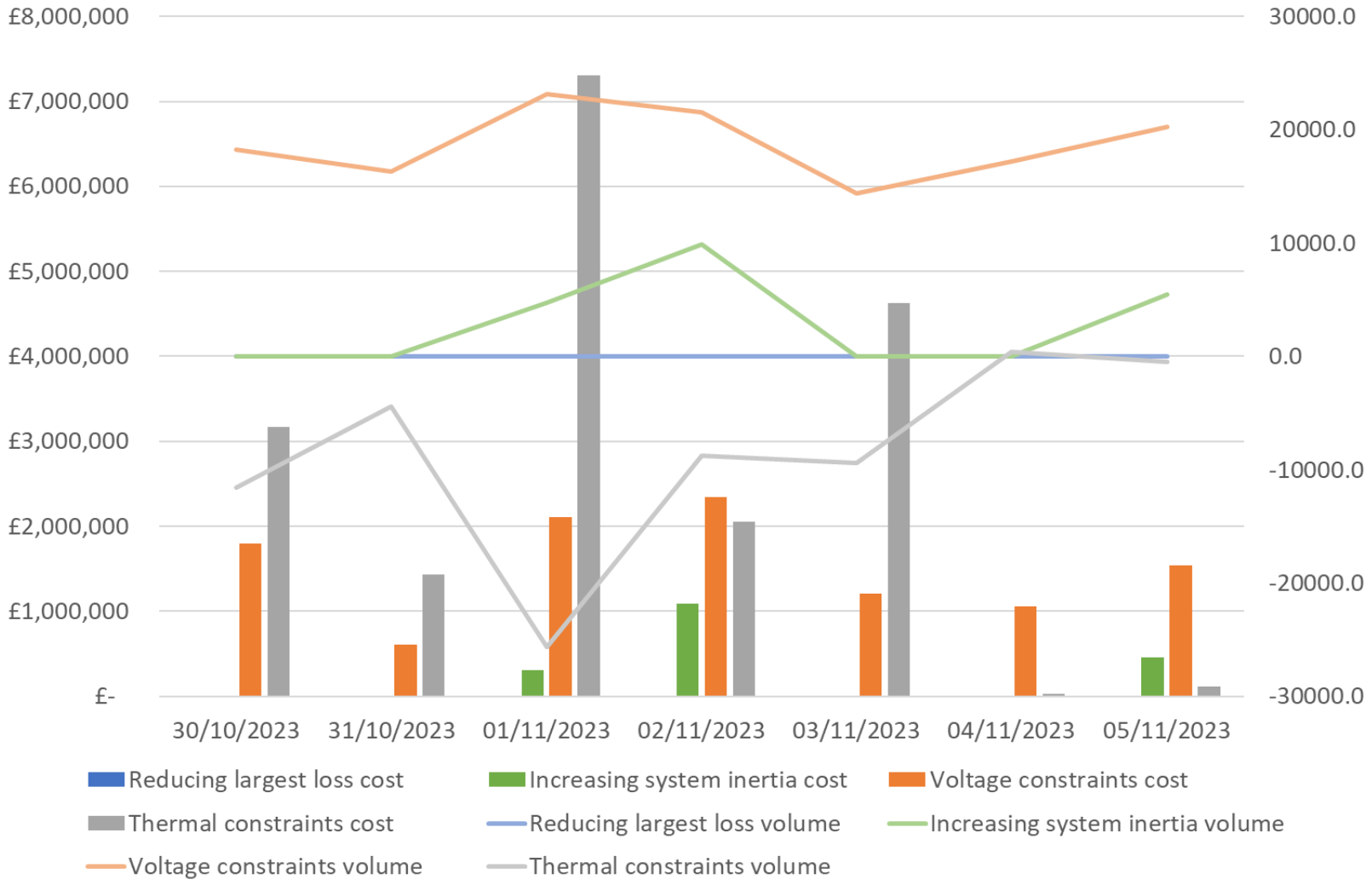
Date	Total (£m)
30/10/2023	8.1
31/10/2023	4.9
01/11/2023	13.7
02/11/2023	11.3
03/11/2023	9.5
04/11/2023	5.6
05/11/2023	6.2
Weekly Total	59.4
Previous Week	77.6

Constraints and Reserve costs were the key cost component for the week.

Please note that all the categories are presented and explained in the MBSS.

Data issue: Please note that due to a data issue on a few days over the last few months, the Minor Components line in Non-Constraint Costs is capturing some costs on those days 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.

ESO Actions | Constraint Cost Breakdown



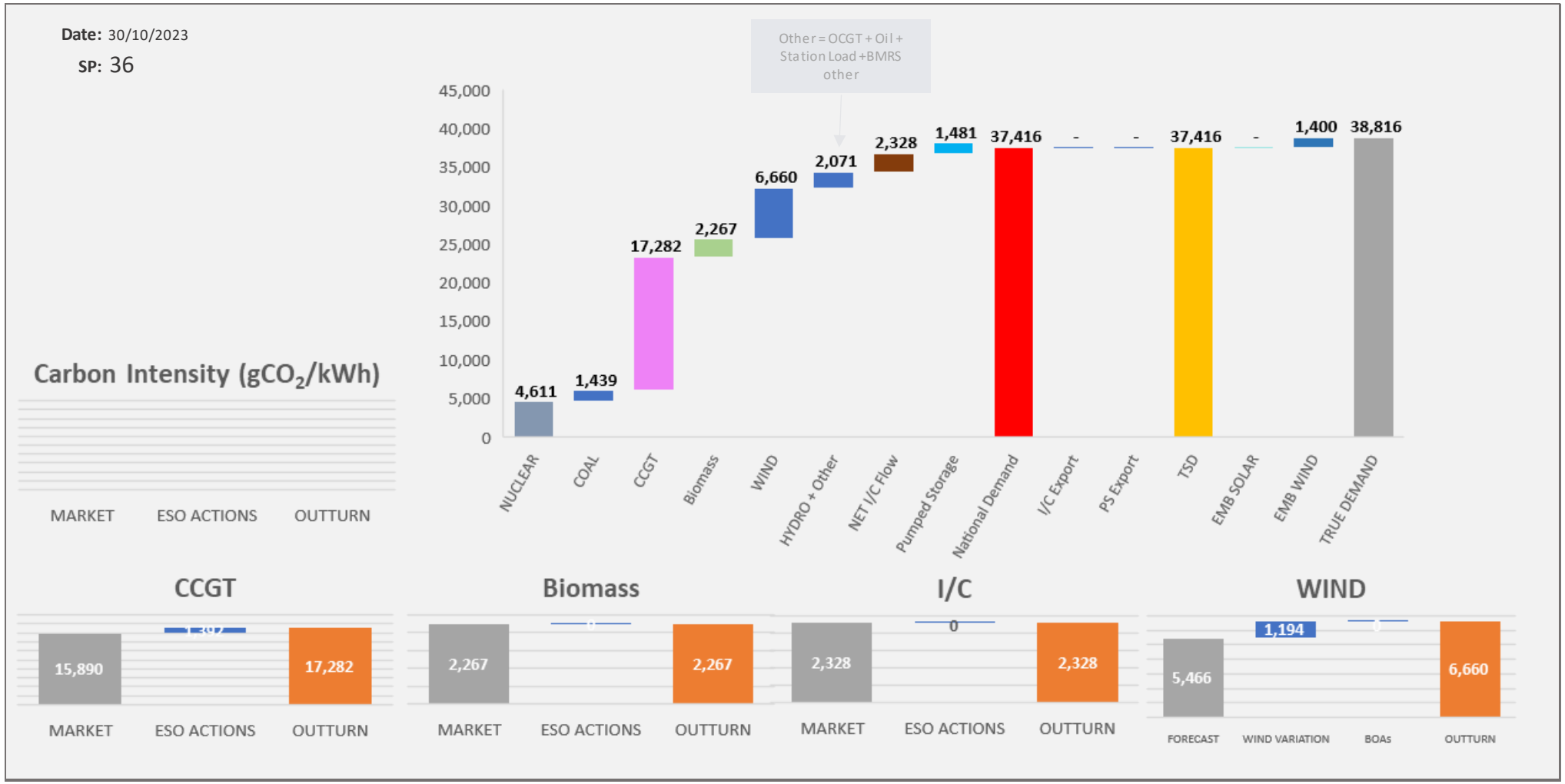
Thermal – network congestion
Actions were required to manage thermal constraints throughout the week with the most significant costs on Wednesday & Friday.

Voltage
Intervention was required to manage voltage levels throughout the week.

Managing largest loss for RoCoF
No intervention was required to manage largest loss.

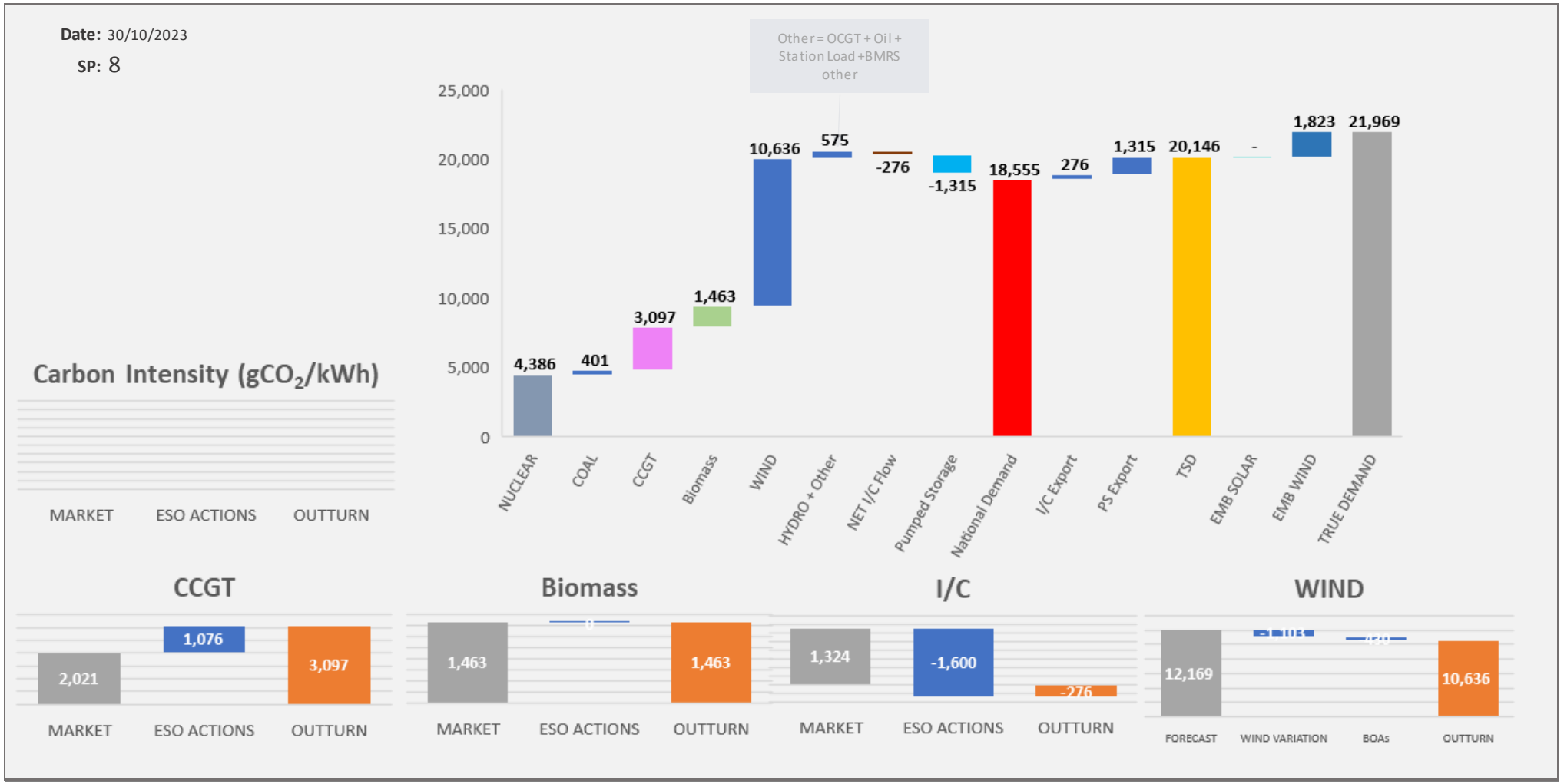
Increasing inertia
Intervention was required to manage System Inertia on Wednesday, Thursday, and Sunday.

ESO Actions | Monday 30 October – Peak Demand – SP spend ~£85k



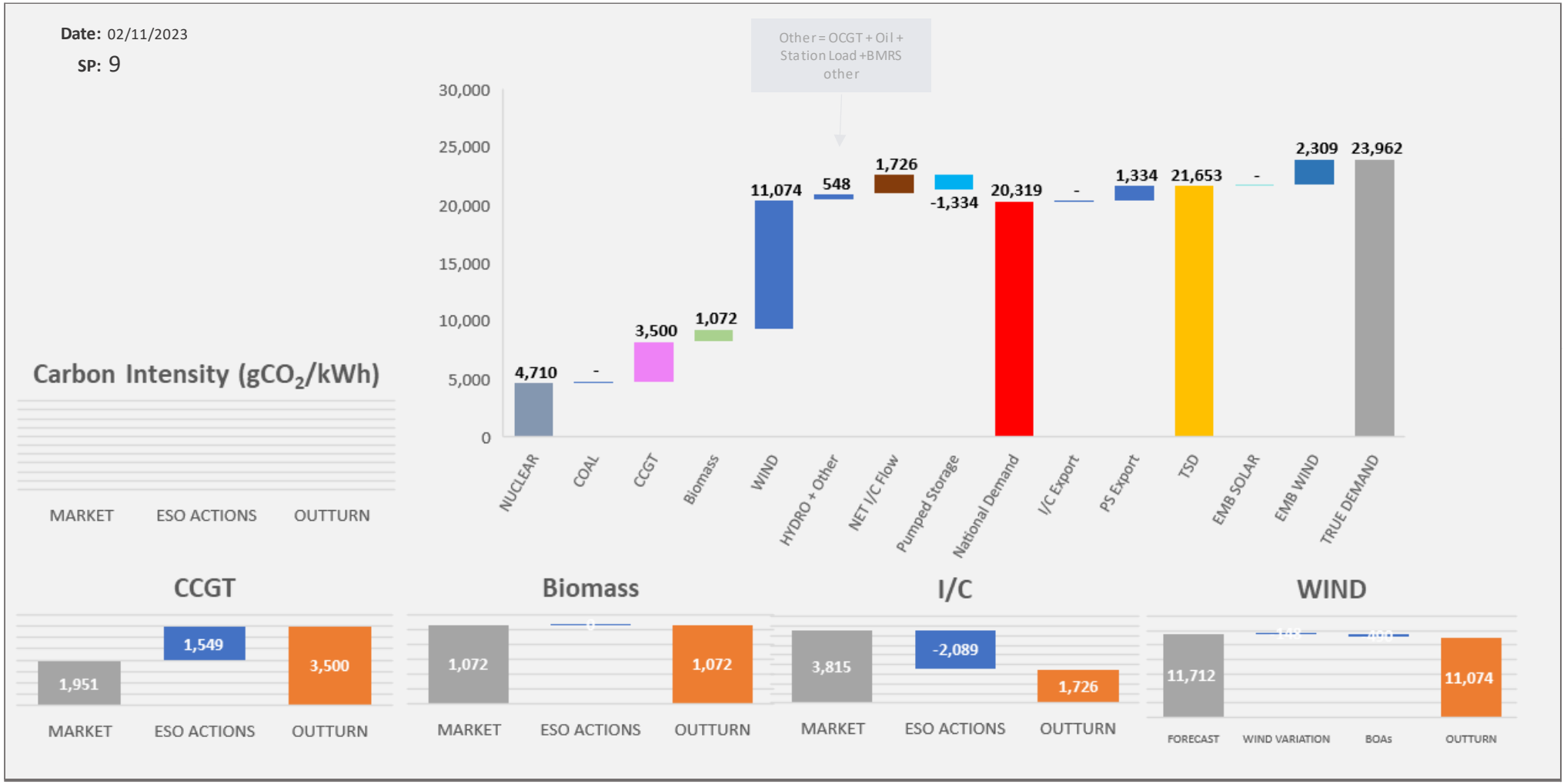
Carbon Intensity data on data portal: https://data.nationalgrideso.com/carbon-intensity1/carbon-intensity-of-balancing-actions

ESO Actions | Monday 30 October – Minimum Demand – SP Spend ~£304k



Carbon Intensity data on data portal: https://data.nationalgrideso.com/carbon-intensity1/carbon-intensity-of-balancing-actions

ESO Actions | Thursday 2 November – Highest SP Spend ~£382k



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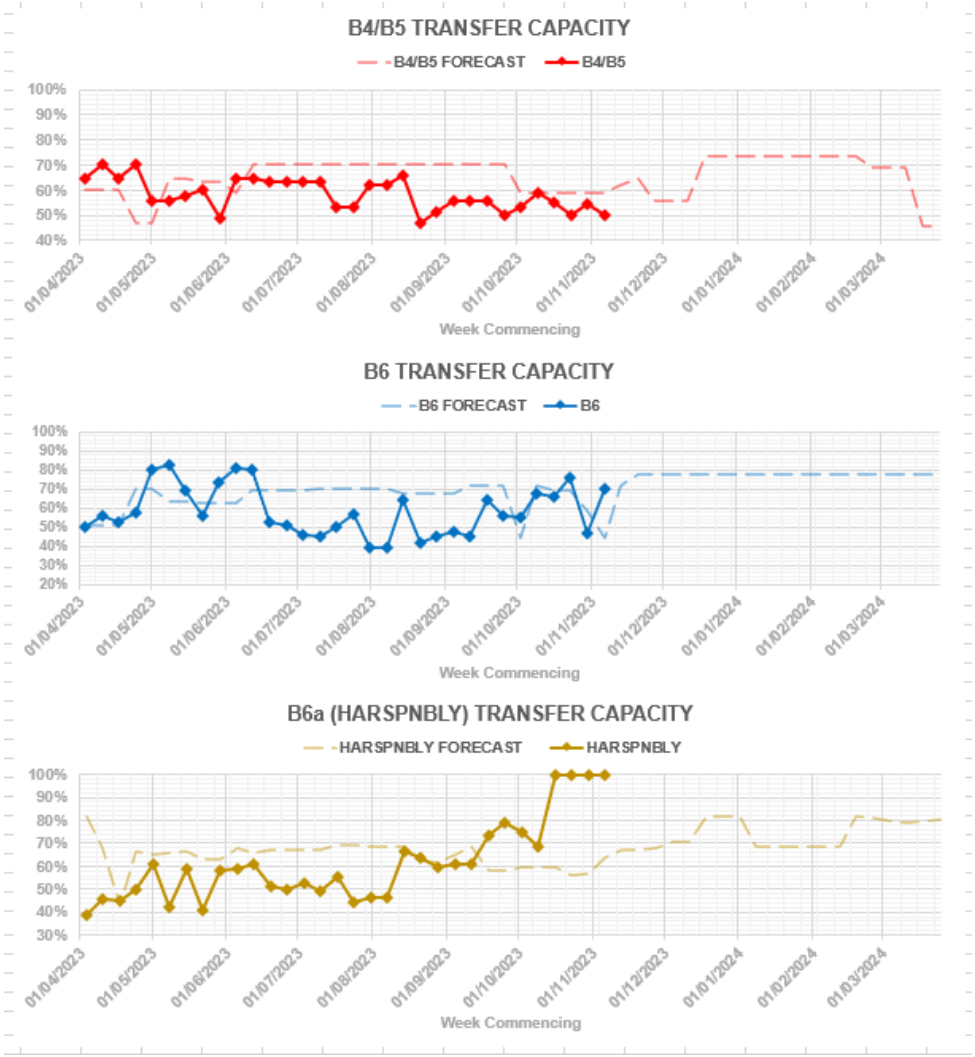
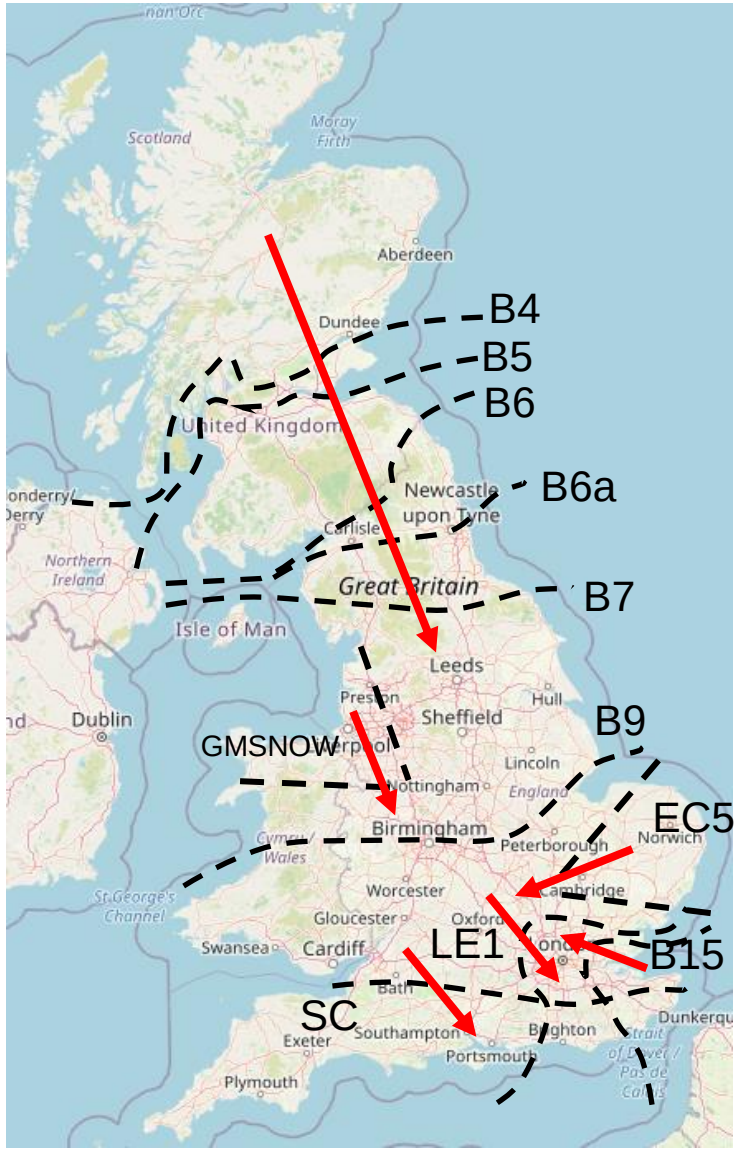
Transparency | Network Congestion

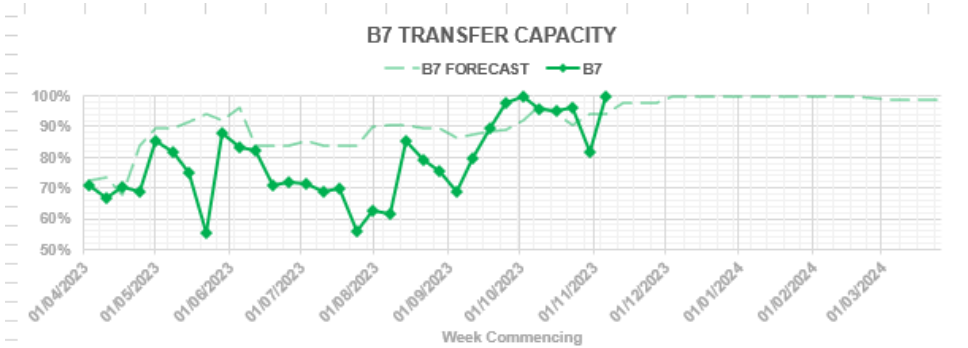


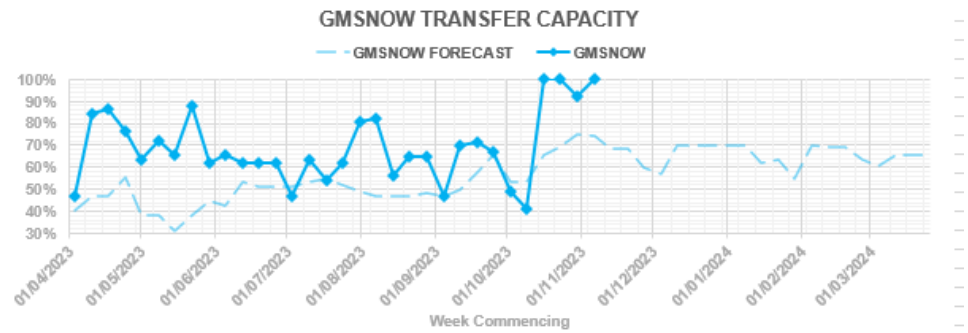
Boundary	Max. Capacity (MW)
B4/B5	3400
B6	6800
B6a	8000
B7	8325
GMSNOW	4700
B9	10600
EC5	5000
LE1	8500
B15	7500
SC	7300

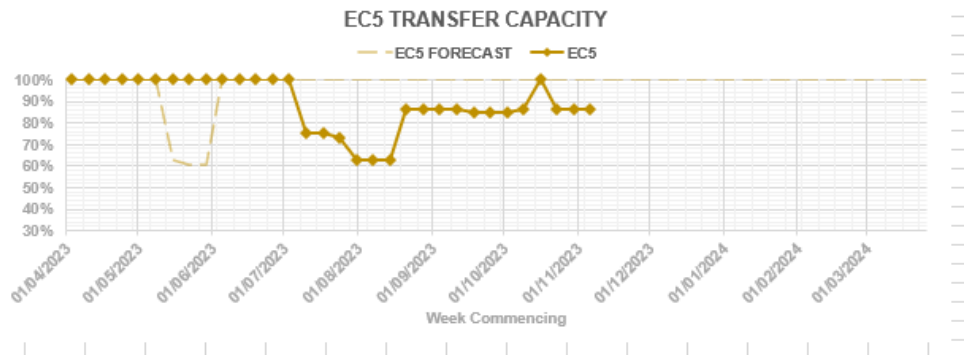


Day ahead flows and limits, and the 24-month constraint limit forecast are published on the ESO Data Portal:
https://data.nationalgrideso.com/data-groups/constraint-management

Transparency | Network Congestion







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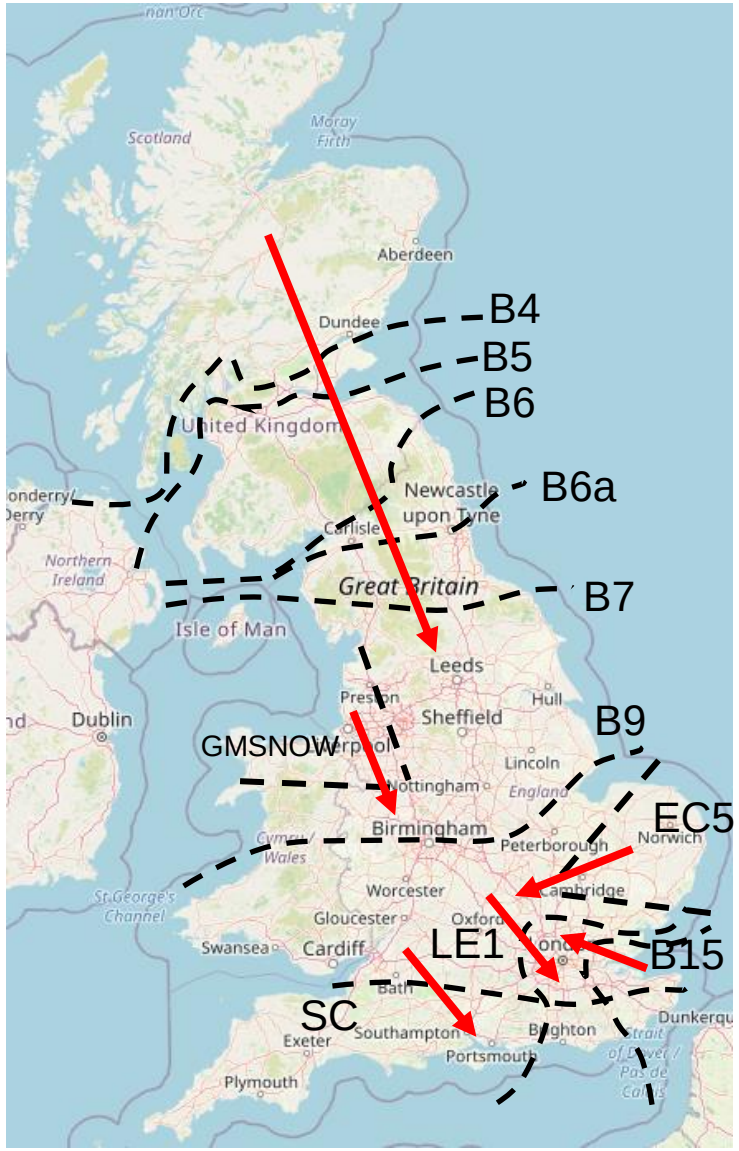

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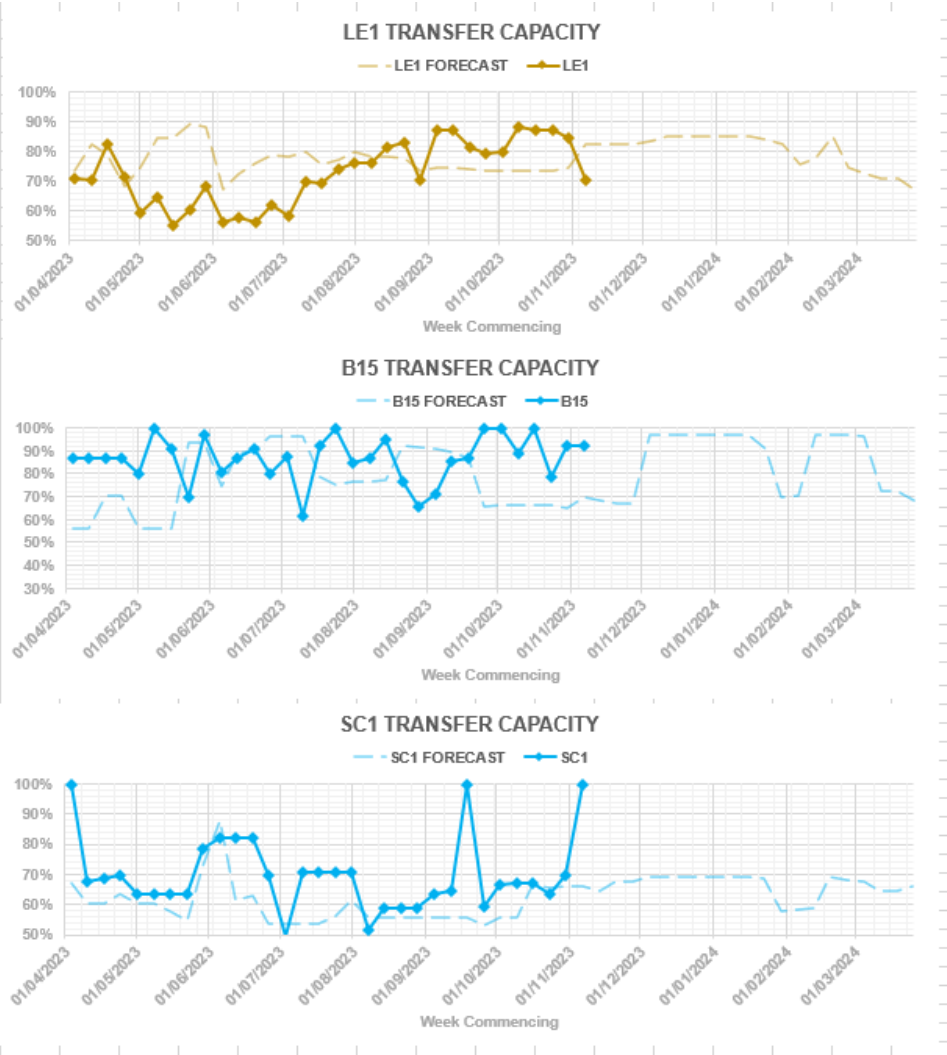
Transparency | Network Congestion



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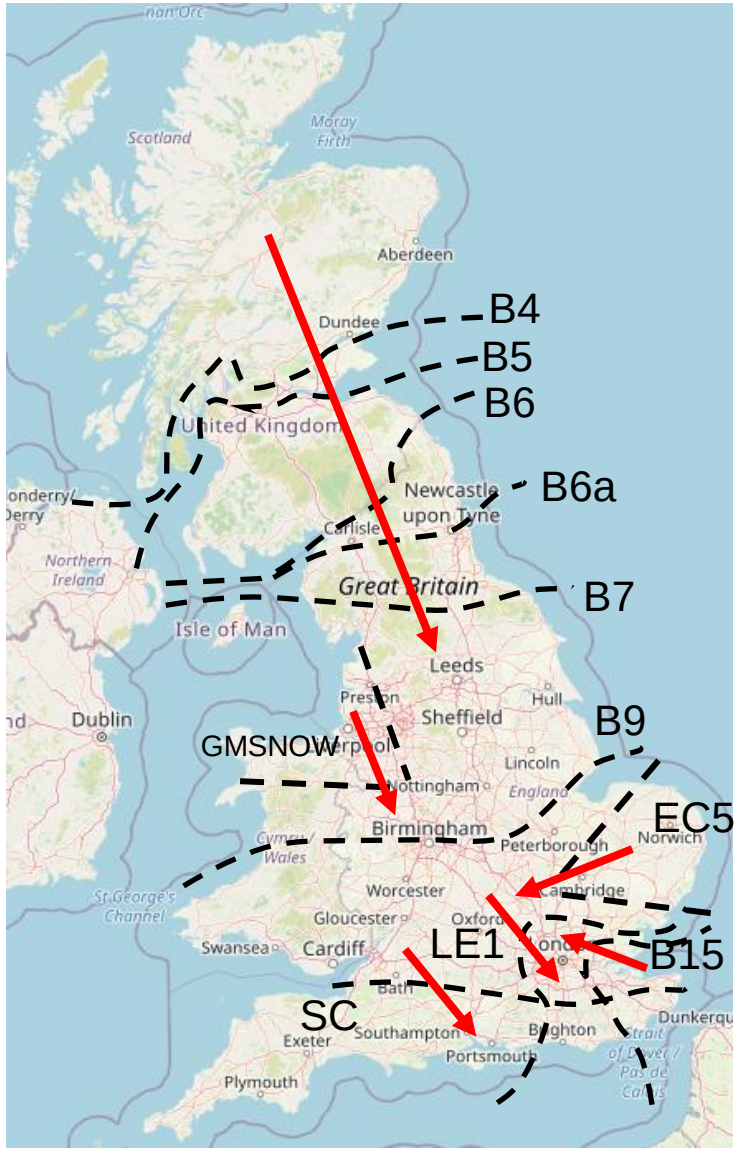

Day ahead flows and limits, and the 24-month constraint limit forecast are published on the ESO Data Portal:
https://data.nationalgrideso.com/data-groups/constraint-management

Previously Asked Questions

Q: ESO currently utilise Dinorwig significantly more often, and at significantly higher offer and lower bid prices, than more flexible plant (e.g. batteries). It is used so much in fact, that it often breaches its MZT numerous times a day. Why does ESO encourage this behaviour with more utilisation?

A: Thank you for providing the requested clarification using 24 October as an example.

The Control Room often uses pump storage units to manage system frequency. The need for these actions are identified in real time and the units must be able to respond urgently to deliver the needed increase or reduction in energy supply. For example:

- Notice to deliver Bids = 0
- Notice to deliver Offers = 0
- Run up rate (Import and Export) = 999
- Run down rate (Import and Export) = 999

On the example day, 24 October, managing the frequency required urgent increases of between 150MW and 300MW in many settlement periods across the day, and urgent decreases of 150MW in the late afternoon. There were no units available at a lower cost which could single-handedly deliver the required increases or decreases in energy supply so urgently. The control room do not currently have an option to identify and combine lower-priced smaller units quickly enough to meet the urgency of frequency instructions. This capability will be provided by the Bulk Dispatch tool due to be available to the control room following implementation of the Operational Balancing Platform (OBP) in December 2023.

Answer continues on the next slide

Previously Asked Questions

Answer continued from previous slide:

The control room always honours the unit technical parameters such as MZT, MNZT, etc. and the way in which this is demonstrated varies between unit types.

For pump storage units there are five possible states:

- >0MW – generating/supplying energy
- 0MW Spin Gen – turbines at speed ready to generate
- 0MW Zero – turbines still or changing direction from generation to pump
- 0MW Spin Pump – turbines at speed ready to pump
- <0MW – pumping/absorbing energy

On 24 October the units were under contract to provide Spin Pump or Spin Gen (as appropriate) when at 0MW. This means they were not at Zero and ensured they were available to respond to urgent instructions without breaching MZT, MNZT and NDZ.

MZT = Minimum Zero Time, MNZT = Minimum Non Zero Time, NDZ = Notice to Deviate from Zero

Previously Asked Questions

Q: Why does ESO bid wind for energy at -£152, opposed to using batteries, who may be priced £0 to -£50? Even if only for an hour, it would save a significant amount if they were utilised. This often results in imbalance prices being far lower than battery's bid prices, this shouldn't happen.

A:Thank you for providing the requested clarification using 18 October as an example.

The control room will typically accept bids on wind units to reduce energy supply behind an active constraint. This topic is explained in detail in the webinar recording from 20 September 2023 with a presentation on Constraints from around 10 minutes to 34 minutes.

To summarise that presentation. The potential supply of energy in Scotland needs to be limited to the amount of energy required in Scotland plus the maximum that can be safely exported to the England and Wales network. On windy days this limitation can only be achieved by reducing energy supply **in Scotland** by several GW. Energy supply is reduced most effectively in Scotland by accepting Bids on Scottish wind units.

There is some capacity of battery units in Scotland, however accepting Bids on these units would only provide a temporary reduction in supply as the energy absorbed would need to be released at some point. Depending on the timescale the battery is prepared to wait to discharge, if the constraint remains active the energy released could require further bids increasing the overall costs.

This same situation can occur in other parts of the network where the potential supply of energy including wind units exceeds the safe network capacity.

Previously Asked Questions

Q: There have been recent cases of units dropping their SEL for the overnights with MEL unchanged to deliver a Schedule 7. There is no mention of this within the Super SEL contract enactment files. How does this align with Ofgems guidance on dynamic data that states this is a technical parameter?

A: On this occasion there was a requirement which we chose to fulfill with trades. When the ESO enters into these trades we seek to buy the most efficient number of MW to resolve our requirements, often at the lowest SEL available. This allows the lowest cost of the trade to be achieved and to bring the lowest quantity of MWs onto the system.

All trades that are entered into with the counterparties are transparent published on the data portal https://www.nationalgrideso.com/data-portal/historic-gtma-grid-trade-master-agreement-trades-data .

Ofgem's open letter on dynamic parameters acknowledges super SEL as a mechanism for ESO to access more flexibility for time limited durations. A Super SEL is one which is not achievable for normal operations, but which can be considered by the unit and offered for a time limited duration under specific conditions including consideration of efficiency, emissions, and generator stability. This lower SEL is a less efficient mode of operation and would not typically be utilised commercially by the unit but can be beneficial to the ESO.

A Super SEL contract enactment occurs when the unit is operational and the SEL needs to be reduced, whereas these are direct trades to a lower SEL from a unit which would not otherwise be generating.

The example mentioned here, the trade was delivered 23:00 – 06:00. The generator would then have changed their SEL when they changed their mode of operation, which looks like it was at 07:45.

Previously Asked Questions

Q: Can you explain why INDQ-1, PETEM1 and CHICK-1 were all rejected in STOR for the 25/10/2023 despite their availability prices being substantially lower (£0-£0.20 availability price) than that of other competitors in the market (£2.34 clearing price)?

A: Following a detailed investigation into the route cause of the STOR auction issues on 24 October, where a potential error occurred affecting 3 units, we can provide the following update. It appears to have been an isolated incident involving an erroneous £0 bid and we continue to monitor the results each day to ensure there are no further issues. We will be responding to each of the 3 providers directly in the next few days to provide further clarifications. Unfortunately as a consequence of the investigations, including trying to replicate the auction of 24 October, there was an issue with the Salesforce platform that caused the auction on 28 October to fail completely and we have taken steps to ensure this cannot happen again.

Outstanding questions

Q: The DC procurement forecast history (and probably other) dataset has recently been given two different date formats. Could NGESO consolidate on one date/datetime format? It would make data handling with your date much easier. Thank you

We followed up with this owner of this question by email as we need more clarification behind this request.

Purpose and scope of the ESO Operational Transparency Forum

Purpose

The Operational Transparency Forum runs once a week to provide updated information on and insight into the operational challenges faced by the control room in the recent past (1-2 weeks) and short term future (1-2 weeks). The OTF will also signpost other ESO events, provide deep dives into focus topics, and allow industry to ask questions.

Scope

Aligns with purpose, see examples below:

In Scope of OTF

Material presented i.e.: regular content, deep dives, focus topics
ESO operational approach & challenges
ESO published data

Out of Scope of OTF

Data owned and/or published by other parties
e.g.: BMRS is published by Elexon
Processes including consultations operated by other parties e.g.: Elexon, Ofgem, DESNZ
Data owned by other parties
Details of ESO Control Room actions & decision making
Activities & operations of particular market participants
ESO policy & strategic decision making
Formal consultations e.g.: Code Changes, Business Planning, Market development

Managing questions at the ESO Operational Transparency Forum

- OTF participants can ask questions in the following ways:
  - Live via Sli.do code #OTF
  - In advance (before 12:00 on Monday) at https://forms.office.com/r/k0AEfKnai3
  - At any time to box.NC.Customer@nationalgrideso.com

- **All questions asked through Sli.do** will be recorded and published, with answers, in the Operational Transparency Forum Q&A on the webpage: Operational Transparency Forum | ESO (nationalgrideso.com)
- **Advance questions** will be included, with answers, in the slide pack for the next OTF and published in the OTF Q&A as above.
- **Email questions** which specifically request inclusion in the OTF will be treated as Advance questions, otherwise we will only reply direct to the sender.
- **Takeaway questions** – we may ask you to contact us by email in order to clarify or confirm details for the question.
- **Out of scope questions** will be forwarded to the appropriate ESO expert or team for a direct response. We may ask you to contact us by email to ensure we have the correct contact details for the response. These questions will not be managed through the OTF, and we are unable to forward questions without correct contact details. Information about the OTF purpose and scope can be found in the appendix of this slide pack