Public

Balancing Programme Event

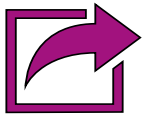
27 November 2024

NESO
National Energy System Operator

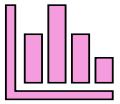
Q&A via Slido

Please post any questions you have for our speakers on Slido - #BPeventNov24- ensuring to list both your full name and organisation; this will enable us to follow up with you after the event where necessary.

All questions posted in Slido will be published online with answers after the event; this will include any questions we are unable to answer in the session due to time constraints or the need for further information.



Out of scope questions will be forwarded on to the appropriate NESO team or expert for a direct response. We may ask you to contact us by email to ensure we have the correct contact details for the response.



Using Slido, you can also suggest topics for future Balancing Programme engagement events & webinars.

Slido will close at the end of the webinar; if you have any further questions, please get in contact with us at box.balancingprogramme@nationalenergyso.com.

Battery Storage Forum Event

#BPeventNov24

We will be holding a Battery Storage Forum event on **04 December 2024**.

This will be the inaugural event for this forum and will be facilitated by NESO leaders and technical experts. It will provide an opportunity for open and collaborative discussions, and solutioneering.

Date & location details

Date: 04 December 2024

Time: Expected start 09:30

Venue: British Motor Museum

Address: Banbury Road, Warwick, CV35 0BJ

Attendance & who this forum is suited for

This event is specifically tailored for professionals closely involved in battery storage related work and follows on from the recent LCP methodology webinar. We recognise that this is likely to be a popular event so attendance is currently by invitation only to ensure a fair distribution across industry partners. We will be publishing content from this forum on our website after the event for those who are not there on the day - Battery storage | National Energy System Operator.

For further information, please contact: Box.Battery-Storage-Strategy@uk.nationalenergyso.com

We have asked what you'd like on the agenda

To ensure the agenda aligns with the interests of battery storage partners, we requested that those invited complete a short survey. This will help us shape the event to address the topics most relevant.

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Welcome & Agenda

Time	Agenda Item	Details
9:00 - 9:30	**Registration**	
9:30 – 9:50	Welcome and Setting the Scene	• The role of NESO & our Strategic Priorities • Balancing Programme system transformation overview & value delivered
9:50 – 10:45	Balancing Systems Update	• 1 year of the Open Balancing Platform (OBP)– Where were we & where are we now? • Longer-term view of the OBP product roadmap and what this means for market participants • Digital enablers in our Balancing Transformation journey
10:45 – 11:00	Forecasting Systems Update	• Deliverables since September 2024 and associated benefits • Looking forward: Committed delivery for FY25/26
11:00 – 11:20	**Break** – 11:20 move to breakout room for 11:25 start	
11.25 – 12.10	Breakout Session 1, 2 or 3	1. National Optimisation in OBP 2. Constraint Management & OBP Demo 3. A Day in the Life of a Control Room Engineer
12.15 – 13:00	Breakout Session 1, 2 or 3	
13:00 – 13.40	**Lunch** - 13:40 move to breakout room for 13:45 start	
13.45 – 14.30	Breakout Session 1, 2 or 3	
14:35 – 14:50	Clean Power 30	Overview of independent analysis of how Great Britain can achieve Clean Power by 2030
14:50 – 15:10	Market Services Update	Update on market products including Quick & Slow Reserve
15:10 – 15:25	**Break**	
15:25 – 16:25	Beyond 2025	Interactive session exploring potential balancing & forecasting capabilities beyond 2025 to ensure the Programme's roadmap aligns with customer expectations, whilst enabling a decarbonised energy system & consumer value.
16:25 – 16:55	Q&A	Please submit your questions via Slido throughout the day
16:55 – 17:00	Next Steps & Closing Remarks	Future engagement opportunities
17:00 – 18:00	**Networking Drinks Reception**	

NESO National Energy System Operator

The Role of NESO and our Strategic Priorities

Colm Murphy, Director of Major Projects

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National Energy System Operator (NESO) Timeline

History of the System Operator:

1989
The Electricity Act was approved by parliament, which paved the way for privatisation of the electricity industry.

1990
National Grid was established, creating one regulated company for England and Wales to provide transmission infrastructure and a marketplace; not to buy or sell energy itself.

1996
Our control room, the Electricity National Control Centre (ENCC) was established, in Wokingham.

Legal Separation of the Electricity System Operator:

April 2019
National Grid Electricity System Operator (ESO), became a legally separate business within the National Grid PLC Group.

The Formation of the National Energy System Operator:

April 2022
Following industry consultation, the UK government decided that the Future System Operator would be a public corporation free from commercial interests and operationally independent.

October 2023
The Energy Act 2023 was passed with cross-party support, legislating for a Future System Operator to be created.

January 2024
The ESO announced the new name for this entity as the National Energy System Operator, or NESO.

October 2024
NESO is established.

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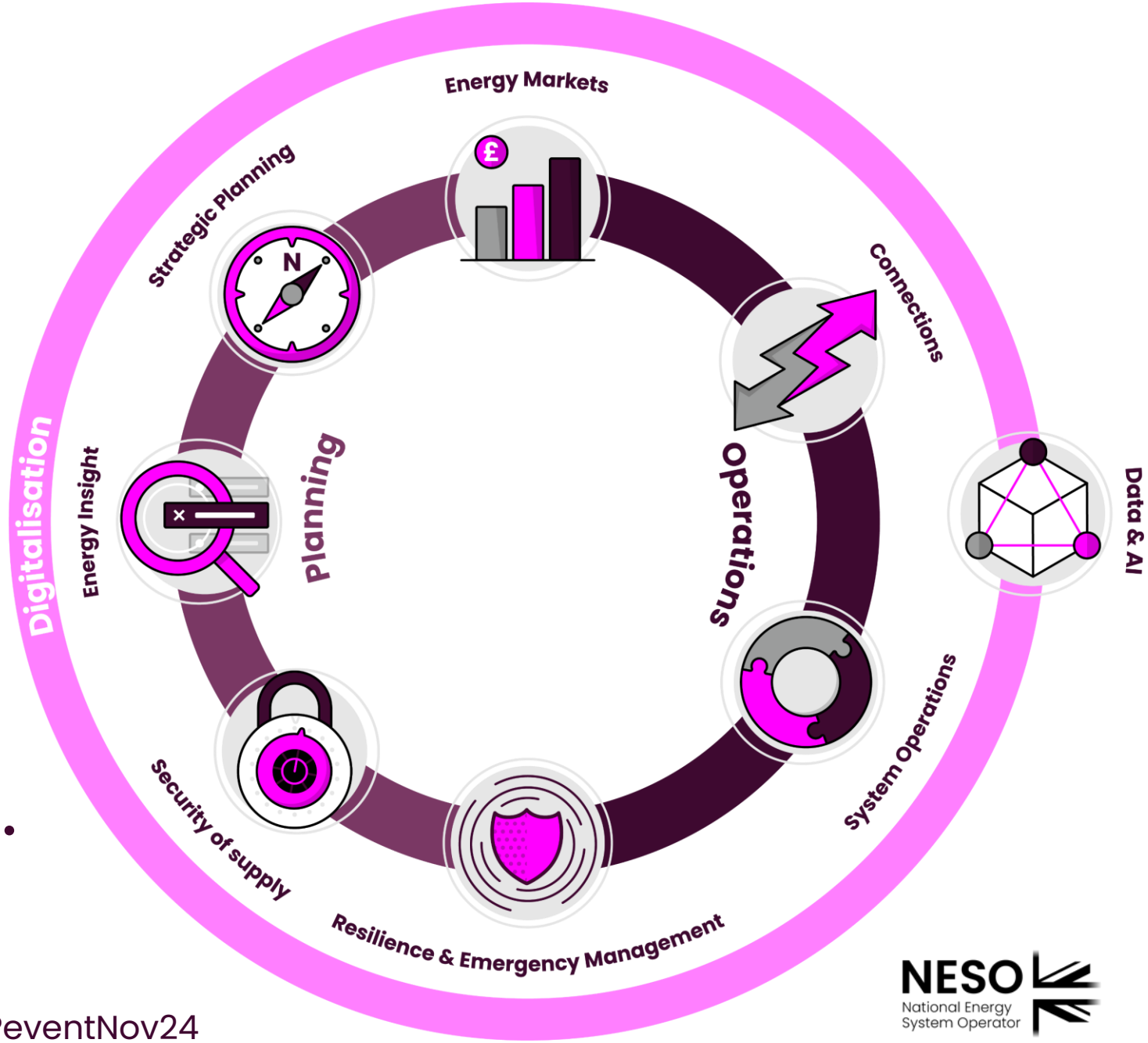
What We Do

We bring together eight activities required to deliver our plans, markets and operations of the energy system of today and the future.

Bringing these activities together in one organisation encourages holistic thinking on the most cost-efficient and sustainable solutions to the needs of our customers, communities and consumers.

Together, we are energising progress.

Together, we are NESO.



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Our Priorities

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We have identified six priorities that will guide our efforts through to March 2026, the end of our current regulatory period called RIIO-2.

Clean Power

We will enable a zero-carbon electricity system by adopting a whole system approach, encouraging innovation and collaboration.

Decarbonised Energy

We will develop integrated plans for a decarbonised, efficient and flexible energy system fit for the future.

Consumer Value

We will have unlocked around £3 billion of consumer benefits by 2026 through delivery of our commitments.

Customer Centricity

We will understand and balance the different needs of our customers to form meaningful partnerships.

Digital Mindset

We will unlock the potential of technology and teamwork through a digital-first approach, enabling a future of seamless connectivity and innovation at pace.

Valuing our People

We will invest in our people, to ensure we are prepared and empowered to embrace the opportunities of the future.

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Balancing Programme Overview

Brendan Lyons, Balancing Programme Director

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System Transformation - Why do we need to Transform?

1. Manage increased **number of market participants**

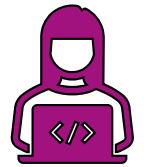
2. Quickly **adapt** to new requirements, innovation and services

3. Enable **level playing field** for new flexibility services

4. Optimise **balancing cost**

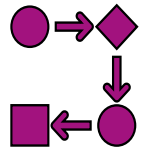
How are we delivering this transformation?

Current System Changes: Delivering changes and improvements to our current balancing systems, responding to identified need, ahead of OBP being fully implemented in 2027.

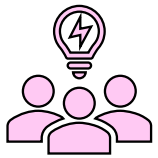


Development of New Systems: Developing and delivering two new platforms for balancing and forecasting which are reliable, resilient and secure, and modernise Control Room operations.

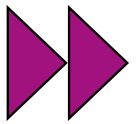
Process Improvement: Reviewing current processes to understand what changes and information are required to enhance operation in line with our objectives.



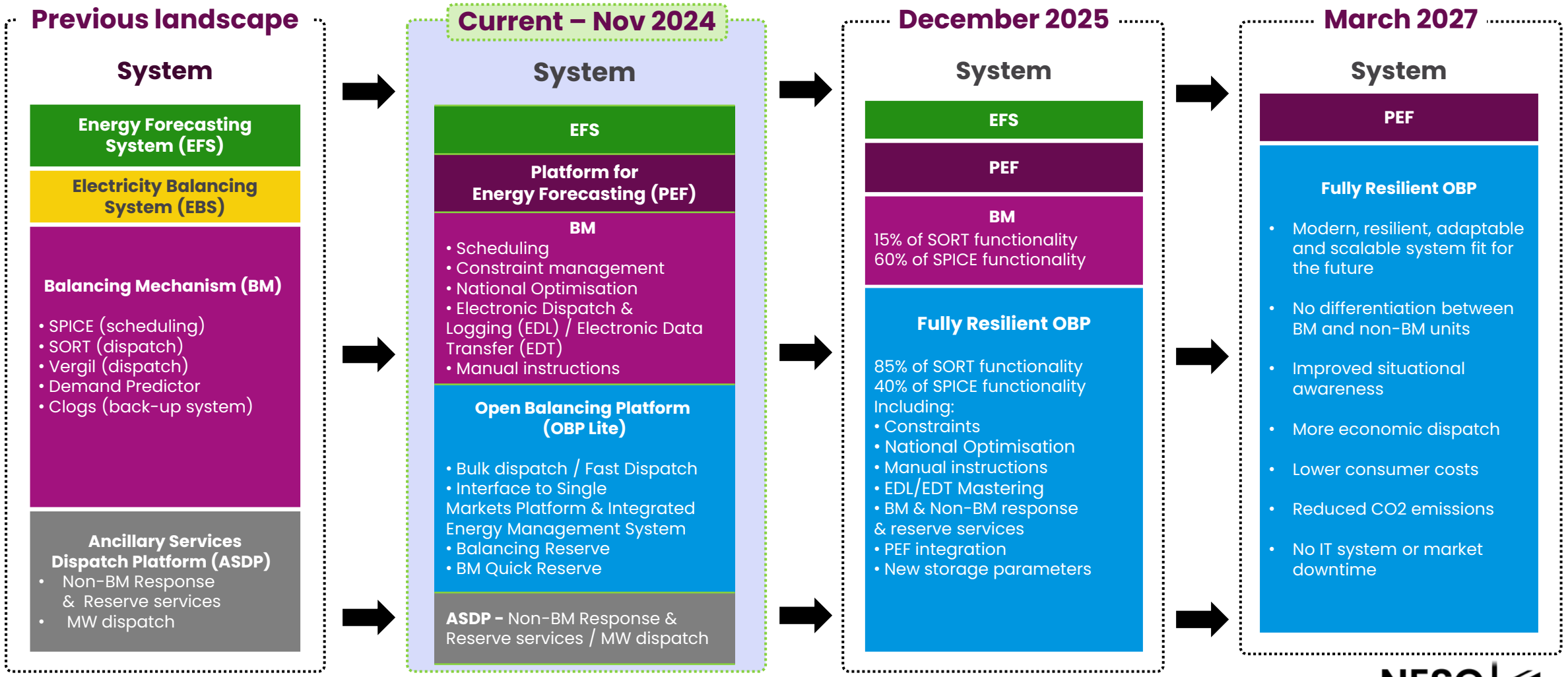
Trials & Innovation Projects: Collaborating on trials & innovation projects to build an understanding of requirements for future balancing capabilities through lessons learned.



Enabling Market reform: Through our system changes and development we enable market reform in response to evolving requirements & need.



System Transformation – where are we?



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Value Delivered by the Programme

Manage an Increase in Market Participation and Use of Flexible Technology

55% increase in the number of assets receiving BM instructions since the programme was established.

286% increase in battery dispatch volume since OBP R1

89% increase in small BMU dispatch volume since OBP R1

941% increase in number of dispatch instructions to batteries

75% increase in number of dispatch instructions to small BMUs

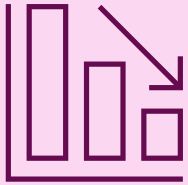
Quickly Adapt to New Requirements, Innovation & Services

Delivered over 1700 changes, improvement, and fixes in OBP with minimal outage time

Enabled bulk dispatch in the battery zone in R1 of OBP

Implementation of:
- Balancing Reserve
- BM Quick Reserve
- MW Dispatch

Delivery of a Dispatch Efficiency Monitor



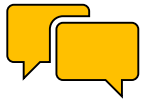
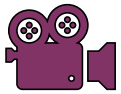
Support a Reduction in CO2 Emissions

The Carbon Intensity Produced per kWh of Energy has decreased from 172 gCO2/kWh in FY21 to 146 gCO2/kWh in FY24, a saving a 26 gCO2/kWh.

2.5% can be attributed to the Balancing Programme providing an estimated carbon saving of £46 million in FY24

49 GWh increase in battery dispatch since OBP release 1 offsetting approx. 50 metric tonnes of CO2 providing a carbon saving of approx. £13m

Stakeholder Feedback – "You said, we did"

More focus was required on the Small BMU zone to increase utilisation		We deployed several improvements to the OBP algorithm to resolve outstanding rounding issues resulting in an increase in the use of these assets when in cost merit order
We needed to improve our dispatch efficiency		We have updated the Legacy Dispatch Algorithm to enable advice for the battery zone and developed a new Dispatch Efficiency Monitor to provide real-time feedback
Input into shaping the Balancing Programme's future delivery & prioritisation process was important to you		We hosted an interactive 'Beyond 2025' session to generate ideas for product development; we will build on this today, as we have through our Technology & Forecasting Focus Groups
You told us contact with the Programme and having someone to reach out to would be useful between events		We have introduced 1-1 relationship managers within the Programme, and are now meeting with several organisations regularly – **this offer remains open**
You told us you wanted to receive content and material in advance of our events / webinars & would like increased accessibility to content from our in-person events		We now share slide content ahead of our events / webinars, and record key messaging from our in-person events; all webinars and focus groups are recorded
More information on constraint management, national optimisation in OBP and our future roadmap		These topics feature in today's event

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Balancing Systems Update

Bernie Dolan, Principal Product Manager
Nisha Bhamidimarri, Senior Delivery Manager

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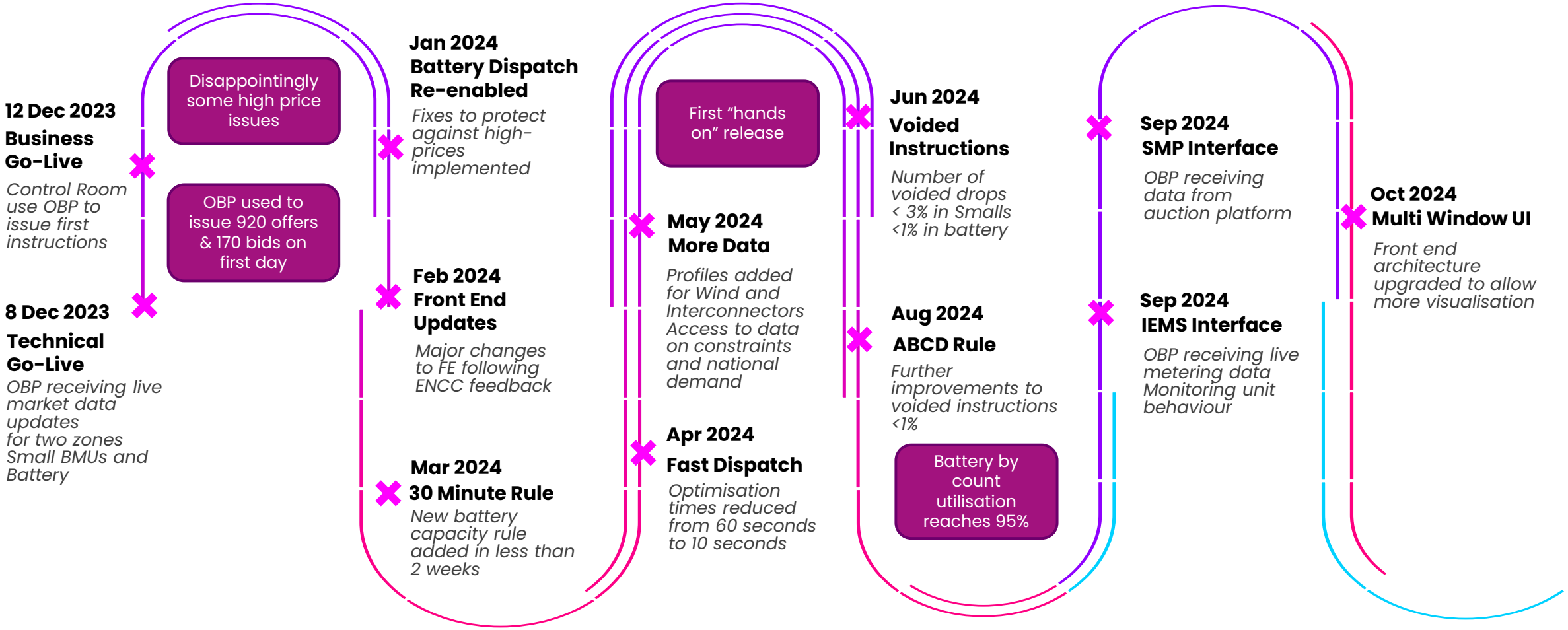
A Year of the Open Balancing Platform (OBP)



SMP: *Single Markets Platform*

IEMS: *Integrated Energy Management System*

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Delivery Since September 2024

Current Systems

- Changes to the Legacy Dispatch Algorithm (LDA) supporting advice for batteries:

Deliverable: Ahead of the introduction of new Grid Code parameters (GC0166) we have made changes to the way LDA creates a Target MW for the battery zone

Benefit: Control engineers do not have to estimate battery zone targets manually but can rely on LDA to do this

What does this mean for you? Better economic dispatch and a reduction in costs overall

New IT system

- Dispatch Efficiency Monitor:

Deliverable: Ability to monitor dispatch efficiency in near real-time

Benefit: Immediate feedback to the control room desks

What does this mean for you? Improvements in economic dispatch

Balancing Systems Release Plan

Legend

- Complete
- Moved to a later date (no. of quarters moved)
- Moved to an earlier date (no. of quarters moved) OR New
- No change

Abbreviations: **DC:** Dynamic Containment **DM:** Dynamic Moderation **DR:** Dynamic Regulation **BOA:** Bid Offer Acceptance **DX:** Dynamic Response **VERGIL:** Versatile Graphical Instruction Logger **NCMS:** Network Control Management System **EDL:** Electronic Dispatch & Logging **EDT:** Electronic Data Transfer **ASDP:** Ancillary Services Dispatch Platform **CLOGS:** Contingency Logging System

Q3 FY 24/25 (Oct 24-Dec 24)

OBP Capabilities:
1. Manual instructions

OBP Enablers:
1. Interface to Data Analytics Platform (DAP)

Non-OBP Capabilities:
1. **ASDP System** – Final release
2. **BM System** – LDA updates
3. **VERGIL** – addition to improve economic dispatch (NEW)
4. **Dispatch Efficiency Monitor** – real-time monitor (NEW)

Q4 FY 24/25 (Jan 25-Mar 25)

OBP Capabilities:
1. Bulk Dispatch Wind BMUs (rule based)
2. Constraint Management
3. Pumped Storage BOAs

OBP Enablers:
1. Interface to Ancillary Settlement for NBM

Q1 FY 25/26 (Apr 25-Jun 25)

OBP Capabilities:
1. Non-BM Instruction Types
2. Non-BM Quick Reserve
3. National Optimiser
4. Optimisation within a Constraint
5. New storage parameters

OBP Enablers:
1. Non-BM APIs
2. PEF Integration
3. OBP becomes Operationally Critical (+1)

Q2 FY 25/26 (Jul 25-Sep 25)

OBP Capabilities:
1. BM & Non-BM Slow Reserve
2. Move MW Dispatch
3. Move Response (DC/DM/DR)

OBP Enablers:
1. Ready to decommission ASDP
2. EDT/EDL mastered from OBP

Q3 FY 25/26 (Oct 25-Dec25)

OBP Capabilities:
1. Constraints Pathfinder
2. Stability Pathfinder
3. Manage Sync/De-sync

Q4 FY25/26 (Jan 26/Mar 26)

Capabilities:
1. Interface to NCMS for constraints
2. Response and Inertia

Retire ASDP, VERGIL & CLOGS

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How we measure Benefit

We have agreed certain "categories of benefit" with Ofgem

Reduced carbon emissions

Improved situational awareness

Using flexible technology

Carbon	
Awareness	
Flex	
Downtime	
I/C	
Inertia	

Score Card

Reduced IT outage downtime

Greater interconnection (IC) leading to reduced costs

Better inertia forecasting

The Instruction Journey

What is it?

- **Manual Instructions:** Instructions for BMUs, in all zones, can be created on OBP
- **Bulk Dispatch Wind:** Wind BMUs do not follow PNs so will be added to OBP with agreed rules
- **Pumped Storage:** These units have additional states that must be managed (Spin Gen, Spin Pump etc)
- **NBM Instruction Types:** These units have open rather than closed instructions

Oct 24-Dec 24
⬇
Jan 25-Mar 25

Jan 25-Mar 25
⬇
Apr 25-Jun 25

What effect will it have?

- Before OBP the creation of instructions is handled by three different systems – now all of this is on OBP
- Increases visualisation, supports the control room in dispatching quickly and it provides new tools to monitor the status of instructions
- The market will see better economic dispatch using a platform that has less downtime
- There is no differentiation between BMUs and non-BMUs as they are managed in one system

Carbon	✓
Awareness	✓
Flex	✓
Downtime	✓
I/C	
Inertia	

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The Settlement & Reporting Journey

What is it?

- **Interface to Data Analytics Platform (DAP):** A new platform providing NESO with an advanced analytic tools to monitor actions taken in the control room
- **Interface to Ancillary Settlement for NBM:** Automated provision of data to allow payment for services (new and existing)
- **Provide Data to the Balancing Mechanism Reporting Agent (BMRA):** Support publication of data to the market including additional items for managing storage etc
- **Interface to Settlement Administration Agent (SAA):** BM payment

Oct 24 - Dec 24

⬇

Jan 25 - Mar 25

⬇

Apr 26 – Jun 26

Apr 26 – Jun 26

What effect will it have?

- Supports the audit of actions taken in both the control room and all processes that support this vital function
- Enhances our current monitoring and feedback
- Allows for faster response to queries from market participants
- Supports publication additional items as required by the market such as the new storage parameters (GC0166)
- Allows faster development of new services through more flexible provision of data for settlement

Carbon	✓
Awareness	✓
Flex	✓
Downtime	
I/C	
Inertia	

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The Constraint Journey

What is it?

- **Constraint Management** – improved visualisation of constraints, manual creation of instructions to manage limits, what-if analysis by observing the effect of planned instructions before sending them
- **National Optimiser** – provides advice for national energy balancing, in longer time scales, while respecting transmission system constraints
- **Optimisation within a Constraint** – builds on Constraint Management to automate this process
- **Interface to NCMS for Constraints** – use look ahead from other online tools

Jan 25 – Mar 25

⬇

Apr 25 – Jun 25

Apr 25 – Jun 25

⬇

Jan 26 – Mar 26

What effect will it have?

- Managing constraints is one of the most important functions for the system operator and so several capabilities will be phased in to support this
- For the market there should be better economic decision making for units behind a constraint
- By interfacing with NCMS (which calculates constraint limits in real-time) more accurate actions can be taken to manage the transmission system
- Overall, this reduces costs for consumers

Carbon	✓
Awareness	✓
Flex	✓
Downtime	
I/C	
Inertia	

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The Reserve Journey

What is it?

- **BM and NBM Quick Reserve (QR) / BM and NBM Slow Reserve (SR)–** control room tools allowing for the introduction of these new market services
- **Manage Sync/De-sync** – moving the on and off times for BMUs to create reserve from four hours ahead to close to real-time
- **Reserve (Up/Down) Margins** – decision support tools that allow what-if analysis for reserve levels from day ahead to four hours
- **Enhanced Interconnector Management** – tools to predict changes to interconnector flows

Jul 25 – Sep 25

⬇

Oct 25 – Dec 25

⬇

Apr 26 – Jun 26

⬇

July 26 – Sep 26

What effect will it have?

- Reserve management is critical to cover periods where there are errors in demand forecasting or when units may have faults
- The business case for QR & SR has been established elsewhere but without OBP to support this it would be difficult to get full benefit
- For the market, these tools allow NESO to publish information so that units can respond to any forecast shortfalls
- For consumers we reduce the cost of procuring reserve

Carbon	✓
Awareness	✓
Flex	✓
Downtime	
I/C	✓
Inertia	

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The Response Journey

What is it?

- **Move Response (DC/DM/DR)** – move the control management of new response services away from current systems and onto OBP
- **Response & Inertia** – the complete end-2-end control room process for response is on OBP: calculating the requirement for different kinds of response, the co-optimisation of services, the call off and monitoring of response. This is integrated with new inertia measurement and forecasting systems.

Jul 25 – Sep 25

Jan 26 - Mar 26

What effect will it have?

- By moving all response services onto OBP there is greater visualisation and monitoring ensuring the correct level of response in being used on the transmission system
- For consumers it will lead to savings
- Supports economic dispatch by streamlining the current control room processes

Carbon	✓
Awareness	✓
Flex	✓
Downtime	
I/C	
Inertia	✓

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The Innovation Journey

What is it?

- **Move MW Dispatch:** Re-platform this Regional Development Programme onto OBP
- **Constraints Pathfinder & Stability Pathfinder:** Procurement of new transmission system assets and schemes to provide transmission system support

July 25 – Sep 25

⬇

Oct 25 – Dec 25

What effect will it have?

- For MW Dispatch moving this service to OBP will allow for future growth
- MW Dispatch is used to manage transmission level constraints using distribution level units and, in the future, can be co-optimised with other services using OBP
- Pathfinders are already delivering value but as the number of contracts increase moving to OBP allows these to be optimised with other services

Carbon	✓
Awareness	✓
Flex	✓
Downtime	
I/C	
Inertia	

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The Digital Enablement Journey

OBP Operationally Critical

What is it?

OBP technology stack will be enhanced to support near continuous availability — **Apr 25-Jun 25**

- Support for geographically distributed but loosely coupled application
- Business services designed for service parallelism
- Observability stack enhanced to support continuous operations

OBP Strategic platform tested for multiple failure and catastrophe scenarios — **Ju 25-Sep 25**

Carbon	
Awareness	
Flex	
Downtime	✓
I/C	
Inertia	

What effect will it have?

- Once OBP becomes operationally critical, control room users and market will have much lower chances of outages due to system failures or while doing upgrade
- Reduced dependency on legacy balancing system and ability to master data directly on OBP and take over operationally critical user journeys

The Digital Enablement Journey

Enabling market data interfaces

What is it?

- **New Storage Parameters:** Enhance IT systems to manage GC0166 — **Apr 25-Jun 25**
- **NBM API:** Provide additional interfaces to NBM units — **Apr 25-Jun 25**
- **EDT/EDL mastered from OBP:** Move this vital service to the highly available OBP — **Jul 25-Sep 25**

What effect will it have?

- Support for larger number of units and larger volume of transactions from the units
- Adaptable to changes with many new services and parameter changes being configurable using business rule engines so speeding up development
- Works in sub-MW
- Implemented using modern tools so giving a larger "pool" of development resources
- Easier system integration supporting end-2-end processes
- All units treated the same – harmonisation of all services

Carbon	
Awareness	✓
Flex	✓
Downtime	✓
I/C	
Inertia	

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Transition Activities – EDL/EDT

1. Getting ready

New EDT/EDL interface on OBP – **same interface spec**

New OBP **Market Participant Test environment**

Software Supplier **Type Testing**

Participant **BPIT Testing**

OBP Testing by **shadowing BM**

Planning ongoing for including MDO/MDB (Max Delivery Offer/Bid) for GC0166 pending conclusion of working group

2. Cutover

Avoid BMU config changes – aim to align with 6-week cycle

Participants allocated to a cutover window

Trading Agent (TA) responsible for updating their system to use OBP (NESO) address, OBP credentials and sftp

NESO responsible for updating BM to stop connecting and OBP to start connecting to **Control Points (CP)**

NESO will manage the reconfiguration internally for **WA API**

3. Transition Complete

Planning ongoing for network routing – seeking to avoid a second transition

Abbreviations:

- **EDL:** Electronic Dispatch & Logging
- **EDT:** Electronic Data Transfer
- **WA API:** Wider Access Application Programming Interface
- **BPIT:** Business Process Integration Testing

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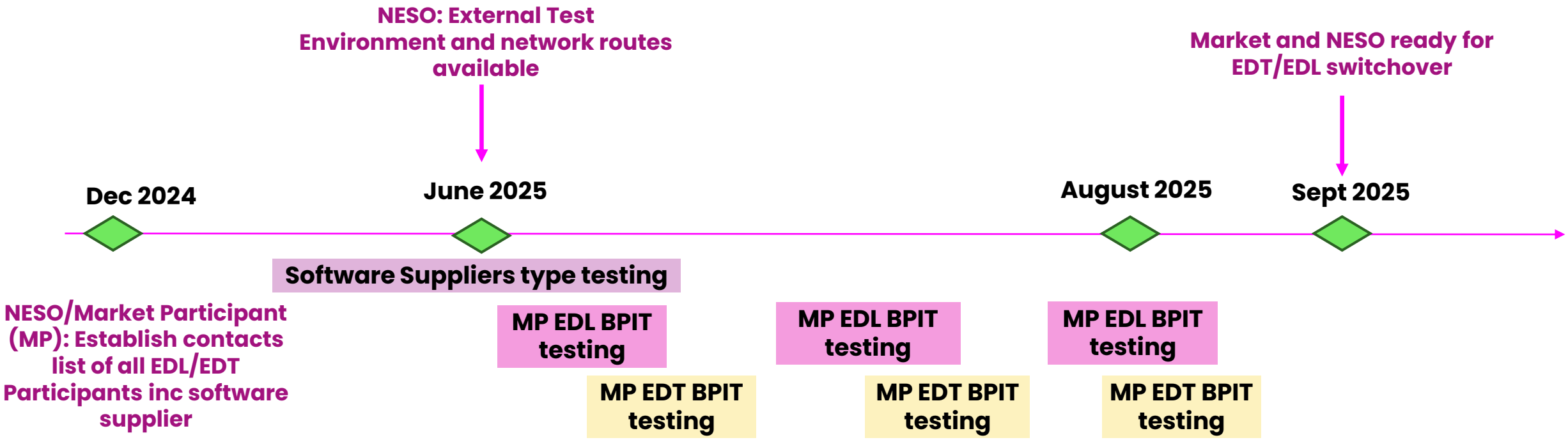
Market Involvement – EDL/EDT Testing



Readiness for CP testing – with MP or Software provider

1. Interlock IP address, CP name, BM unit name to be used in testing, channel for communication (Leased Line, WAAPI, Interconnector)
2. Confirmation from network team around stability of connection
3. Confirmation that it is test environment and any testing will not affect real energy
4. Connectivity test to validate EDL redecs and EDL instructions

Readiness for TA testing – with MP or Software provider

1. Interlock IP address, TA name, BM unit name to be used in testing, File Transfer Protocol (FTP) username and password
2. Confirmation from network team around stability of connection
3. Confirmation that it is test environment and any testing will not affect real energy
4. Connectivity test to validate EDT submissions

Contact details for testing: box.balancingprogramme@nationalenergyso.com

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EDT/EDL Transition Strategy

Refined to Avoid Big-Bang Cutover of Trading Agents (TA) & Control Points (CP)

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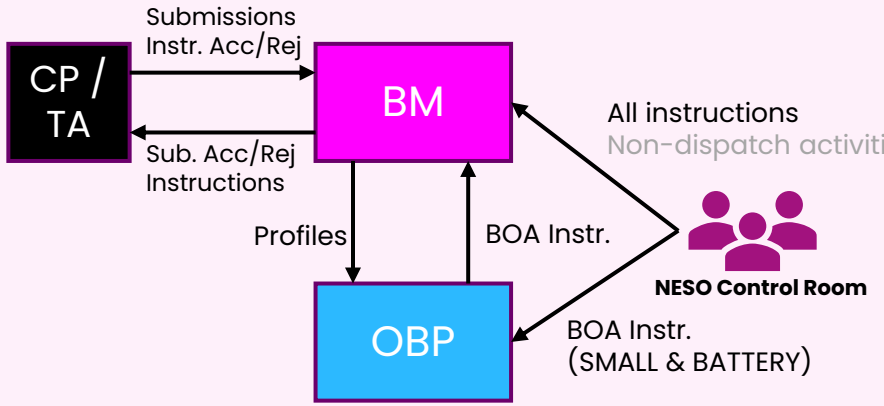
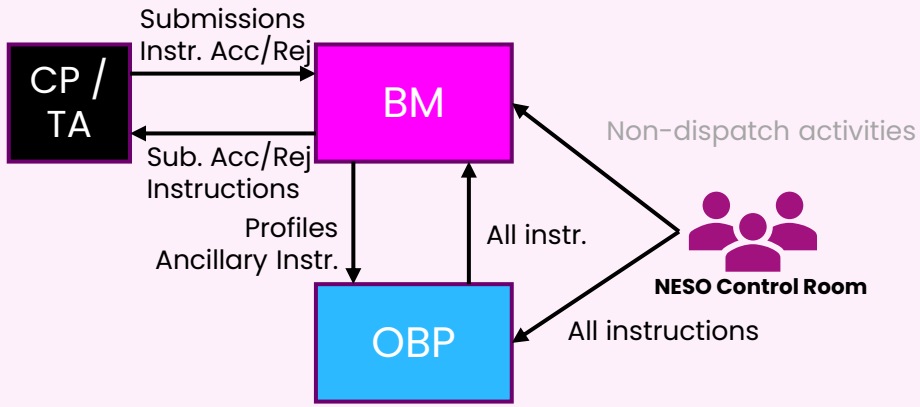
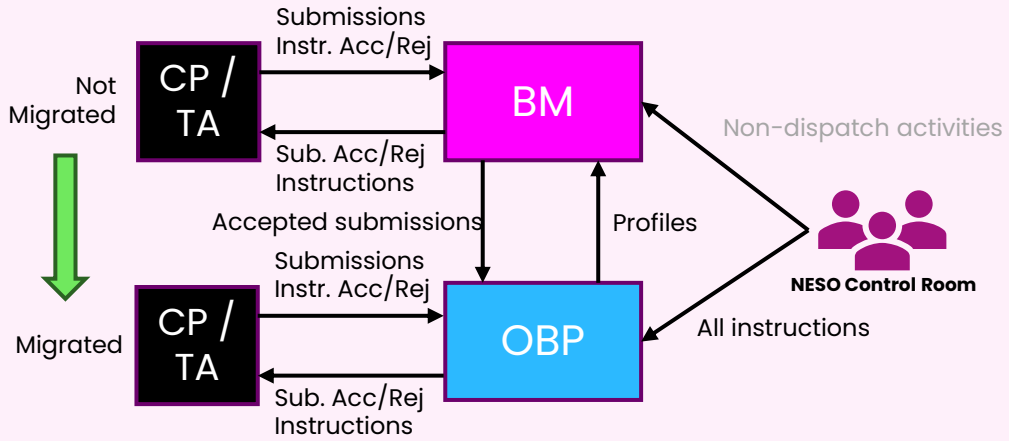
TODAY: BM is master; OBP provides bulk dispatch



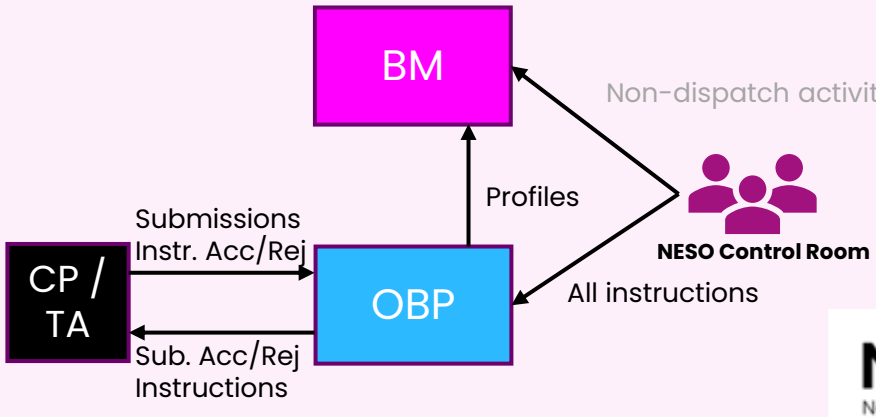
GETTING READY: OBP able to send all instructions via BM



CUT-OVER: OBP takes over profiling, defaulting and reporting; BM validates and forwards submissions until CP/TA migrates



TRANSITION COMPLETE: OBP is master and continues to provide data to BM for non-dispatch activities



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Update to Non – BMU Services

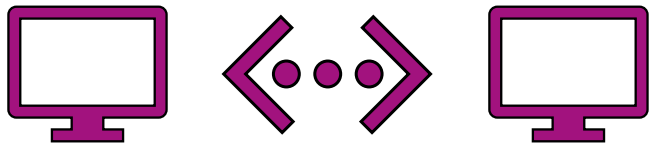
Non-BM services are currently supported on the ASDP system and need to be migrated to OBP

Non-BM STOR and Fast Reserve (FR) will be phased out and replaced with Slow and Quick Reserve

- Short Term Operating Reserve (STOR) and FR will remain on ASDP until they are phased out
- Slow and Quick Reserve will be built on OBP using the ~~current V3~~V4 web services interface
- Dynamic Response and MW Response will be migrated from ASDP to OBP using the ~~current V3~~V4 web services interface

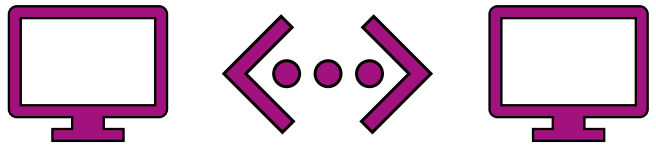
The V4 interface has been required to address NESO rebranding

Alternative interfaces will be explored for 2026 +

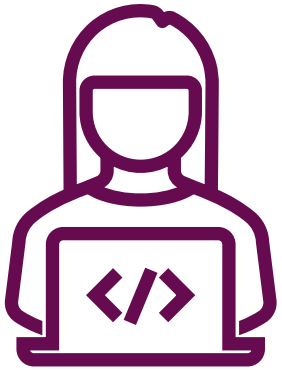


NBM API Updates for new Reserve services

- Informal industry consultation held closed 10 September
    - SOAPv4 as proposed API
    - Operational Metering to iHost
    - Settlement metering direct to Settlement System via API (out of OBP scope)
    - Treatment of crossovers (moving from one window to next)
    - Ramp Rates as potential dynamic parameter
- As part of service registration, MPs will be signed-up for testing that will occur in April 2025



Summary of Changes for Existing ASDP Providers



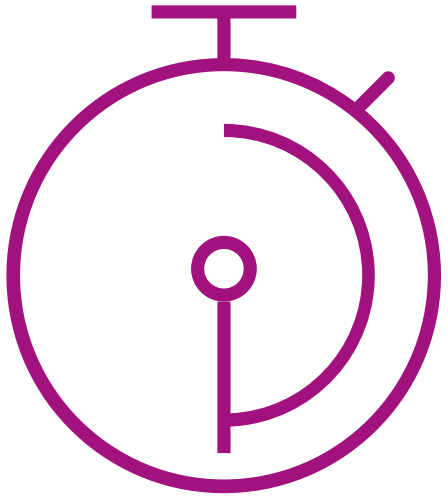
- New URL for rebranding
- Revision of message schema for rebranding
- Operational metering (RTM) through iHost Data Concentrator
- Settlement metering through new interface
- PNs required on all units (not service-specific)
- Multiple starts for same unit with different power levels
- Can be available with non-zero PN - E.g. 50MW unit already generating 10MW can make 40MW available to NESO
- Heartbeat required for all units on all services
  - Every 5 minutes
  - Timeout if two HBs missed
- Scheduled Date Time in dispatch message to be observed - Start ramping up at start time
- (Subject to approval) Battery units to supply import and export capacity - New optional parameters in heartbeat Max Export, Max Import (MWh); aligned with GC0166 (State of Charge)
- Connection to OBP will be via a new Internet Gateway; updated IP address whitelisting required

New Storage Parameters

Grid Code Modification, GC0166

Two aspects to this modification

- Replace the “30 minute” rule with time-varying, one minute resolution, parameters informing NESO of the volume of Offers and Bids available
- Provide for asset specific models that allow what-if analysis outside of the BM Window



Where are we in the process?

- Consultation started on 18 November and lasts 15 days
- Please give your feedback via this process
- The consultation can be found at >> GC0166: Introducing new Balancing Mechanism Parameters for Limited Duration Assets | National Energy System Operator

Forecasting Progress Update

Richard Sykes, Product Manager

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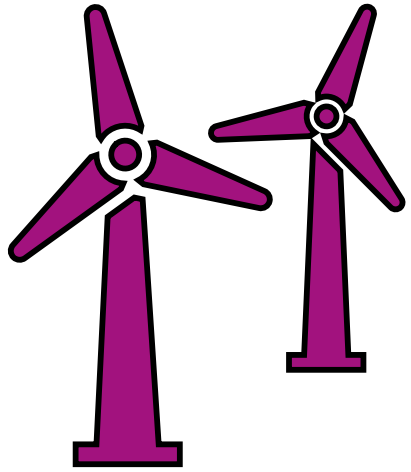
National Energy System Operator

Delivery of a New Wind Model

Achievements since September 2024

- Achieved a successful Business Go-Live of Platform for Energy Forecasting (PEF) feeding the Control room systems
- October's PEF Mean Average Percentage Error (MAPE) *exceeded* the Ofgem 1C benchmark of 5.13%
  - PEF MAPE 4.53%
  - Legacy EFS 4.80%



The benefits with the new model on the strategic platform:

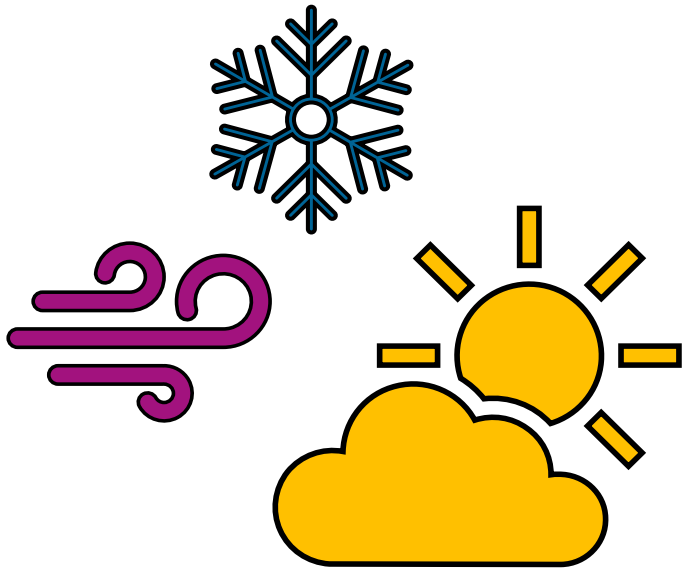
- Use of richer weather forecast (NWP) data.
- 24 frequent forecasts per day (from 8 per day)
- Ensemble forecasting, where a range of equally-likely weather scenarios are used to support risk-based decision making (e.g., constraints, margins, reserve).
- Automated adjustments for *notified* windfarm outages (inc partial reductions).

...Leads to improved 1C Metric performance.

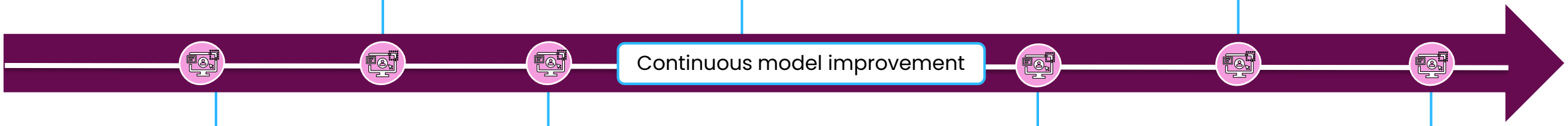
Delivery of a Strategic Platform

Benefits provided by the new platform

- Access to far richer weather forecast data, from 6 industry-leading weather forecast models
- More frequent forecast updates (every hour, up from 8 per day)
- Flexibility to quickly add new wind farm locations
- Ensemble forecasting, where a range of equally-likely weather scenarios are used to support risk-based decision making (e.g., constraints, margins, reserve)



Platform for Energy Forecasting (PEF) Release Plan



Q3 FY 24/25 (Oct 24-Dec 24)

Key Capabilities:
- Visualisations and validation tools for the Energy Forecasting team

Q1 FY 25/26 (Apr 25-Jun 25)

Key Capabilities:
- Reporting and situational awareness tools for the control room

Key Enablers
- Integration with Network Access Planning tools for improved studies

Q3 FY 25/26 (Oct 25-Dec 25)

Key Capabilities:
- Continuous visualisations and validation tool improvements

Q2 FY 24/25 (Jul 24-Sep 24)

Key Capabilities:
- New Strategic Azure Platform deployed
- New Wind Power Generation Model

Key Enablers
- API's to enable OBP integration

Q4 FY 24/25 (Jan 25-Mar 25)

Key Capabilities:
- Migration of Solar and GSP products onto the new platform
- Migration of an enhanced National Demand model onto the new platform.

Key Enablers
- Forecast output changes for Quick and Slow Reserve

Q2 FY 25/26 (Jul 25-Sep 25)

Key Capabilities:
- Continuous reporting and situational awareness tool improvements

Key Enablers
- Forecast grouping to support restoration regional reporting

Q4 FY 25/26 (Jan 26-March 26

Key Capabilities:
- Advanced Analytics data integration

Key Enablers
- EFS system retirement strategy

National Optimisation in OBP

Manos Loukarakis, Optimisation Manager
Nicolas Melchor, Optimisation SME

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Optimisation So Far

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Optimisation Group Timeline & Feedback

June 2023 (online)

- Initial kick-off / group scope
- Bulk Dispatch introduction

November 2023

(Balancing Programme engagement event, Optimisation session)

- Control processes structure
- Bulk Dispatch optimiser (BDO) details

February 2024 (online)

- BDO details (costs)
- Fast Dispatch

June 2024

(Balancing Programme engagement event, Optimisation session)

- Fast Dispatch demo
- Instruction algorithm

November 2024

(Balancing Programme engagement event, Optimisation session)

- National Dispatch
- Intro to GC0166 parameters, group constraints & wind (relative to dispatch)

- Group constraints management (optimised)
- Limited duration asset modelling
- Risk management in control
- More documentation
- More on future challengers/problems
- Comparison with other System Operators (SO)

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Open Balancing Platform Overview

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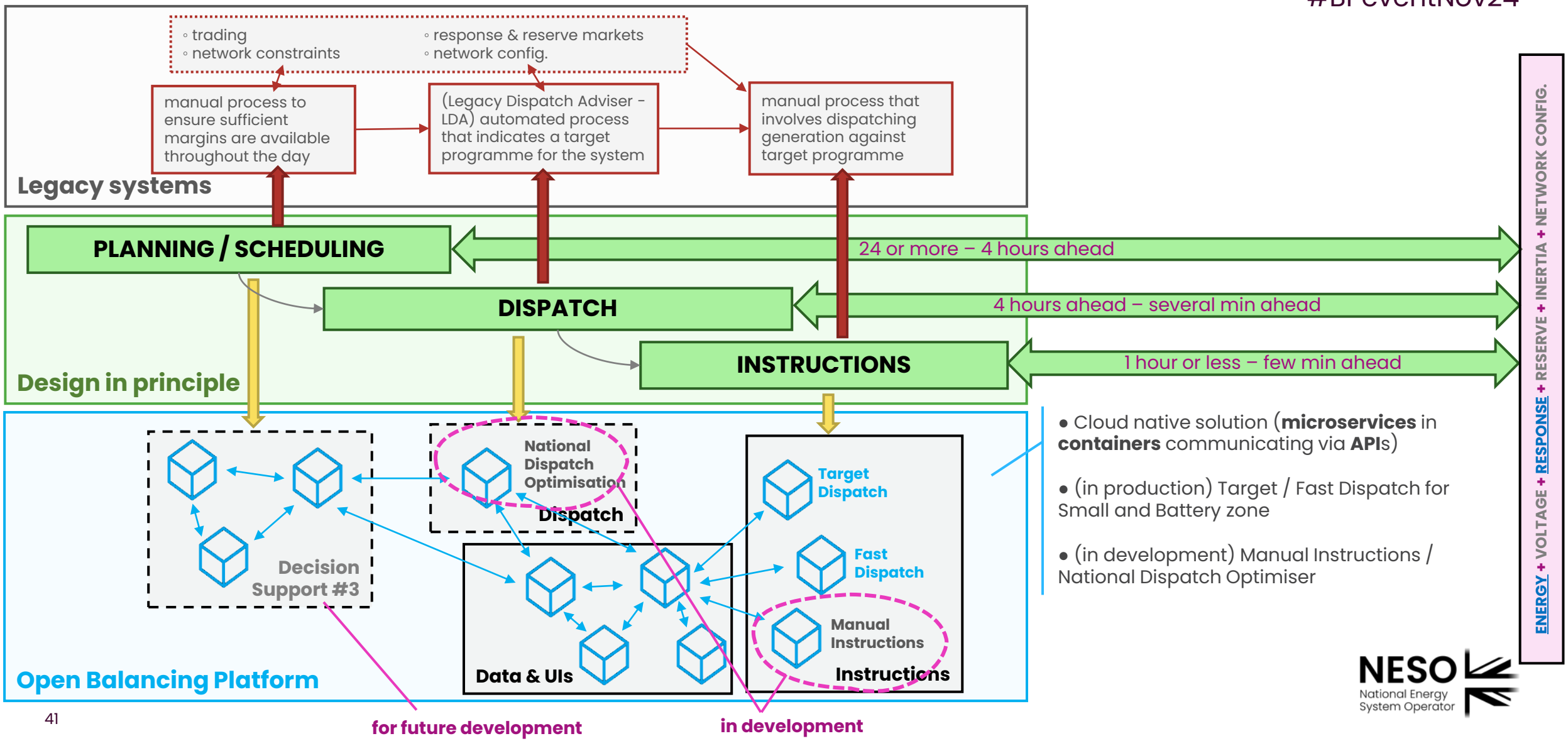

- Cloud native solution (**microservices** in **containers** communicating via **APIs**)
- (in production) Target / Fast Dispatch for Small and Battery zone
- (in development) Manual Instructions / National Dispatch Optimiser

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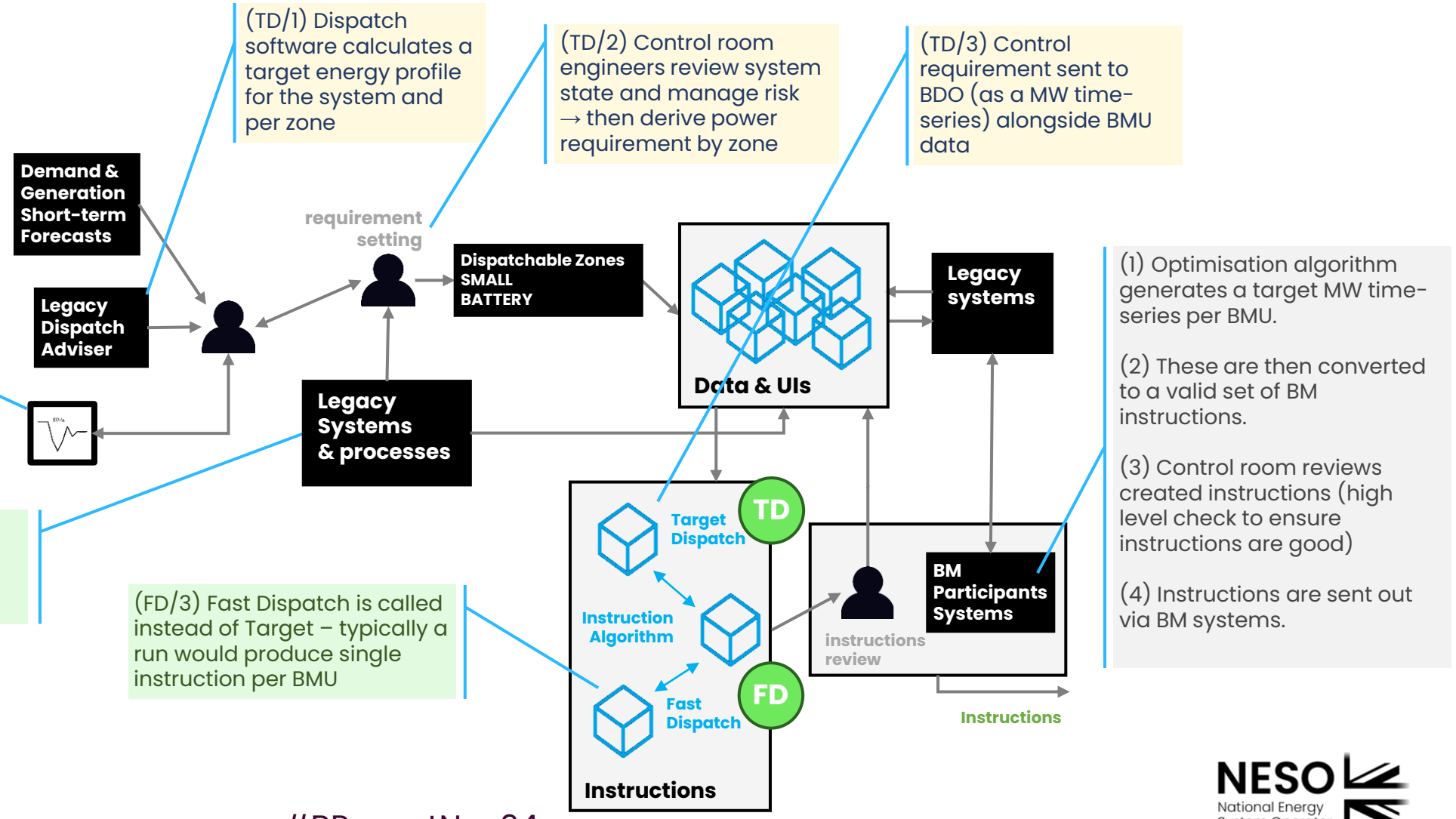
How Things Work (Instructions on OBP)

ZONE – a collection of units (historically geographically related, but more recently not so, e.g. for batteries or small BMUs).

Split into Zones facilitates workload management for control.



Abbreviations:

- **FD:** Fast dispatch
- **TD:** Target dispatch

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National Dispatch Optimisation

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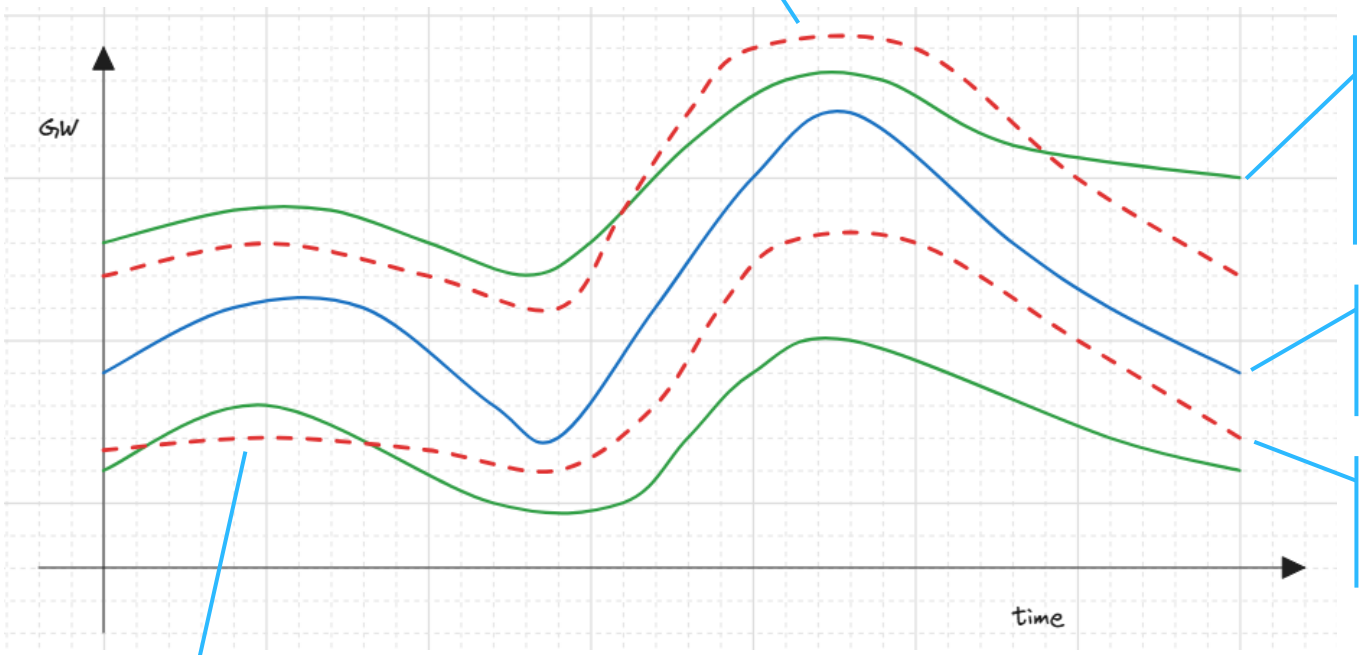
Margins

- Scheduling / planning time-frame is all about determining which long MZT/MNZT units need to be dispatched to ensure sufficient margins.

- At dispatch time-frames there is a System Operating Plan.

- When "national dispatch" runs syncs/desyncs) unit commitment decisions ((for large BMUs with long MZT/MNZT units) have already been made. The same applies to trades over interconnectors.

Abbreviations:
- **MZT:** Minimum Zero Time
- **MNZT:** Minimum Non-Zero Time
- **SEL:** Stable Export Limit



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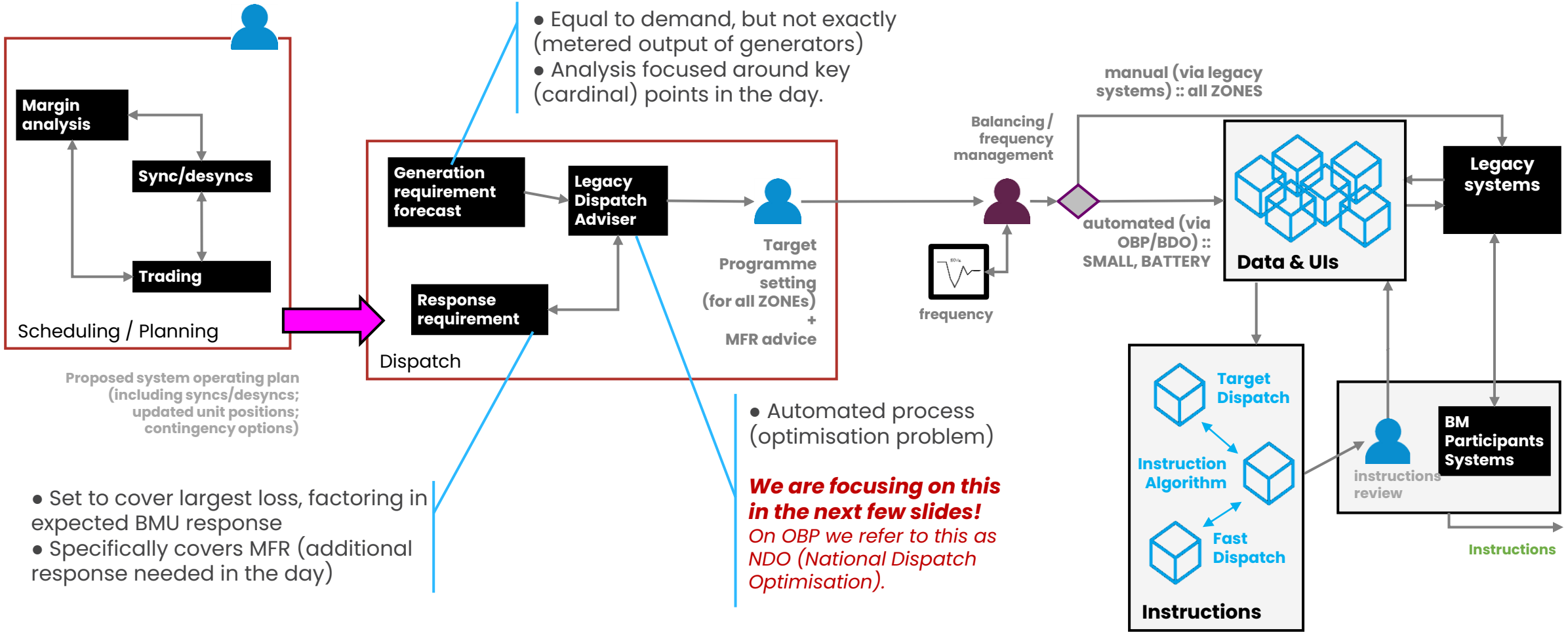
How Things Work (National Dispatch in BM)

Abbreviations:
- **MFR:** Mandatory Frequency Response



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Optimisation-Based Dispatch Processes Compared

	National	Target	Fast
Control process time			
… out of which solve time	<5min	60s	10s
Scope	all units	zone	zone
… look-ahead	4-5 hours	1-1.5 hours	30min
Constraints			
… generation requirement	✓	✓	✓
… response requirement	✓	✗	✗
… ramp rates	✓ (simplified)	✓	✓
… SEL/SIL	✗	✓	✓
… MZT/MNZT	✗	✓	✓
… MFTT	✗	✓	✓
… group constraints	✓	✗	✗
… response capabilities	✓	✗	✗
… response up/down times	✓	✗	✗

Abbreviations:

- **MFTT:** Minimum Flat Top Time
- **MZT:** Minimum Zero Time
- **MNZT:** Minimum Non-Zero Time
- **SEL:** Stable Export Limit
- **SIL:** Stable Import Limit

Commitment decisions are not done in national dispatch – these are manually handled before that point

We will be looking to align how our dispatch processes work over time

These are currently handled via a different logic, but this will likely change in the future

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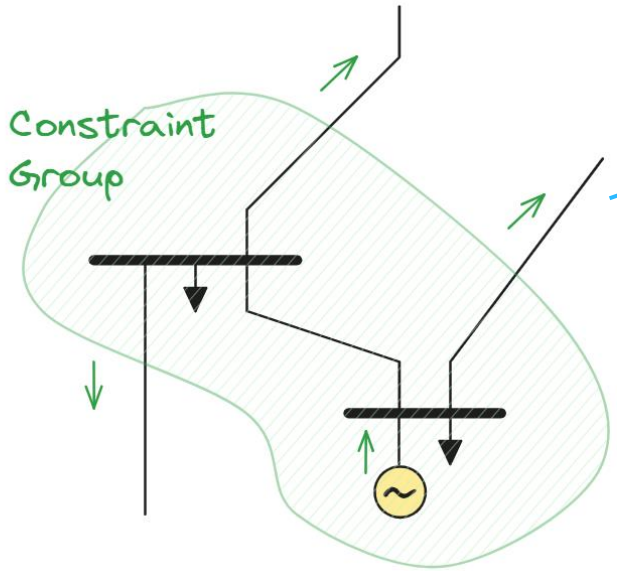
Group Constraints

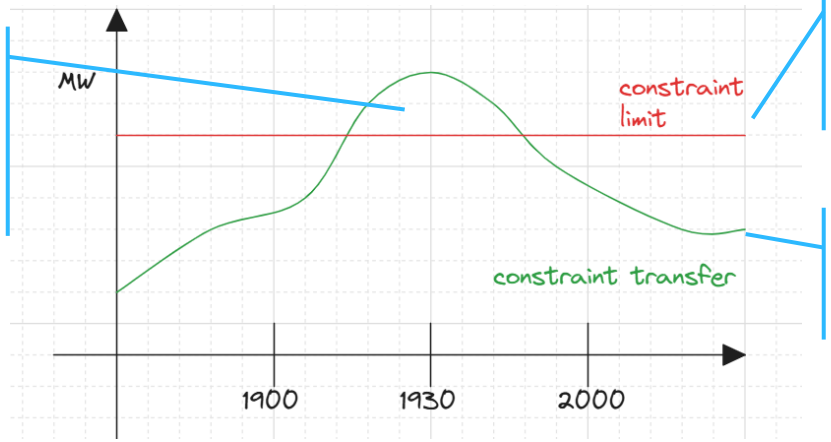


(1) This is a collection of BMUs that affect a part of the network in a similar way.

They may need to be restricted to avoid, e.g.
… thermal overloads (typically under outage)
… instability (again under certain events)

GROUP CONSTRAINTS – note these refer to network limitations, not general mathematical optimisation problem constraints!

(4) This volume will need to be re-dispatched via BOAs – these will be tagged as system actions



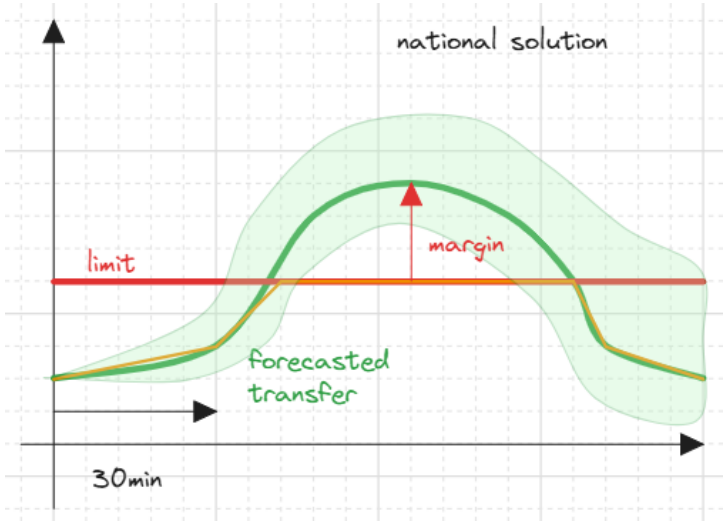
(2) Can vary over time (depends on weather and circuits loading).

(3) This is total BMU expected output minus group demand

A simple set of constraints – note that assumes a uniform contribution from all units in the constraint (to improve in future)

$$groupLimitDown \leq \sum_{BMUinGroup} power - groupDemand \leq groupLimitUp$$

Group Constraints

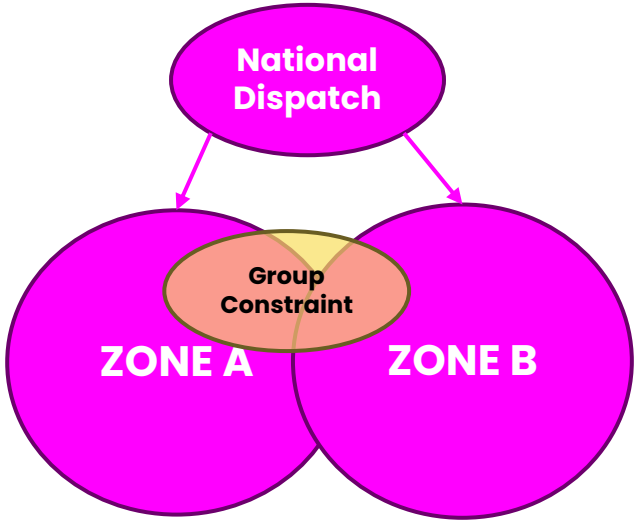


- Group constraints are typically managed ahead of balancing. Control will instruct some units based on dispatch output early on.
- There are two further related problems

.. ensuring that balancing does not break group constraints

.. resolving a constraint closer to real-time

- Coordination across zones :: one way to achieve this is via restricting BMU redispatch volumes at each individual zone *(covered in more detail in the constraints session today)*



- Optimising for a constraint ::

... can simply involve dispatching directly from national dispatch solution

... OR in more urgent situations solving a variant of target/fast dispatch problems in the specific zone

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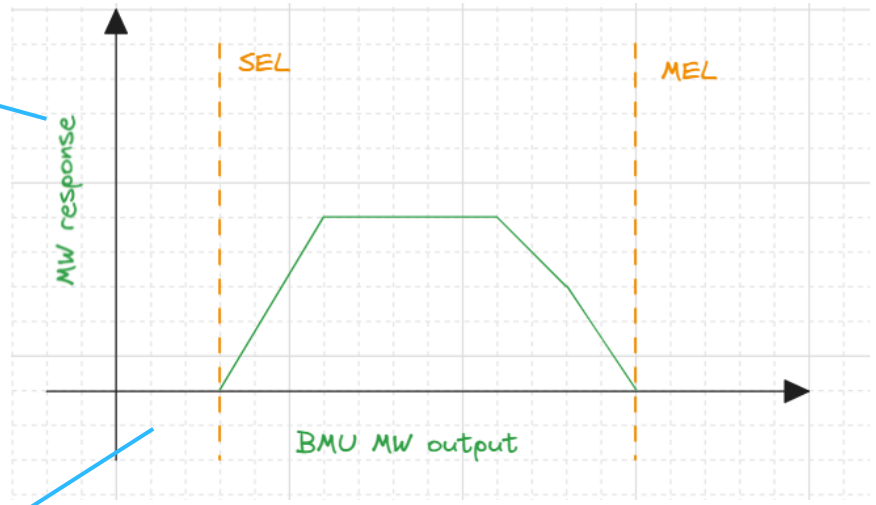
Mandatory Frequency Response (MFR) Constraints

(1) About MFR

- There are 3 different services/products Primary, Secondary, High
- BMUs submit prices and capabilities monthly
- Units are dispatched close to real-time



(2) Capability curves

… defined relative to MEL (at specific de-loading points)
… separate for P,S,H
… different operating modes are possible P+S, or P+S+H
… for a given output level the full response has to be procured for a specific mode

We need to meet response requirement for each service

$$\sum_{allBMUs} response_P \geq requirement_P$$

Response as a function power is not necessarily a convex function

$$response_P = f(outputMW) \;\; if \; mode \; enabled$$

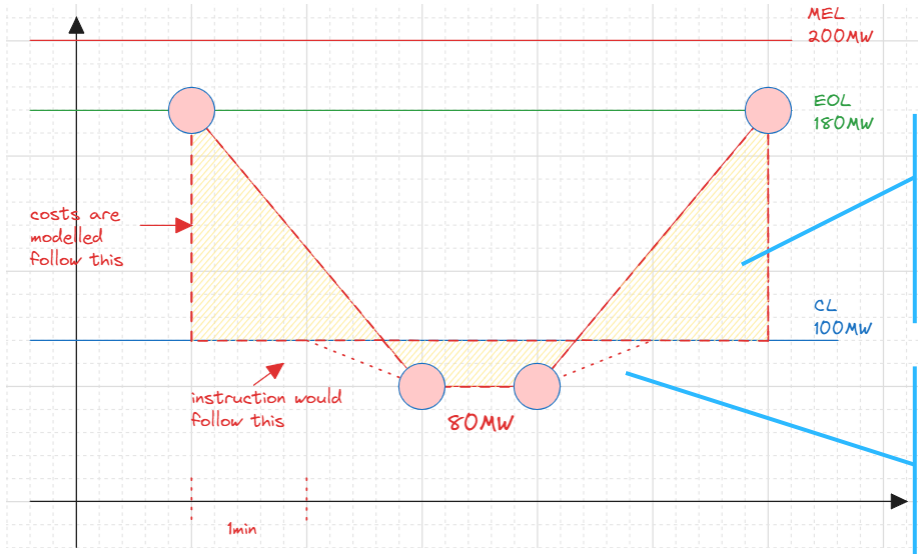
there are additional constraints depending on operating mode

$$response_P = response_H = response_S$$

and there are additional constraints that ensure that if a unit is set on/off response, it has to maintain that for a period of time.

Wind

Involves some general issues that apply to any asset whose CL, differs from its actual operating level



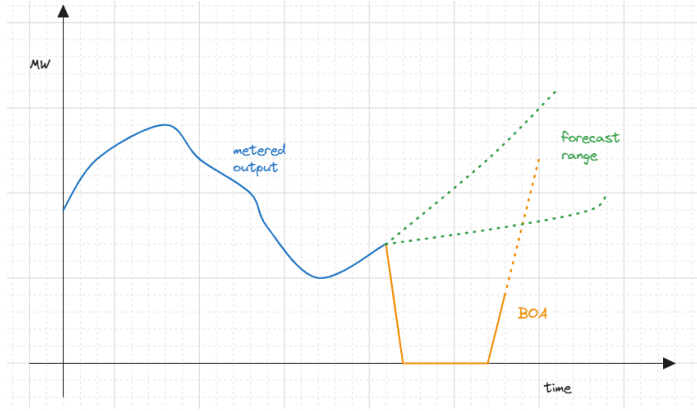
(1) We can cost and solve for this – note that we would apply dynamic parameters from EOL

(2) But the actual instruction and costs would be off CL

Such issues would be less pronounced for smaller forecasting errors

SOME FURTHER DETAILS – please also refer to our earlier wind related content in the June 2023 Balancing Programme event https://www.neso.energy/document/282086/download

MEL for wind indicates available nominal capacity (considering outage of individual turbines) – which is different to what can be delivered, which again may differ significantly from CL.



For many sites there is no accurate forecast of the level at which BMUs will return post instruction. Currently this is resolved manually from control by limiting how many units are returned back to CL at a time.

Abbreviations:

- **CL:** Committed level
- **EOL:** Expected Operating Level
- **MEL:** Maximum Export Limit

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Dispatch & GC-0166

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Limited Duration Assets

Abbreviations:

- **SORT:** System Operation in Real-Time
- **MDO/MDB:** Minimum Delivery Offer/Bid
- **SOE:** State of Energy

Currently in SORT dispatch

… a time-boxed approach applies, allowing batteries to move unconstrained in the BM window, but then are constrained to follow their CCL.

… this aligns with the general principle that NESO should not do scheduling for such assets but rather dispatch closer to merit order in BM

… MFR capability for batteries is not currently modelled so no relevant advice is generated

ON NEW PARAMETERS – please note that these are yet to be confirmed, for more information please see https://www.neso.energy/industry-information/codes/gc/modifications/gc0166-introducing-new-balancing-mechanism-parameters-limited-duration-assets

GC-0166 parameters

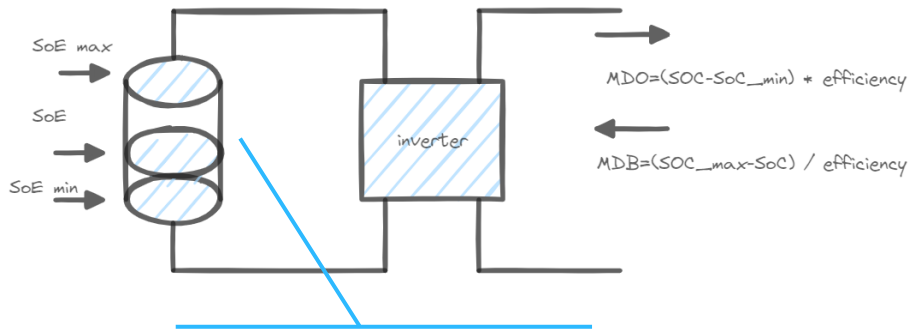
… used for Instructions (maximum delivery volumes)

MDO/MDB :: maximum volume of an Offer or Bid that can be dispatched via BOAs.

… used for Planning (future state of energy parameters subject to a model being agreed) e.g.

SoE limits :: including volumes restricted due to the provision of services

Efficiency :: for charge/discharge



SoE is an internal (to the model) parameter

MDO/B depends on the model to be calculated, but does not presuppose a model to be used

Furthermore, this instantaneous MDO/B is not the one we are looking for in the data above.

Battery Storage Modelling

National Optimiser Problem

Target/Fast Dispatch Problem

+

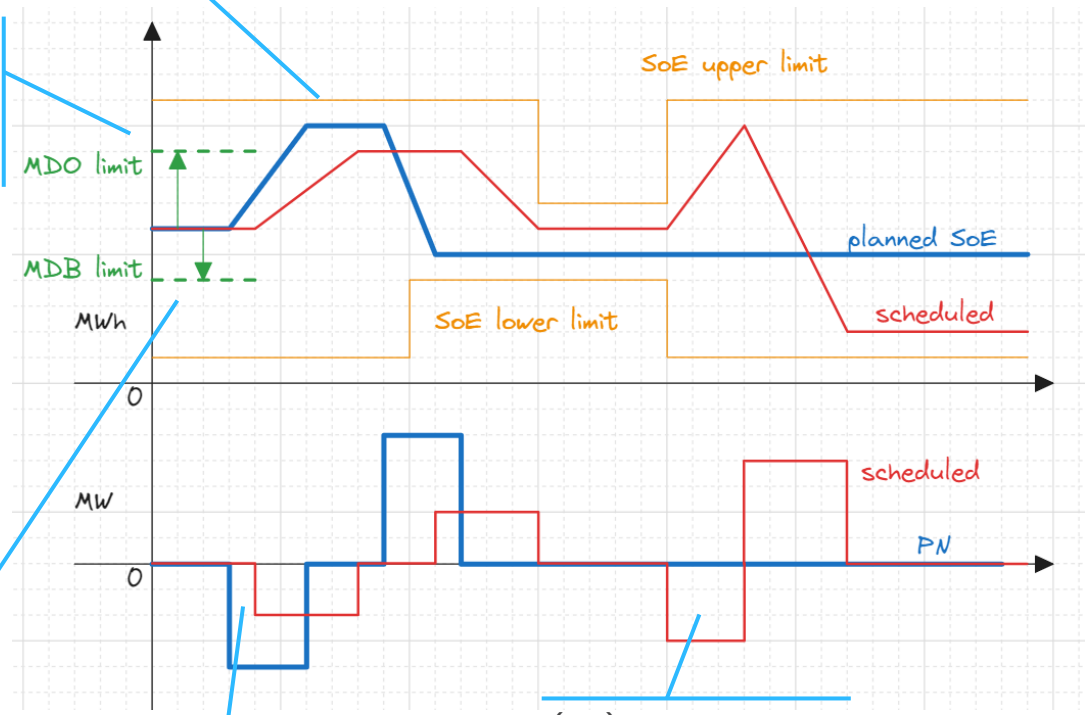
$$SOE_t = SOE_{t-1} + P_t^{IM} \cdot \eta - P_t^{EX}/\eta$$
$$\underline{SOE_t} \leq SOE_t \leq \overline{SOE_t}$$
$$P_t^{EX} - P_t^{IM} = PN_t + BOA_t$$
$$P_t^{EX} \cdot P_t^{IM} = 0$$
$$0 \leq P_t^{EX} \leq \overline{P}$$
$$0 \leq P_t^{IM} \leq \overline{P}$$

$$\sum BOA_t^{+} \leq MDO$$
$$\sum BOA_t^{-} \leq MDB$$

(1) SoE limits (alongside agreed model) indicate region within which the SoE should remain

(2) MDO/B should in principle be tighter bounds than what SoE model would indicate

(3) In principle we could leave SoE unconstrained while MDO/B applies



(5) For very short horizons, a detailed model is not needed

(4a) This would be a BOA

(4b) This does not have to be a BOA, rather an estimate

We are reviewing how formulation should be extended to factor in margin related considerations.

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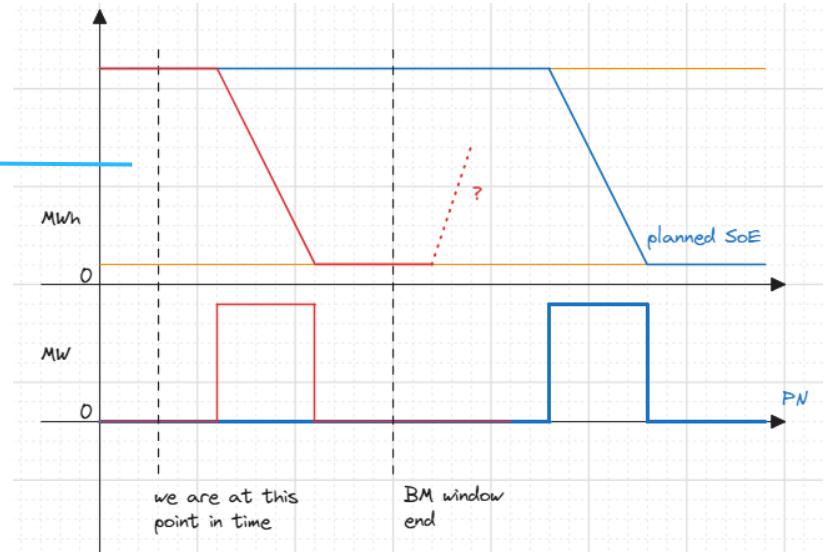
Re-Dispatching Limitations

Abbreviations:

- **PN:** Physical Notification

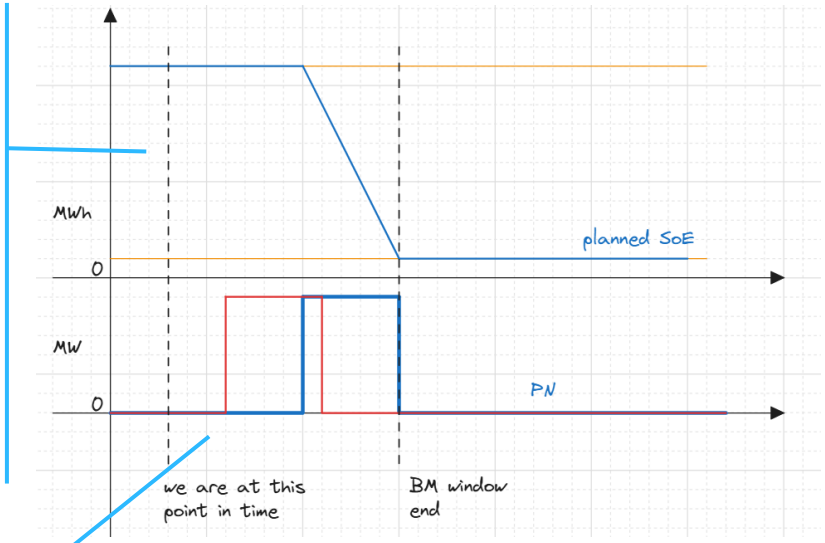
(1) Asset submits MDB=0 (at full capacity)
MDO=95MWh (assuming max SoE of 100MWh)

While if fully dispatched the asset won't be able to meet PN later, presumably there is enough time to address that in other markets.



(2) Asset submits MDB=0 (at full capacity)
MDO=0 (given that it won't be able to meet PN otherwise).

For the last settlement period in BM window MDB could be full asset volume.



We are exploring options to facilitate this in a clearer more efficient manner.

(3) What might be possible outside the BM window, might not be possible within the BM window

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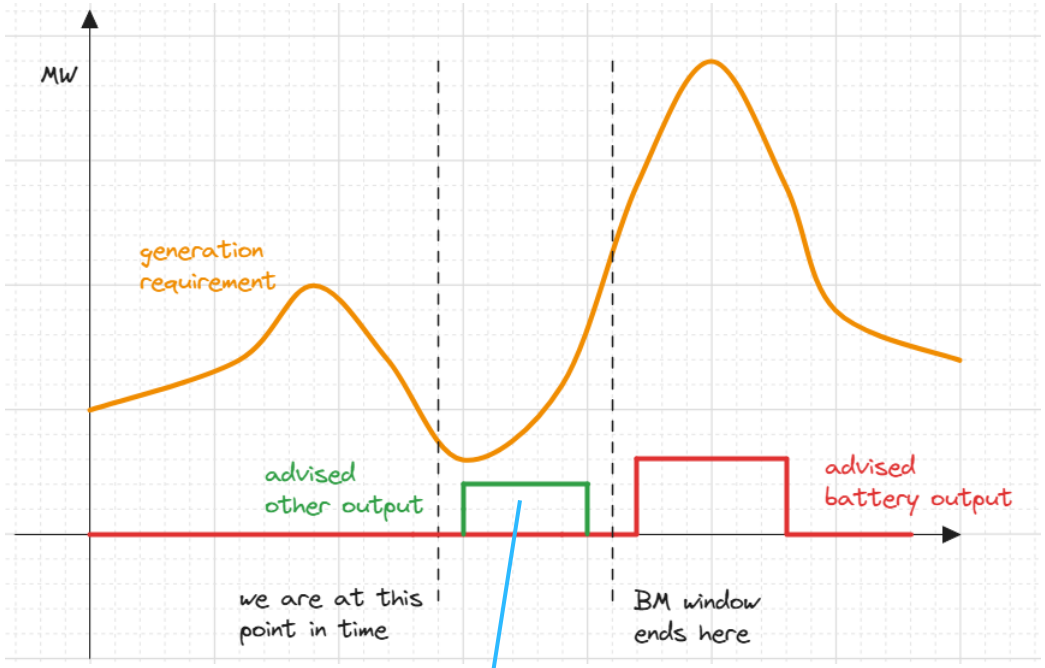
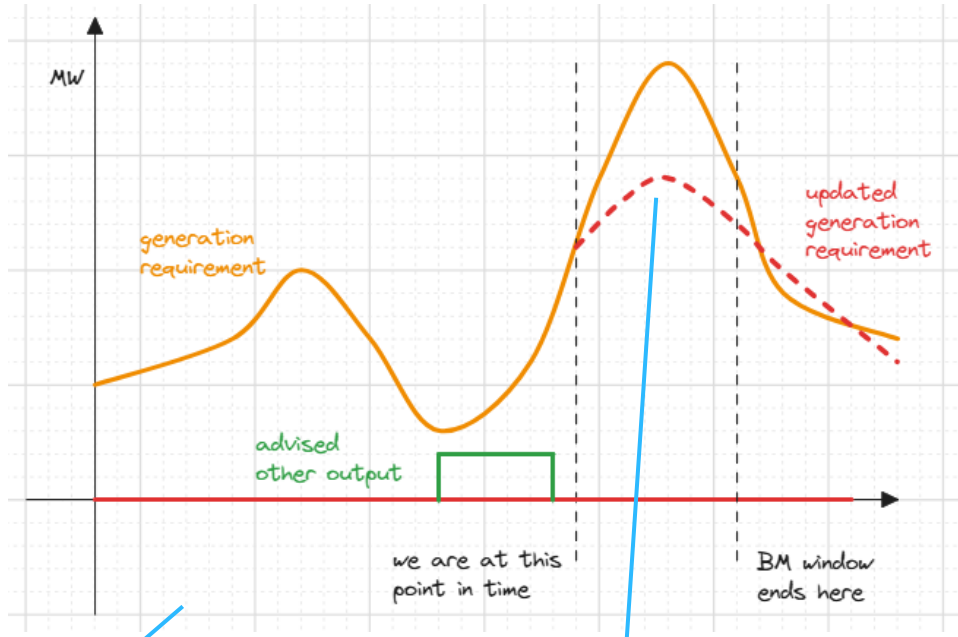
Weighting Problems





(1)
- Some OFFER volume needed here
- Battery may be cheaper but advised use is over peak
- Another BMU dispatched within BM window

(2)
- Demand less than expected, so battery no longer required and not dispatched

We acknowledge that any deterministic modelling about future storage plans can be highly inaccurate given current market structure, and…
- are considering how to weight shorter vs longer-term costs
- further testing to follow post national dispatch initial implementation
- reserve products are part of the solution

Thank you

Any questions?

Constraint Management & OBP Demo

Shaunie-Louise Thomas, Product Manager
Chi-Ho Lam, Lead Product Manager
Usman Bagudu, Product Owner

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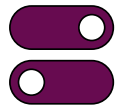
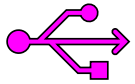
National Energy System Operator

Balancing Programme Approach

The Balancing Programme intends to tackle the problem of constraints in phases:



Constraint Management - Q4 FY 24/25 - moving the process from BM systems to OBP, whilst improving it.



National Optimisation - Q1 FY 25/26 - which includes constraints advice in OBP.

Optimisation within a Constraint – Q1 FY 25/26 – using an optimiser to move units inside a constraint.

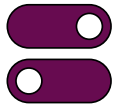
Pathfinder - Q3 FY 25/26 - support for implementing the pathfinder solutions.

Interface to new real-time transmission analysis systems (Network Control Management System - NCMS) – Q4 FY25/26 - OBP to ingest live updates from "look ahead" facilities from online analysis tools.

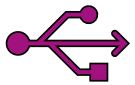
Innovation projects - For example "Forecasting the Risk of Congestion" - Forecasting the Risk of Congestion | ENA Innovation Portal (energynetworks.org).

Balancing Programme Approach

The Balancing Programme intends to tackle the problem of constraints in phases:



Constraint Management – Enabling units within a group constraint (nested & complementary) to be utilised in energy balancing, without breaching any group constraint limits and providing the functionality for the Control Room to take manual actions. This session will provide more information on our near-term solution



National Optimisation – Creation of target programs for each BMU taking into account group constraints, MFR constraints, ramp rates etc. More information will be presented in the National Optimisation breakout with Manos.

Optimisation within a Constraint – Proposal of an optimised movement of units within a group constraint based on a requirement specified by the Control Room.

Constraint Management

How are we going to enable constrained units to be utilised for energy balancing?

What Happens Now?

NESO has obligations to ensure the safe & secure supply of energy across GB.

Since release 1, the Open Balancing Platform (OBP) has been reliant on a manual process for managing group constraints.

We are moving towards more pre-processing to utilise constrained units.

BM System

- Control Room manually 'System tag' group constraints/units
- BM sends the System tag to OBP

OBP

- Cross-reference the BMU with the constraint data
- Exclude from energy optimisation based on the direction of associated group constraint

The evolution of group constraints becoming more dynamic in recent years has resulted in NESO's need to adjust its current practices

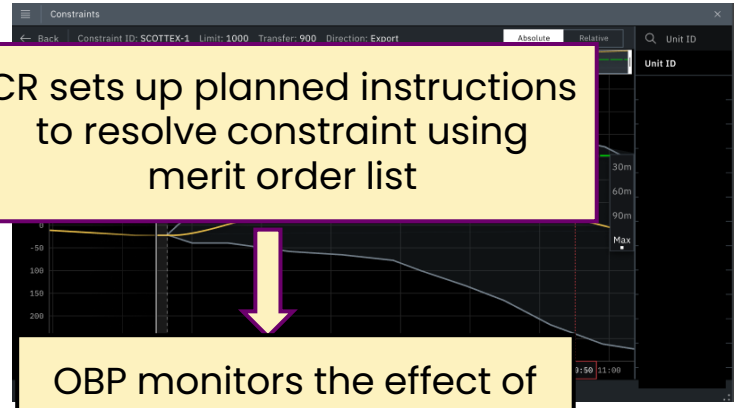
An Indicative Example

Constraint Journey

Constraints to be monitored are sent to OBP (via SPICE/SORT)

Using OBP, the CR identifies active constraints

CR sets up planned instructions to resolve constraint using merit order list



OBP monitors the effect of these planned instructions

If another constraint is violated by the plan warning is given

OBP calculates available capacity for energy balancing

Control room sends instructions to solve constraints

Energy Journey

For a given zone CR decides MW requirement

BDO solves taking into account constraints

CR sends instructions to solve energy

Control Point

Abbreviations: CR – Control Room, **BDO** – Bulk Dispatch Optimiser **SORT:** System Operation in Real Time **SPICE:** Scheduling Process In A Controlled Environment

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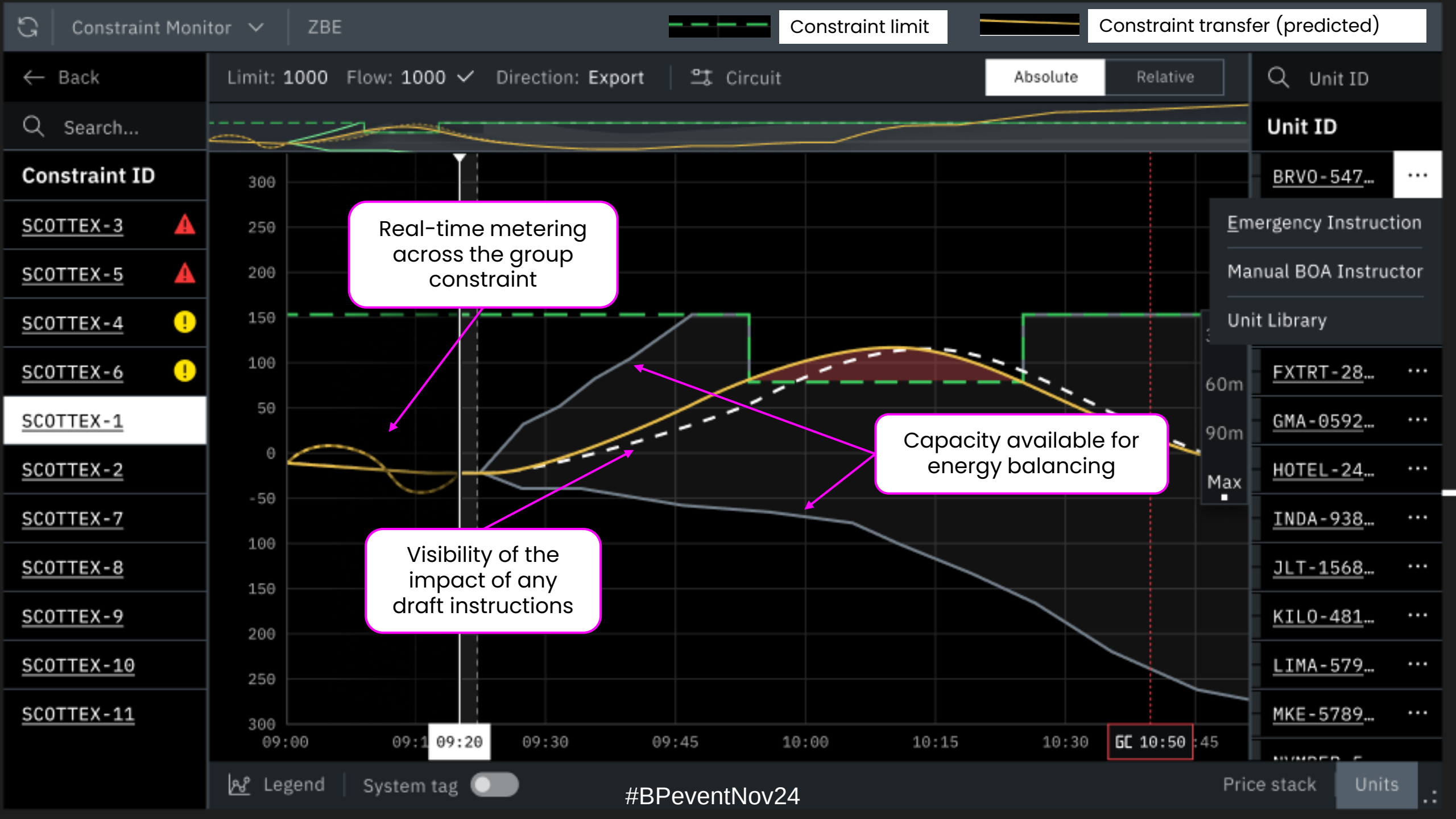

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Capacity Available for Energy Balancing

Enhanced process with decision support tools with the purpose of ensuring that units within a constraint can still be utilised for energy balancing without breaching any of the group constraint limits

OBP will no longer rely on manual System tagging in BM

1. Work out when the predicted transfer breaches the limit and exclude the energy optimiser from utilising those units (in the same direction as the constraint)

2. Work out when the max./min. transfer breaches the limit and exclude the energy optimiser from utilising the most expensive units, until the maximum transfer is within the limit

Resolution of breached constraints is continued through manual BOAs via OBP

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OBP Demo

Multi-User Interface & Fast Dispatch

*** Will be shared after the event ***

Thank you

Any questions?

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A Day in the Life of a Control Room Engineer

Alex Carter, Control Room Operational Manager
Colin Webb, Operational Manager
Ronan Jamieson, Operational Manager

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Managing the System

Network Access Planning (NAP) Team

Carryout network analysis using the offline transmission analysis tool (OLTA) in a time frame from 8+ year ahead to 24 hour ahead – produce outage plan.

Trading Team

Energy Market, sufficient margins

Energy Forecasting Team

National Demand
Solar, wind, GSP demand

Systems:
- Energy Forecasting System (EFS)
- Platform for Energy Forecasting (PEF)

Handover of outage notes

Handover of Transmission System Operating Plan (TSOP)

Strategy Team

Plan for security of the system based on Security & Quality of Supply Standard (SQSS), from 24 hours to 4 hours ahead of time.

Scheduling, System Operating Plan, Margin Analysis, Data Processing and Profiling

System: Scheduling Platform in Controlled Environment (SPICE)

Handover of System Operating Plan (SOP)

Real Time Operation

Transmission Team

- Monitoring & managing System flows, outages, faults, and voltages following SQSS to ensure Security of the System.

Energy Team

- Monitoring & managing System Frequency following SQSS, and Transmission Constraints.
- Demand Prediction, Dispatch Advice, Energy Balancing i.e., Issuing Instructions (BM & Non-BM), Ancillary Service Management.

Systems:
- System Operation in Real-Time (SORT)
- Versatile Graphical Instruction Logger (VERGIL)
- Contingency Logging System (CLOGS)
- Open Balancing Platform (OBP)
- Ancillary Services Dispatch Platform (ASDP)

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Control Room Teams

Power System Manager (PSM)

Strategy Team

- Operational Strategy Manager (OSM)
- Control Technical Assistant (CTA)
- Assistant National Scheduling Engineer (aNSE)
- National Scheduling Engineer (NSE)
- Transmission Analysis Engineer-Scotland (TAEs)
- Transmission Analysis Engineer-E&W (TAEe&w)
- Day Ahead Congestion Forecasting Engineer (DACF)

Energy Team

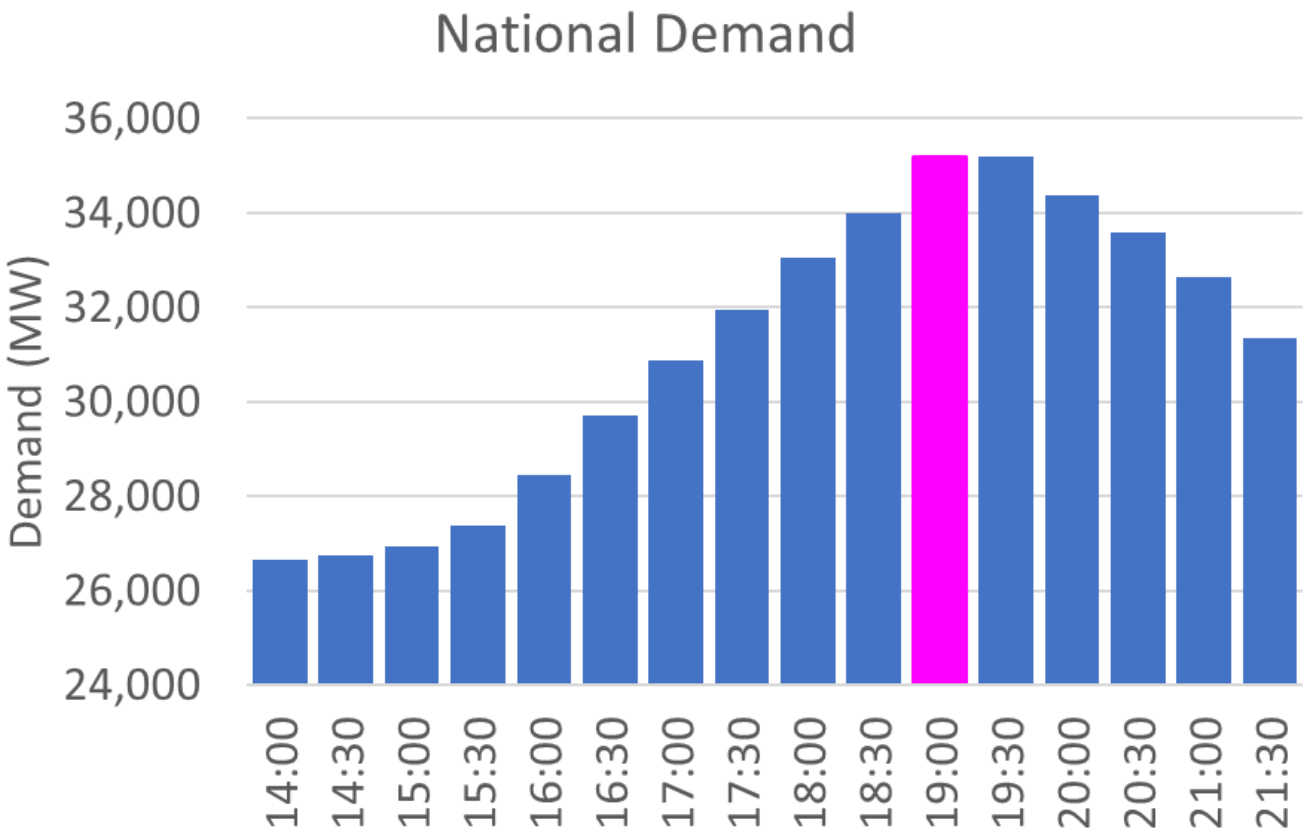
- Operational Energy Manager (OEM)
- National Balancing Engineer (NBE)
- Assistant National Balancing Engineer South (aNBE)
- Assistant National Balancing Engineer North (aNBE)
- Assistant National Balancing Engineer – Battery (additional post added)

Transmission Team

- Transmission Security Manager (TSM)
- Transmission Security Engineer-Scotland North(TSESc-n)
- Transmission Security Engineer-Scotland South(TSESc-s)
- Assistant Transmission Security Engineer – E&W North (aTSEe&wn)
- Transmission Security Engineer- E&W North(TSEe&wn)
- Transmission Security Engineer- E&W South(TSEe&ws)
- Assistant Transmission Security Engineer – E&W South (aTSEe&ws)

Managing the 30-Minute Peak Period

From the perspective of the Energy Team



Evening Peak (19:00 – 19:30)
Thursday 03/10/24

Normal Autumn Evening peak

3.8 GW wind

5.8 GW interconnector import

Demand rising from 26.6GW to 35.1GW

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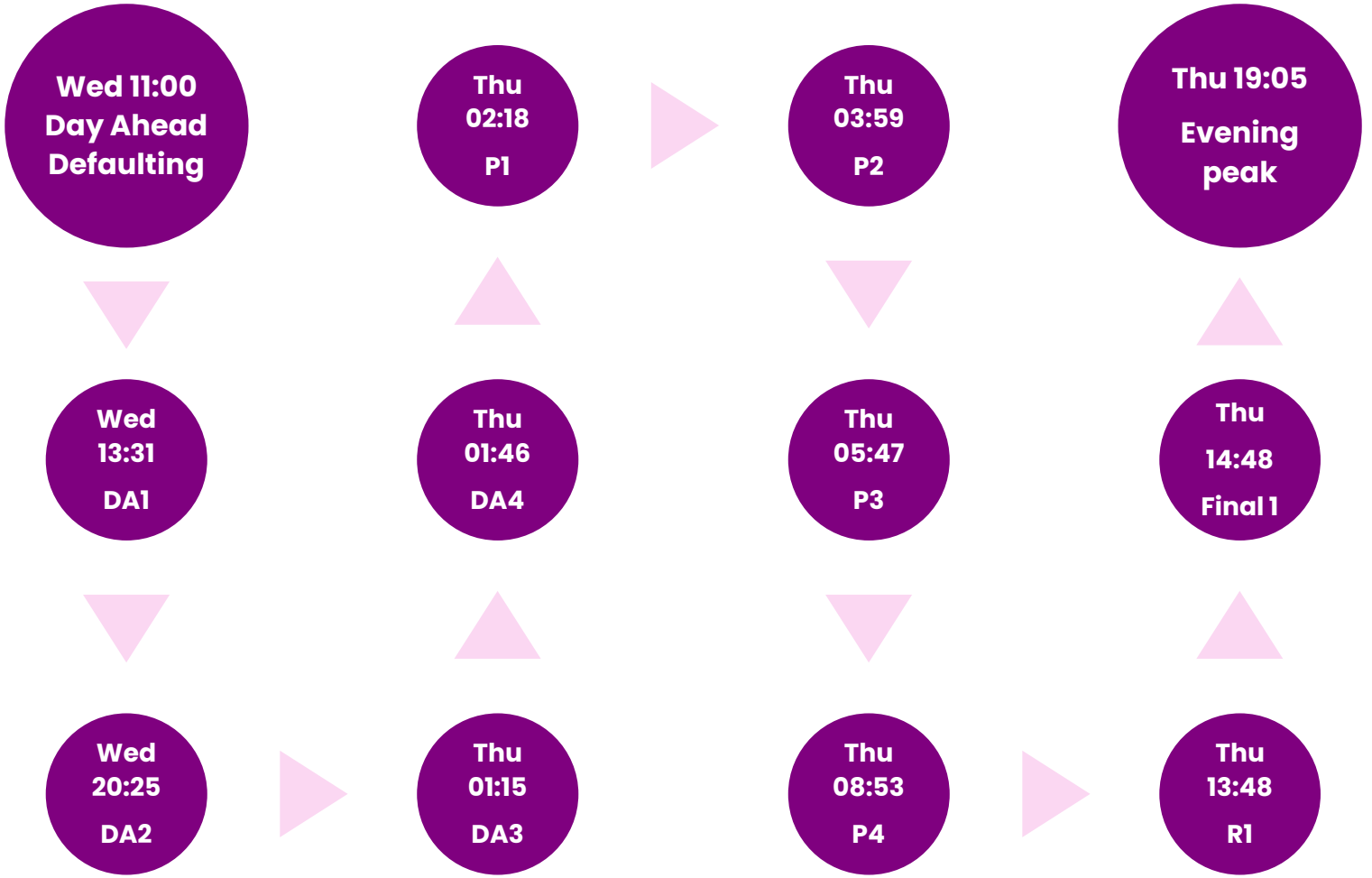
System Operating Plans



System Operating Plan (SOP) details the cost-effective actions needed to deliver a secure solution

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System Operating Plans

Revised 1 Plan @ 13:48

- 3.9 GW wind
- 5.8 GW interconnector import
- 0.7 GW batteries (PN)
- 0.6 GW Small BMUs (PN)
- 1.3 GW constraint pullback

NESO Actions

- +0.4 GW batteries
- +0.2 GW Small BMUs
- Coryton South (CCGT) order at 14:25 (0.7 GW)
- Connah's Quay 3 (CCGT) order at 14:30 (0.3 GW)

Final 1 Plan @ 14:48

- 3.8 GW wind
- 5.8 GW interconnector import
- 0.7 GW batteries (PN)
- 0.6 GW Small BMUs (PN)
- 1.3 GW constraint pullback

NESO Actions

- +0.4 GW batteries
- +0.2 GW Small BMUs
- Coryton South ordered at 14:25 (0.7 GW)
- GSMA03 (CCGT) ordered at 14:30 (0.06 GW)
- Cruachan 1 & 2 (Pumped Storage) order at 19:00 & 17:23 (0.24 GW)

Abbreviation: CCGT: Combined Cycle Gas Turbine

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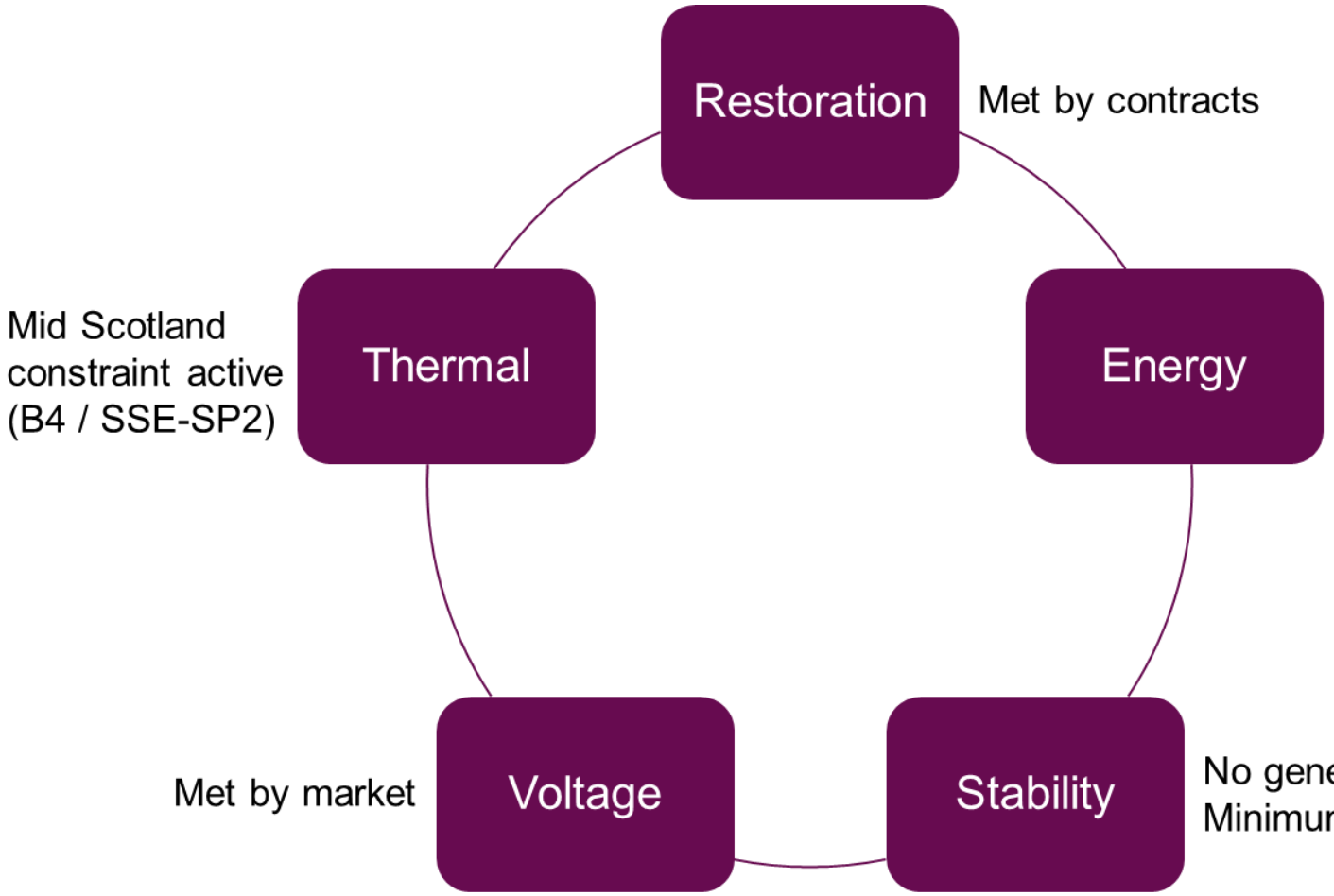
System Security

Evening Peak Thursday 03/10/24

Abbreviations:
STOR: Short Term Operating Reserve
DC: Dynamic Containment
DM: Dynamic Moderation
DR: Dynamic Regulation



Reserve
Need 750 MW positive,
Balancing Reserve = 345MW, additional needed
2300 MW negative met by market
STOR requirement met by contracts
Response –
DC/DM/DR contracted, small additional needed

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Evening Peak Thursday 03/10/24

Abbreviations:
MEL: Maximum Export Limit
SEL: Stable Export Limit

14:00 Start of Shift

Some demand uncertainty and wind expected to be near forecast

Risk of losing MW on the interconnectors based on market forecasts

- Coryton South ordered at 14:25 to run from 15:25 to 21:25 at £145/MWh
  (COSO-1, CCGT, MEL 738MW, SEL 440MW)
- Connah's Quay 3 planned to be ordered at 14:30 to run from 15:55 to 21:55 at £144/MWh,
  (CNQPS-3, CCGT, MEL 332MW , SEL 230MW)
- Alternatives: ~2000MW at prices up to ~£230/MWh

- Connah's Quay 3 not ordered in favour of shorter notice units and GSMA03
- GSMA03 ordered at 14:30 to run from 15:50 to 21:50 at £134/MWh
  (Smartest Energy, small CCGT, MEL 60MW, SEL 38MW)
- GSMA03 had an issue and the sync was delayed to 16:20

Evening Peak Thursday 03/10/24

15:00 Journey to the peak continuously evolving through time

15:00

380MW loss on the interconnectors 16:00-17:00

16:00

100MW gain on the interconnectors 17:00-18:00, 240MW gain 18:00-19:00

17:00

650MW loss on the interconnectors 18:00-19:00

17:30

Wind starting to be bid down for SSE-SP2 constraint

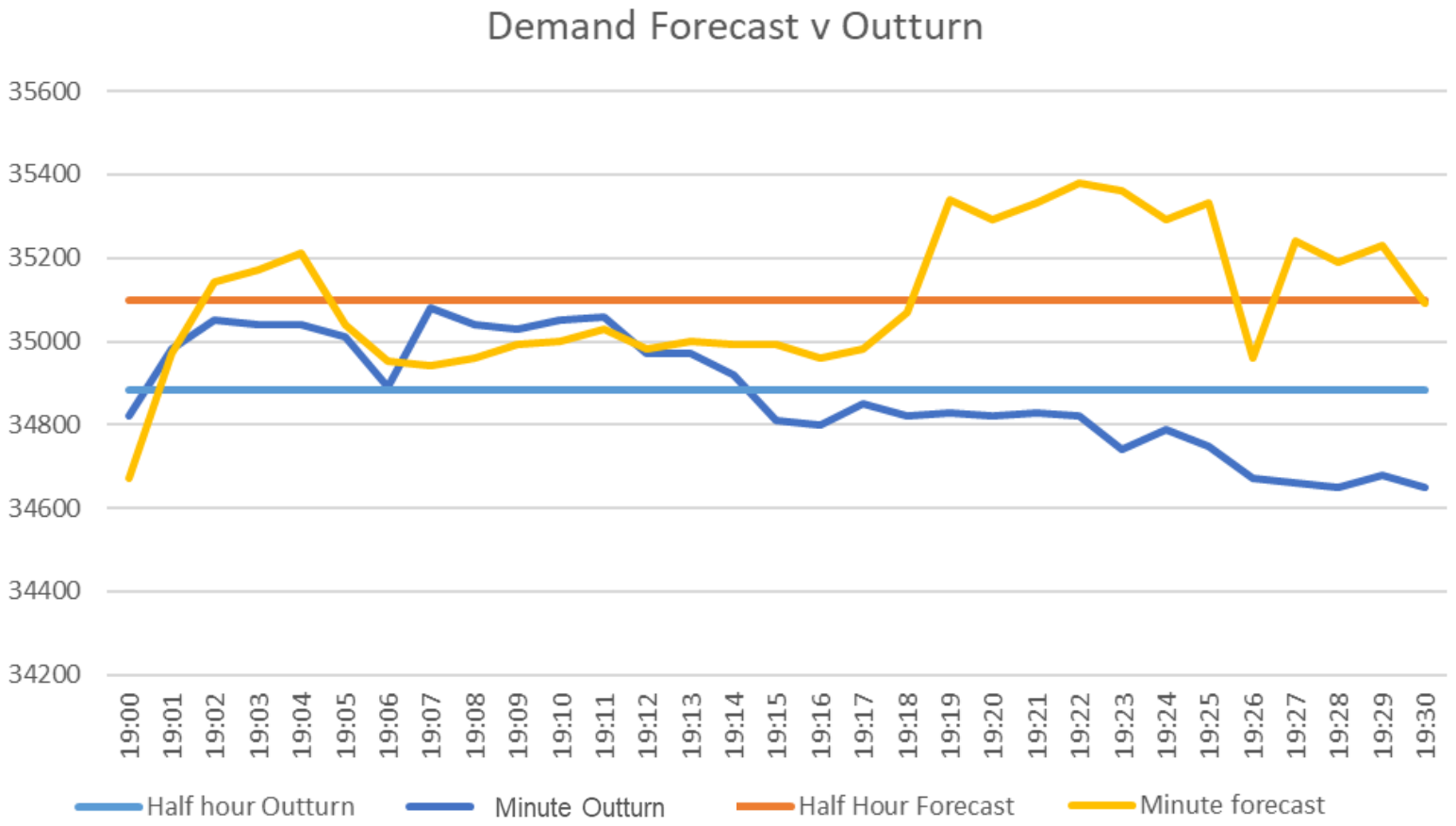
18:00

675MW loss on the interconnectors 19:00-20:00

Evening Peak Thursday 03/10/24

19:07 At the peak

- At 19:07, Peak out turned at 34.8GW, 300MW below the forecast
- Wind was 300MW higher than forecast
- Interconnectors were 675MW lower than forecast
- Generation shortfall 125MW
- **Net difference i.e., residual balancing – 200 MW**



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Evening Peak Thursday 03/10/24

19:07 At the peak

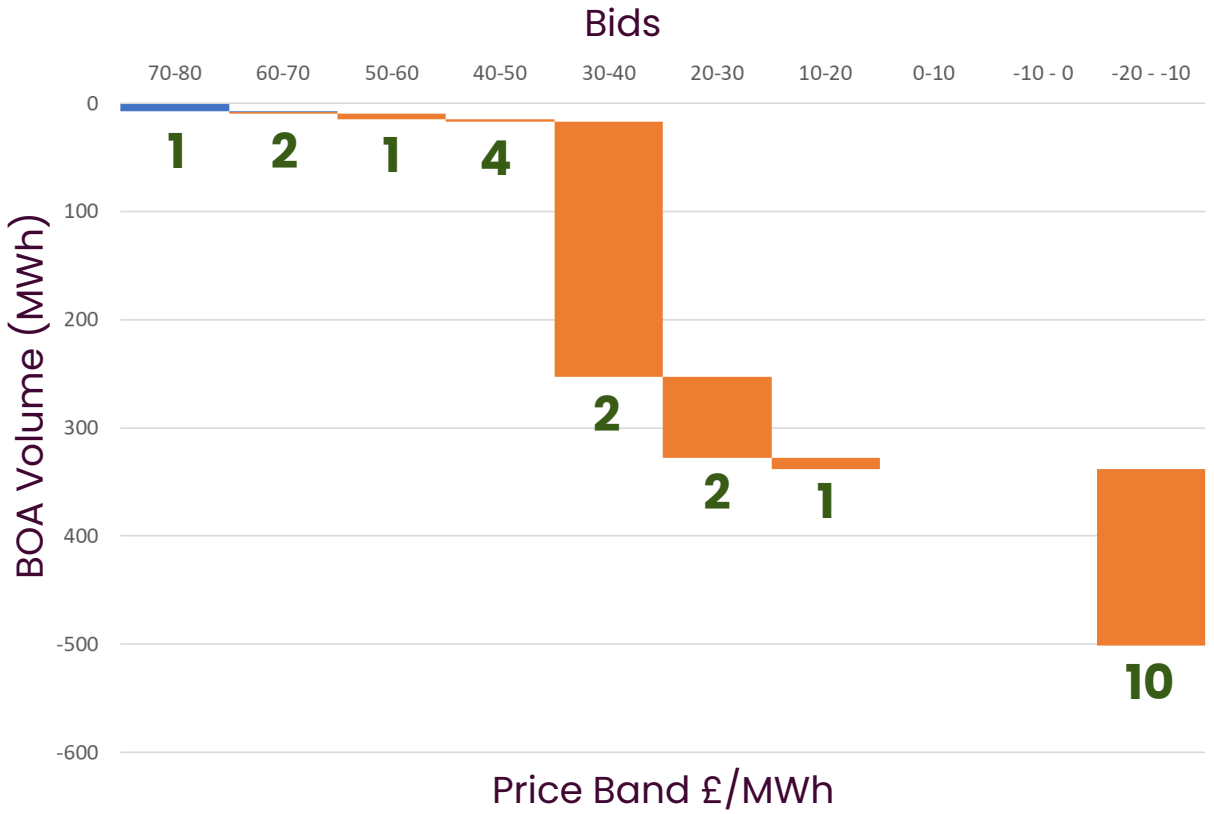
- 800 MW of bids for System (£60/MWh to £-10/MWh)

- 1000 MW of offers for Energy (£110/MWh to £140/MWh) – covering shortfall caused by bids, demand forecast error and shortfall on generators; breakdown as follows:

    - 500MW via OBP 32/39 energy actions i.e., 350 MW Small BMU + 150MW Batteries
    - 440MW on Coryton South at SEL, with 298MW of headroom (£145/MWh)
    - 60MW on GSMA03 at MEL over the peak and at SEL (38MW) for the rest of its run (£134/MWh)

Peak BOA Volumes

Key:
- No. of Instructions
- Energy (MWh)
- System (MWh)



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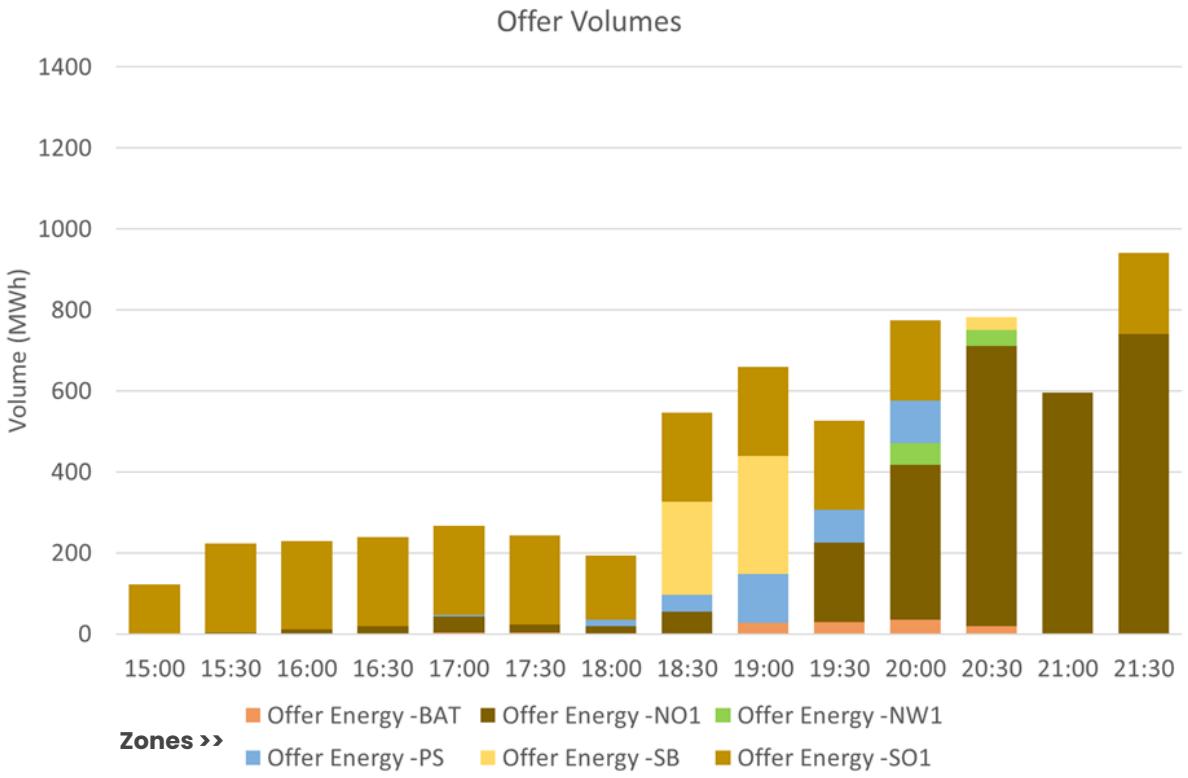
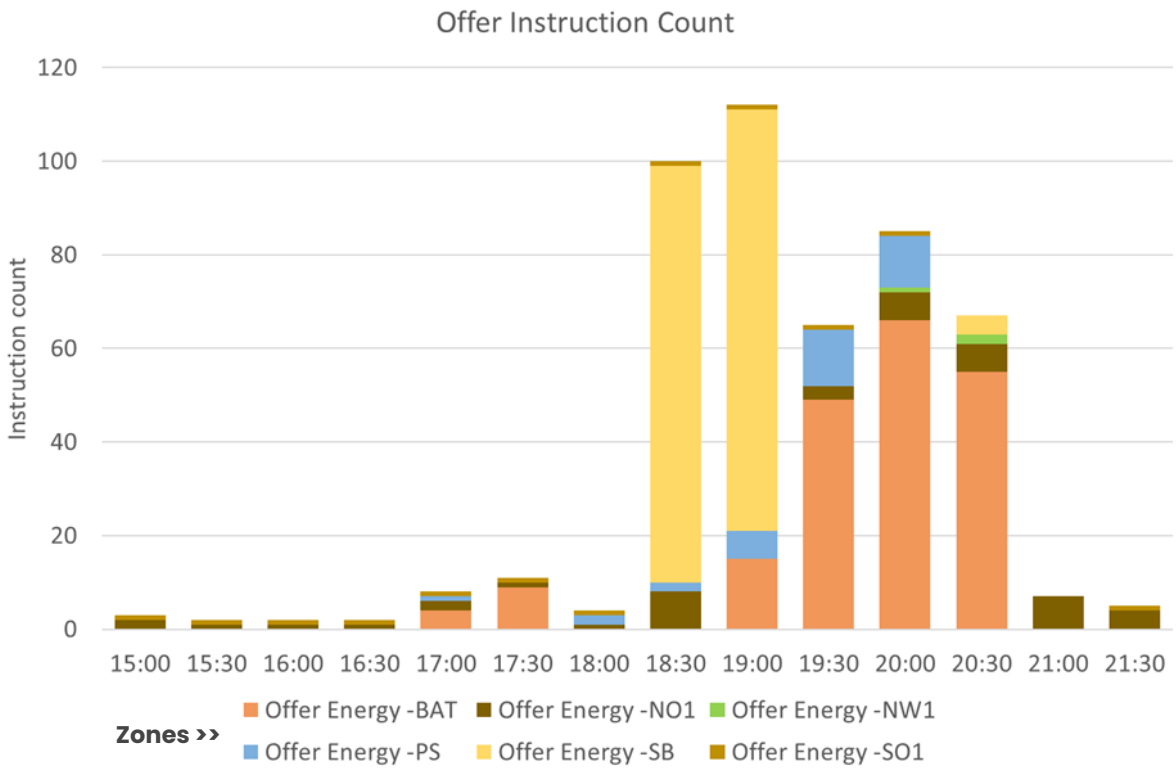
Offers Across the Shift

Small BMU and Battery zones need significantly more actions to achieve the same volumes
Max offer price £168/MWh @ 18:30





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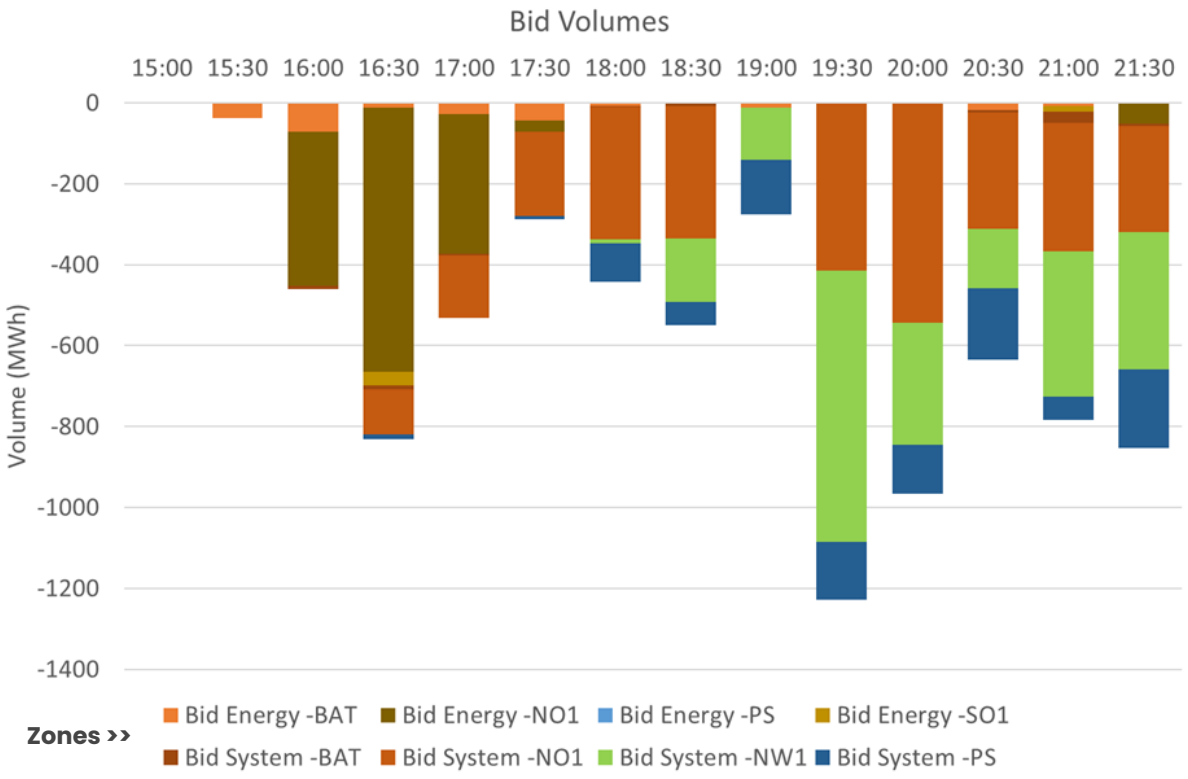
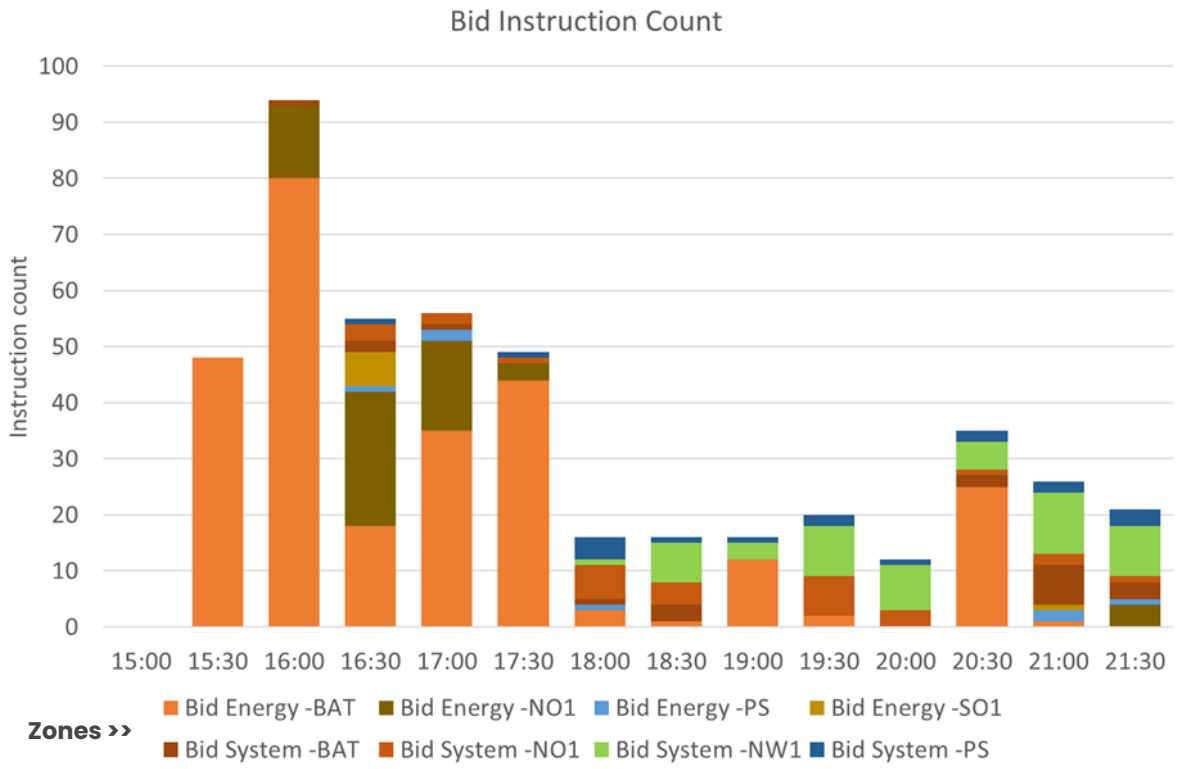
Bids Across the Shift

Initially most bids for energy, then system





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Review of the Peak

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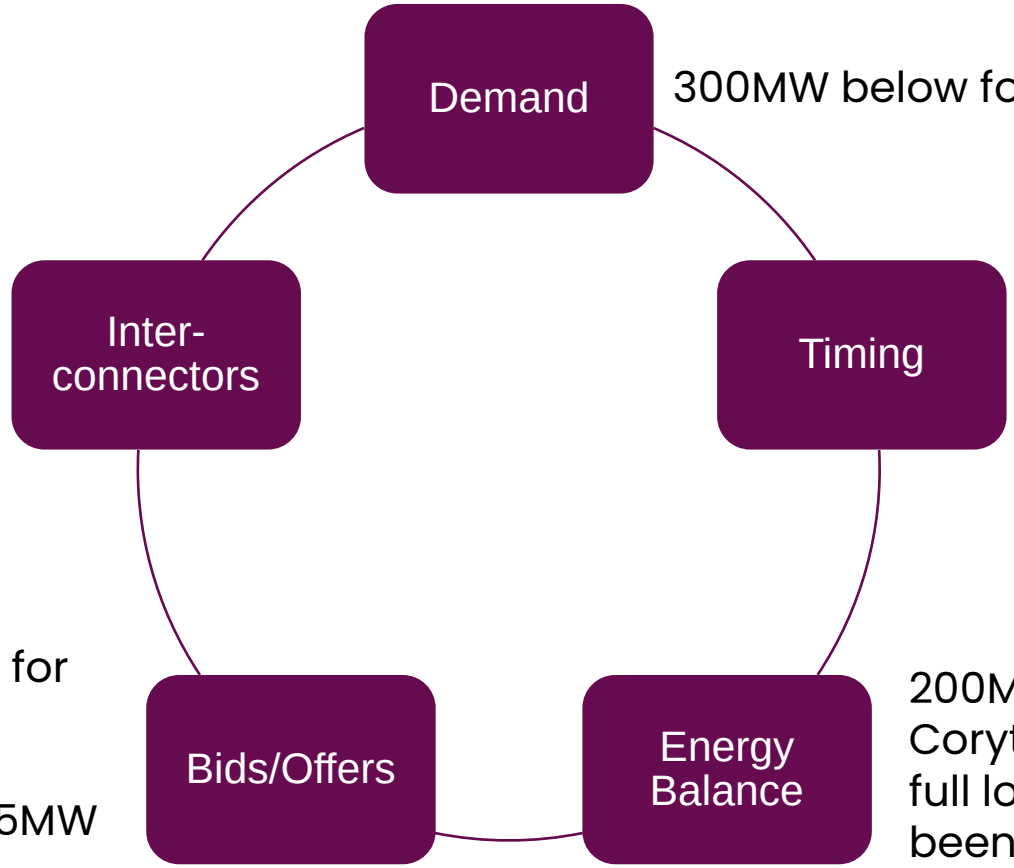

300MW below forecast

Coryton South had to be ordered by 14:25
BM gate closure 17:30
Gate closure at 18:00

200MW residual balancing actions
Coryton South would have been at full load if demand or wind had been at forecast

800MW of system bids for constraints
1000MW offers
Generation shortfall 125MW

675MW below forecast

Need to balance cost, security and risk across all timeframes not just single half hour

Thank you

Any questions?

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Achieving Clean Power by 2030

National Energy System Operator advice to UK Government

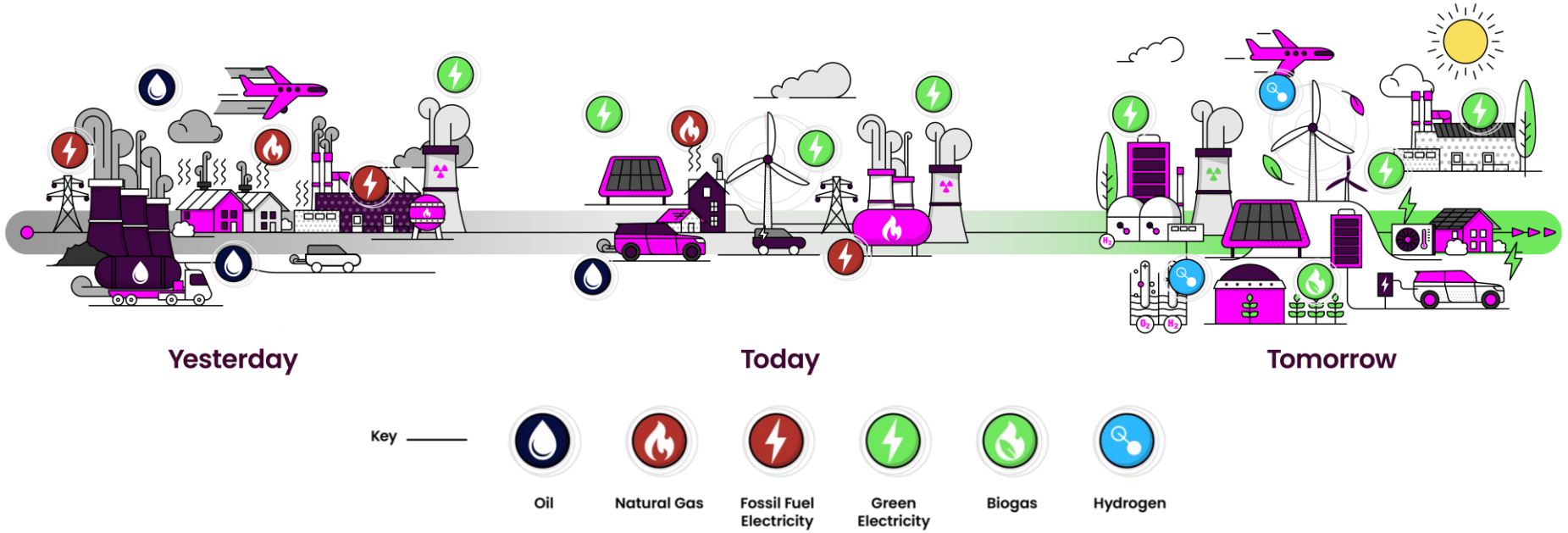
Colm Murphy, Director of Major Projects

NESO
National Energy System Operator

What did Government ask NESO to do?

The Government has an ambition for Britain to be supplied with clean power by 2030. The Government has made Clean Power one of their five missions. Mission Control, led by Chris Stark, is overseeing the delivery of a clean power 2030 action plan, consistent with long-term net zero, security of supply and affordability objectives.

The National Energy System Operator was asked to provide independent advice on the pathway towards the 2030 ambition, with expert analysis of the location and type of new investment and infrastructure needed to deliver it. We submitted our advice to Government and published it in November 2024. Government will now consider the advice in developing its clean power action plan later this year.



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Describing clean power

**this was a NESO working assumption in the development of the advice and has not been formally agreed by Government*

How is NESO describing clean power?

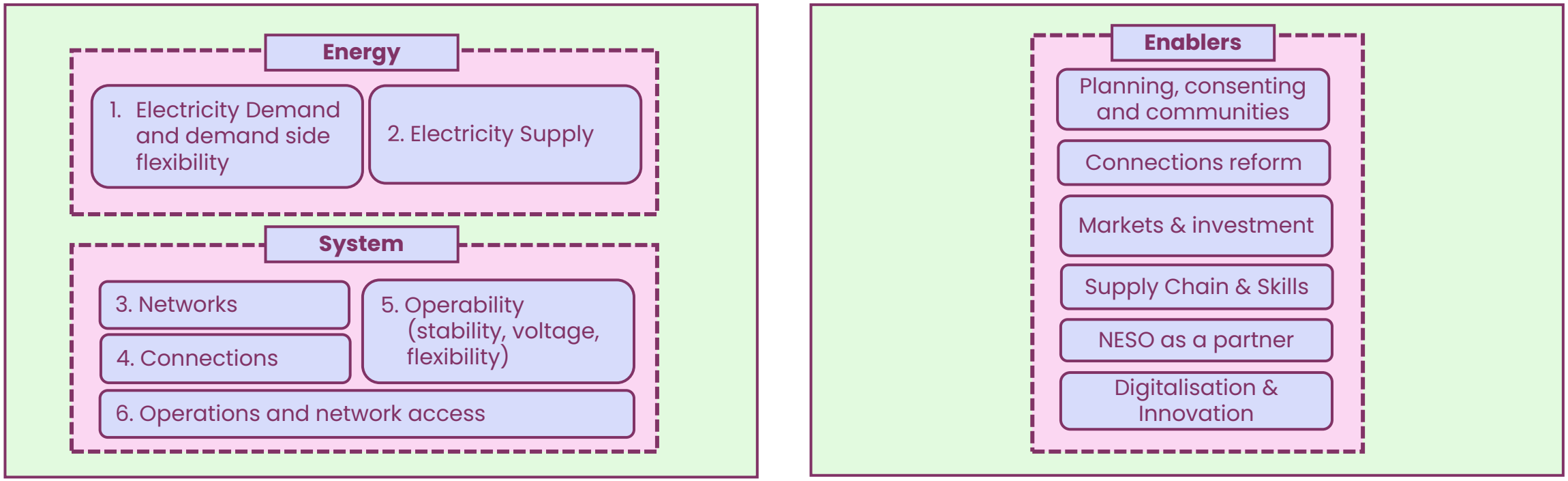
GB produces at least as much clean power as our total annual electricity demand. Unabated fossil fuel generation is reduced to the minimum required to keep the system secure, considering the availability and deliverability of alternatives.
For 2030, we expect this to be less than 5% of total power generation in a typical year.

Clean Power in numbers

	Share of GB clean power produced to GB consumption[1]	**Share of unabated fossil generation[2]**	**Carbon Intensity[3]**
Today	~60%	33%	~150 gCO2e
Clean Power 2030	≥100%	<5%	< 20 gCO2e

[1] Annual TWh domestic clean power production over total electricity consumed by GB homes and businesses
[2] Unabated fossil generation as a proportion of total electricity generation excluding exports
[3] Carbon emitted from GB electricity production (gross, excl combined heat and power, and energy from waste)

Different Components of NESO's Clean Power Analysis



Critical considerations such as **emissions and environment, consumer and community impacts, energy security, whole energy and beyond 2030 and economic impact** cut across the six key elements.

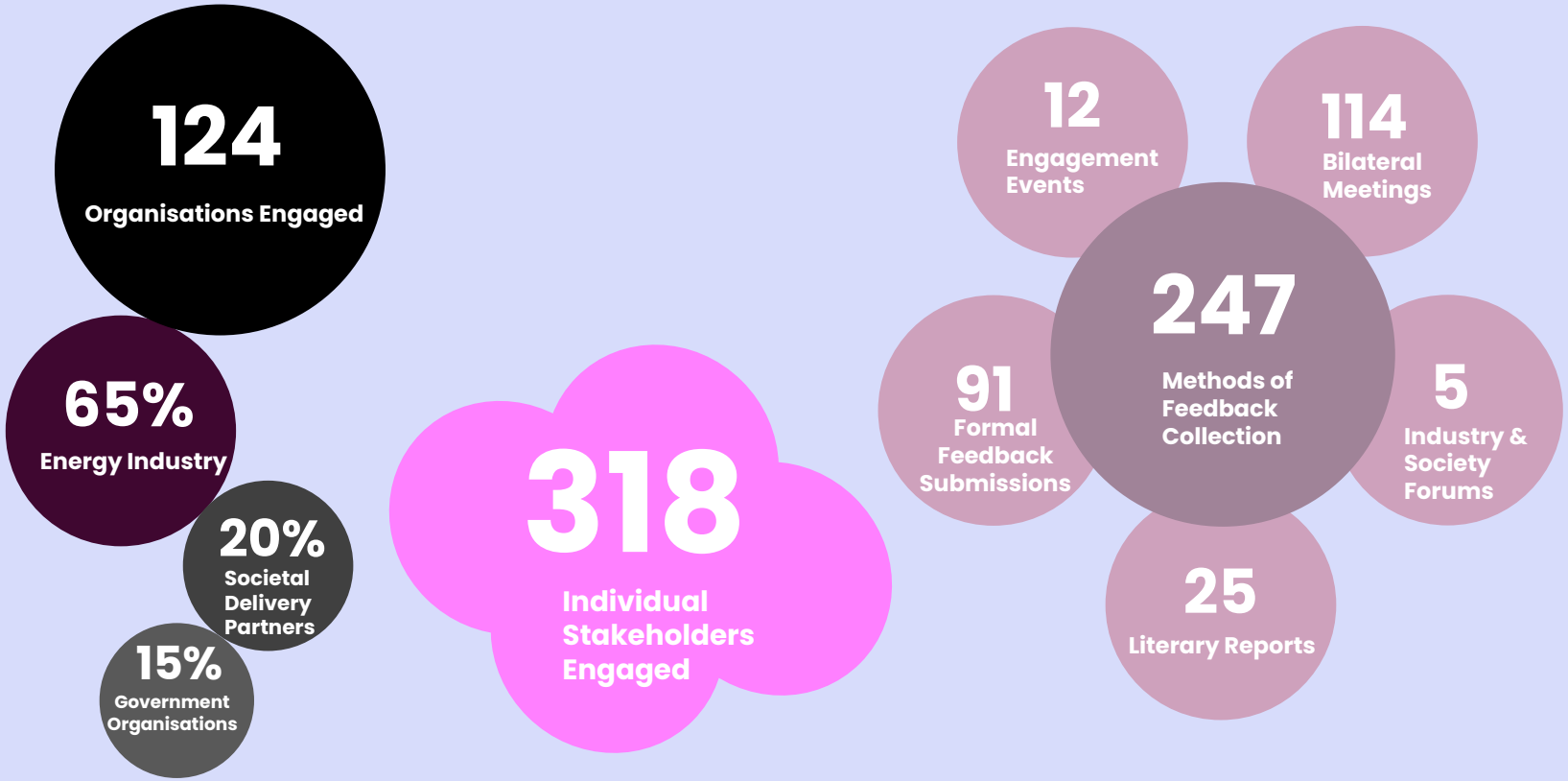
How We've Engaged

= Organisations engaged across the energy industry

The majority of these being from energy industry with Societal Delivery Partners & Government Organisations making up a large part of this too.

= Verifiable individual stakeholders engaged throughout our engagement process. Hundreds more engaged through externally hosted events.

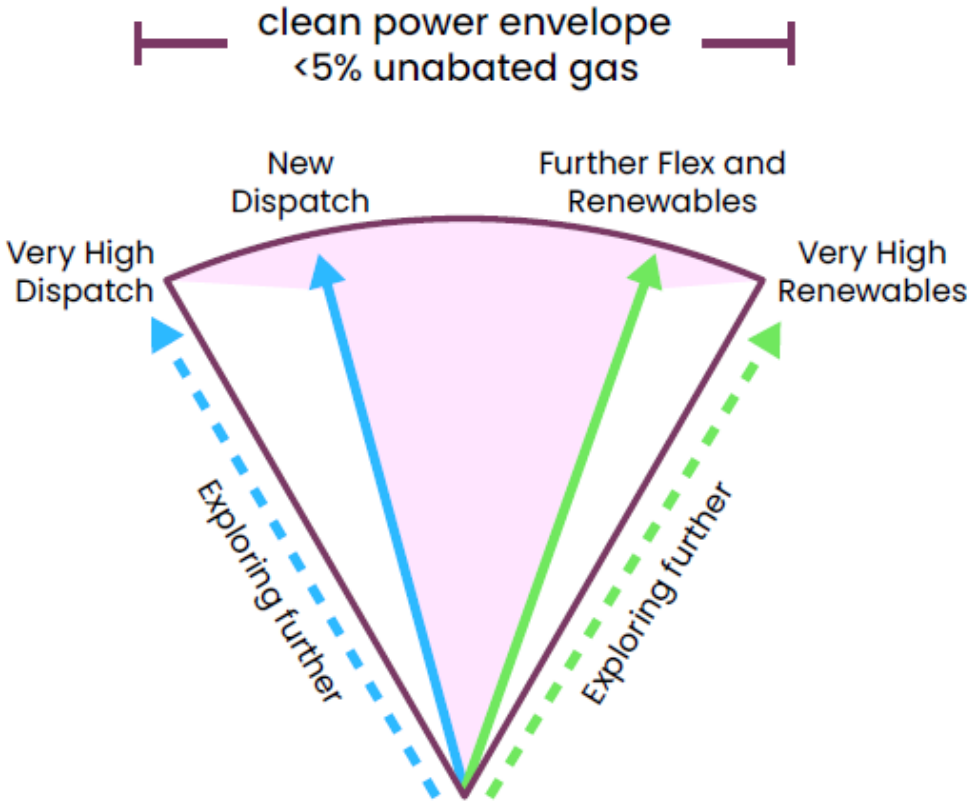
= All methods of feedback collection throughout the process



Societal Stakeholder Forum – included representatives from environment and community groups, planning bodies, local, devolved and central government. We took feedback on the development of our proposals and have been working their feedback through the plan.

Networks and technology Forum – included Trade association and network companies which spanned a wide range of market participants across the power industry.

Pathways to Clean Power



New Dispatch

- Growth in renewables but at a lower level compared to Further Flex and Renewables.
- Deployment of new low carbon dispatchable power (CCS and hydrogen) alongside highest nuclear capacity.

Further Flex and Renewables

- Highest levels of societal engagement, with higher residential and industrial demand flexibility and more storage.
- Fast deployment of renewables (50 GW offshore wind), but no new dispatchable power.

All pathways see increased electrification of transport, heat and industry by 2030 as needed to meet economy-wide carbon targets. Energy efficiency improvements continue across both pathways. Clean power pathways will all require increased digitalisation, open data and Innovation.

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Headline findings from clean power analysis

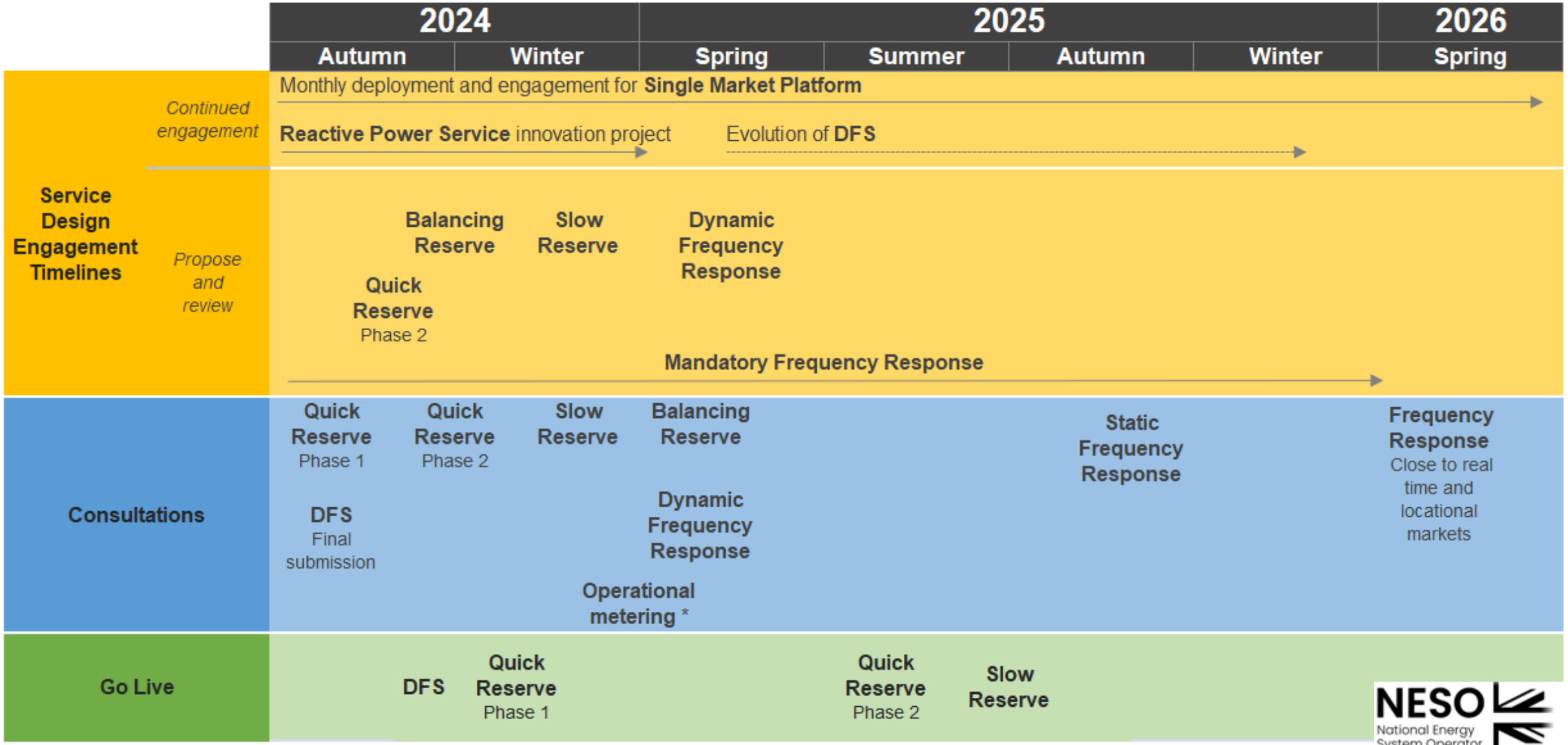
- **Clean power by 2030 is achievable** – it requires a herculean effort, and swift action must be taken immediately from decision makers to unblock delivery challenges.
    - The required energy capacity to deliver clean power is already within the grid connections pipeline.
    - The required electricity transmission network is already under development and was recommended over two years ago by NESO & Ofgem.
- **Clean power will require doing things differently**, establishing and maintaining momentum every year to 2030
    - **Key elements for success:** demand and supply flexibility, renewables acceleration, delivering First of A Kind technologies, timely network expansion, gas stays on but operates much less.
    - **Key areas for action:** planning reform; connection reform; market reforms; community engagement; supply chain; data/digital; and regulatory approvals.
- **Clean power can bring benefits for GB**
    - **Help meet carbon targets** and create local industrial and job opportunities
    - **Cut the link with gas prices**, without increasing costs to consumers

New Market Services Update

Jon Wisdom, Head of Market Change Delivery

NESO
National Energy System Operator

Product Update



Quick Reserve (Phase 2) and Transition

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11 October 2024
Proposed Service and Procurement Design published to industry

15 November 2024
Industry feedback closes

w/c 25 November 2024
Publishing our OBP API non-BM interface specification

December 2024
Article 18 consultation expected to be launched

June 2025
Enduring Quick Reserve service expected to go live

Transition

- Optional Fast Reserve (OFR) market will likely remain open until December 2025
- From December 2024 Quick Reserve (BM), June 2025 (NBM) will be operational together with OFR.
- Drop-in sessions, sandbox and mock auctions will follow similar approach as phase 1.

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STOR to Slow Reserve Transition

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WC 25 November 2024

Proposed Service and Procurement Design published to industry

WC 25 November 2024

Publishing our OBP API non-BM interface specification

20 December 2024

Industry feedback closes

January 2025

Article 18 consultation expected to be launched

September 2025

Service go live expected

Transition

- STOR market will remain open until December 2025
- From September 2025 Slow Reserve and STOR will be operational together

Beyond 2025

Neil Morgans, Principal Product Manager
Ronan Jamieson, Operational Manager

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National Energy System Operator

Product Development: 2026 - 2030

- At the June 2024 event we hosted 3 breakout sessions which looked **at product development beyond 2025** in the balancing & forecasting space.
- We shared the most popular suggestions received at our September webinar.
- Since then, we have started internal engagement to create an initial view of future capabilities.
- Today, we are presenting these initial capabilities and would like to get your feedback to ensure our roadmap aligns with stakeholder needs and expectations.

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Public

Timeline & Next Steps

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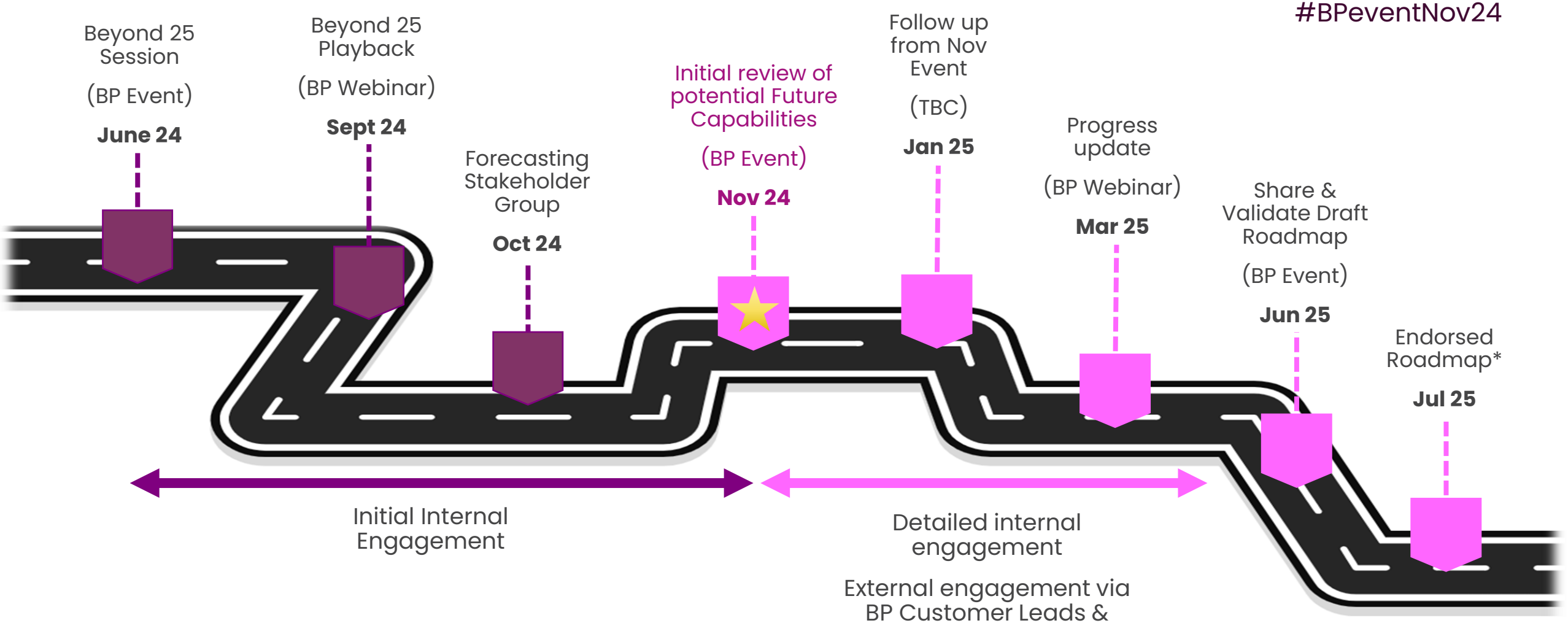

*Timelines for the RIIO-3 Price Control Submission are yet to be confirmed

BP: Balancing Programme

NESO National Energy System Operator

Initial View: Potential Capabilities 26-30

ENHANCED DISPATCH	WHOLE SYSTEM & FLEX	DATA & TRANSPARENCY	MARKETS
Co-optimization (Energy, System, and Ancillary Services)	TSO/DSO Coordination	Data Publication for Distributed Assets	Zonal Pricing (REMA)
Non-integer Bid Offer Acceptances (BOAs)	Integration of New Asset Types	Data Exchange (e.g. Industry Standard APIs)	Self/Central Dispatch (REMA)
Increased Number of Bid Offer Pairs	Evolution of Demand-Side Flexibility Markets	Network Model Exchange (Common Information Model - CIM)	Shorter Settlement Periods (REMA)
Aggregated Dispatch for Sub-1MW Resources	Availability of Demand-Side Flexibility	Transparency of Non-Balancing Mechanism (Non-BM) Data	Review shortening gate closure (REMA)
Decentralised Dispatch	Enhanced European Coordination	Automated Reporting of Optimisation Decisions	Stability: Y-1, Y-4, DA (Markets Roadmap)
AI-Based Decision Support Tools	Zonal and Local Demand Optimisation	Continuous Improvement in Dispatch Efficiency Monitoring and Transparency	Voltage: Y-1, Y-4 (Markets Roadmap)
Including Carbon in Balancing Mechanism (BM) Decisions	Constraint Forecasting	Inertia Forecasts	Frequency: Intraday & Locational Procurement (Markets Roadmap)
			Engagement managed outside of the Balancing Programme

Pink boxes represent ideas suggested at June Event

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NESO National Energy System Operator

Structure of the Session

- **Facilitators**: Each table has a NESO facilitator to assist with any clarifications regarding the proposed capabilities.

- **Discussion**: For each of the 3 capability areas, participants will have 10 minutes to discuss the items on your table.

- **Scoring**: At the end of the discussion period, you will then have 5 minutes to score the items using the Microsoft Forms survey for that area.

- **Additional Capabilities**: Participants can also suggest any additional capabilities missing from the list on the forms provided.

- **Anonymity**: Please provide your name and company for follow-up purposes. Individual submissions will remain confidential; all results will be aggregated and anonymised.

Survey Questions

- **Significance to Business**: How significant is the delivery of this capability to your business? (Score: 1-7, NA)
- **Delivery Challenges**: How challenging would it be to deliver this capability for you? (Score: 1-7, NA)
- **Understanding of Capability**: How well do you understand the capability? (Score: 1-7)
- **Additional Comments**: Any additional comments or suggestions regarding this capability? (Optional)
- **Additional Suggestions**: Are there any capabilities missing from this priority that the Balancing Programme should be delivering? (Optional)
- **Scoring Explanation:** To ensure we gather meaningful and actionable feedback, we will be using a 1-7 scoring scale. Here's what each score represents:

  - **1 - Not at all:** Not relevant or significant, no challenges or value.
  - **2 - Very Low:** Very little relevance or significance, minimal challenges or value.
  - **3 - Low:** Low relevance or significance, some minor challenges or value.
  - **4 - Moderate:** Moderately relevant or significant, moderate challenges or value.
  - **5 - High:** Highly relevant or significant, considerable challenges or value.
  - **6 - Very High:** Very high relevance or significance, substantial challenges or value.
  - **7 - Extremely High:** Extremely relevant or significant, major challenges or exceptional value.

Discussion 1: Enhanced Dispatch

Pink boxes represent ideas suggested at June Event

ENHANCED DISPATCH

Co-optimization (Energy, System, and Ancillary Services)
Non-integer Bid Offer Acceptances (BOAs)
Increased Number of Bid Offer Pairs
Aggregated Dispatch for Sub-1MW Resources
Decentralised Dispatch
AI-Based Decision Support Tools
Including Carbon in Balancing Mechanism (BM) Decisions

Discussion Timer

Scoring Timer

Discussion 2: Whole System & Flex

Pink boxes represent ideas suggested at June Event

WHOLE SYSTEM & FLEX

TSO/DSO Coordination
Integration of New Asset Types
Evolution of Demand-Side Flexibility Markets
Availability of Demand-Side Flexibility
Enhanced European Coordination
Zonal and Local Demand Optimisation
Constraint Forecasting

Discussion Timer

Scoring Timer

NESO National Energy System Operator

Discussion 3: Data & Transparency

#BPeventNov24

Pink boxes represent ideas suggested at June Event

DATA & TRANSPARENCY

Data Publication for Distributed Assets
Data Exchange (e.g. Industry Standard APIs)
Network Model Exchange (Common Information Model - CIM)
Transparency of Non-Balancing Mechanism (Non-BM) Data
Automated Reporting of Optimisation Decisions
Continuous Improvement in Dispatch Efficiency Monitoring and Transparency
Inertia Forecasts

Discussion Timer

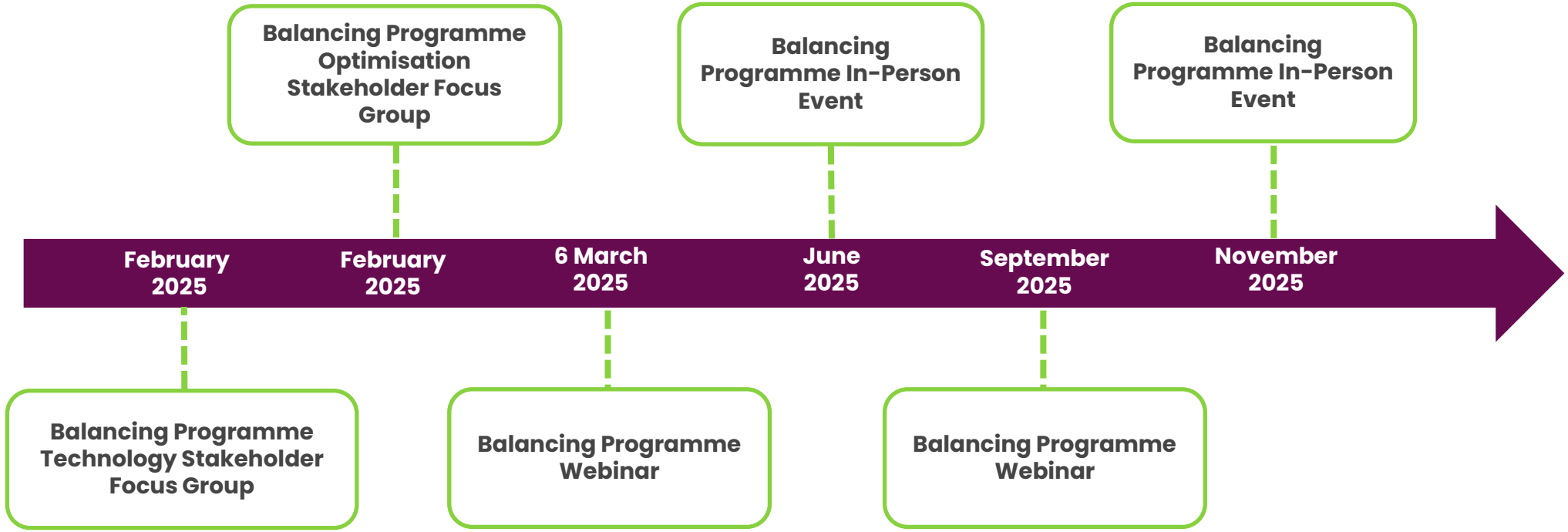
Scoring Timer

Q&A

#BPeventNov24

Future Engagement Opportunities . . .

#BPeventNov24



Additional Stakeholder Focus Group dates to be added beyond February; will be communicated to members & via NESO newsletter

Offer of 1-1 relationship managers within the Balancing Programme remains open

NESO newsletters with Balancing Programme content issued regularly, providing updates between online & in-person events

Next Steps . . .

Slides from today's session will be published on our website.

Subscribe to our new NESO newsletter here **-** please select **Future of Balancing Services inc. Balancing Programme** to keep up to date.

We welcome your feedback & questions – please get in contact with us at box.balancingprogramme@nationalenergyso.com.

Sign-up to our Stakeholder Focus Groups for Optimisation, Technology, & Forecasting - Balancing Programme Stakeholder Focus Groups.

If you are interested in a regular meeting with a representative from the Programme and would like more information, please get in contact using the email address above.

Public

Balancing Programme Event

27 November 2024

NESO
National Energy System Operator