Public

Constraints Collaboration Project Webinar

Quarterly update

5 November 2025

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National Energy System Operator

Overview of Constraints Collaboration Project

Between January and February 2024, NESO ran the constraints collaboration project (CCP) with the industry to find solutions for thermal constraints, which could be implemented and deliver results in the short term. We have now categorised proposed market-based solutions received into 2 main themes: 'Constraints Management Markets' and 'Increasing how much can flow over boundaries'

1. Constraints Management Markets (CMM)

1A. Demand for Constraints / Long-term CMM

- **amp** (Clean Energy): Increasing demand for power in constrained areas for electrification of heat
- **eneus energy**: Flex PtX to produce green H_2 and related derivatives
- **Statkraft**: Demand signal product
- **ScottishPower**: Incentivising new discretionary demand (H_2 production and electricity storage)
- **Flexitricity**: 'COOLER HEATING' – commercial heat loads as responsive assets
- **sse** Business Energy: Long-term constraint management contracts (incentivising new demand)

CMM – Long term

- **TEL** (the energy landscape): Constraints management markets (CMMs)
- **Scottish Futures Trust**: Long-term contract to manage a portion of the forecast constraint volumes
- **sse** Business Energy: Competitively allocated season ahead constraint management availability contracts
- **EDF**: Long-term auction of excess wind

1B. Short-term Constraints Management Markets

- **ZENOBĒ**: Pre gate closure constraint management product using schedule 7 trade
- **sse** Business Energy: Competitively allocated short-term constraint management contracts (D-7)
- **EDF**: Discounted demand turn up
- **EDF**: Weekly generation turn down market
- **Flexitricity**: The 'Big Friendly Battery' for ~8 hours duration

2. Increasing how much can flow over boundaries

2A. Extended intertrip scheme / 2B. Grid booster (post fault)

- **FIELD**: Extended intertrip scheme
- **FIELD**: Grid booster
- **ZENOBĒ**: Intertrip scheme utilisation
- **Kona Energy** (Delivering the zero carbon future): Paired storage systems across key boundaries
- **sse** Business Energy: Enhance utilisation of transmission network
- **ZENOBĒ**: Flexibility for Active Network Management (ANM) zones and Generation Export Management (GEMS)
- **Eku**: Battery for constraints: Reducing the line rating from 10 to 3 mins

2C. Boundary flow smoothing: Pre-fault

- **ZENOBĒ**: Transfer booster

Key

- Demand for Constraints
- CMM – Long term
- CMM – Short term
- Increasing how much can flow over boundaries

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Introduction

Agenda	Timings	Speaker
Introduction	5 mins	Qi Zhong
Project update	5 min	Alifa Starlika
Topic 1: Extended intertrip scheme	10 mins	Dave Phillips Steve Kelly
Topic 2: Boundary flow smoothing	30 mins	Jack Dowell (Frazer-Nash Consultancy) Anthony Simpson
Topic 3: Demand for constraints	15 mins	Alifa Starlika
Discussion and Q&A	20 mins	Elliot Leighton
Next steps	5 min	Alifa Starlika

Objectives

Objectives of this session

1. To provide an update on the progress of Constraint Management Intertrip Scheme (CMIS)

2. To present outcomes from ‘Data Analysis’ and ‘Technological Charaterisation’ work packages of the Boundary Flow Smoothing Project

3. To share insights on Demand for Constraints (DfC) project

4. To provide industry the opportunity to ask questions and share feedback

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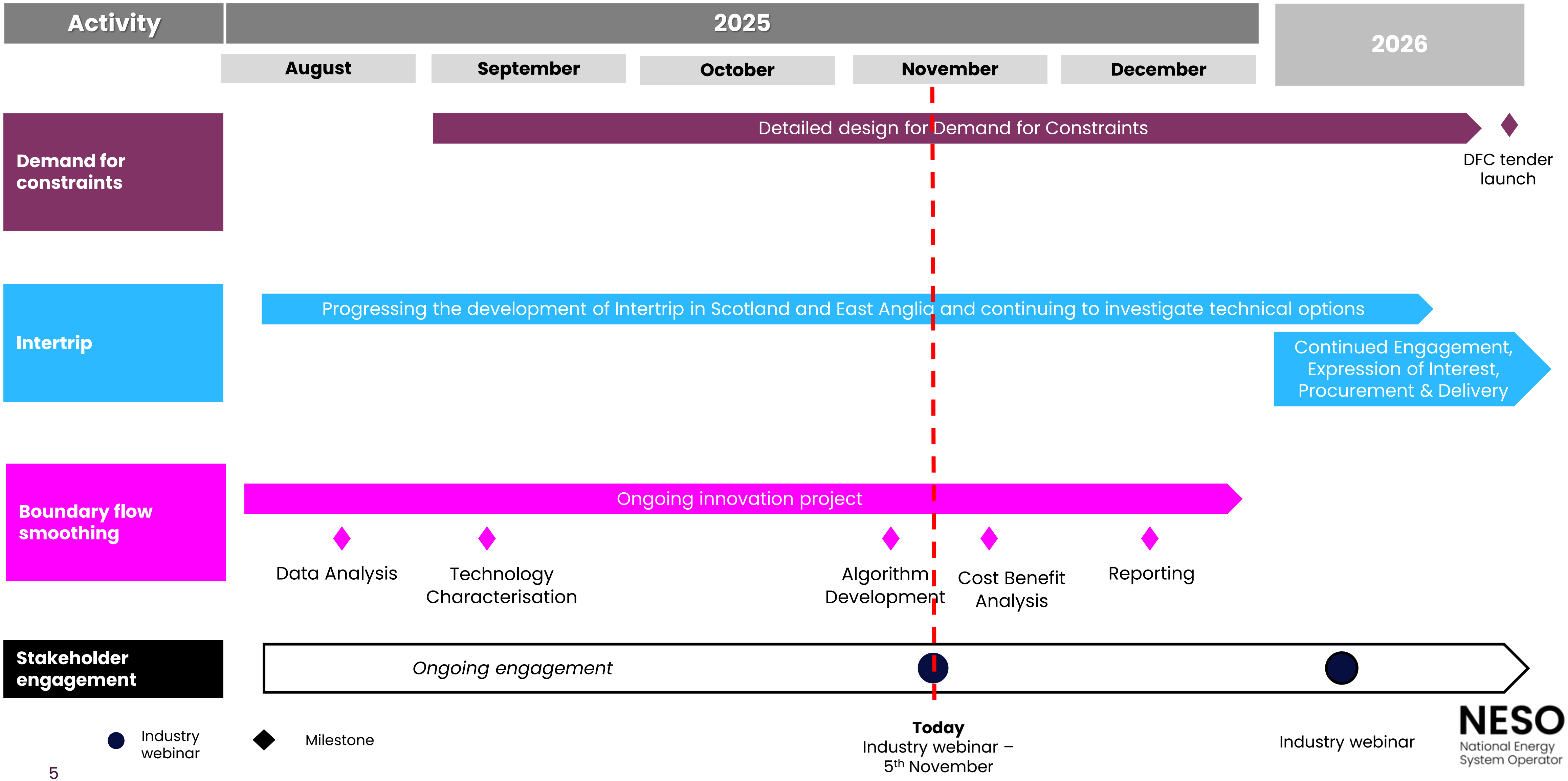
Project update: delivery plan and timeline



Industry webinar
Milestone

Key

These dates are indicative and subject to change

Project Update

Topic 1: Constraint Management Intertrip Schemes (CMIS)

Dave Phillips and Steve Kelly

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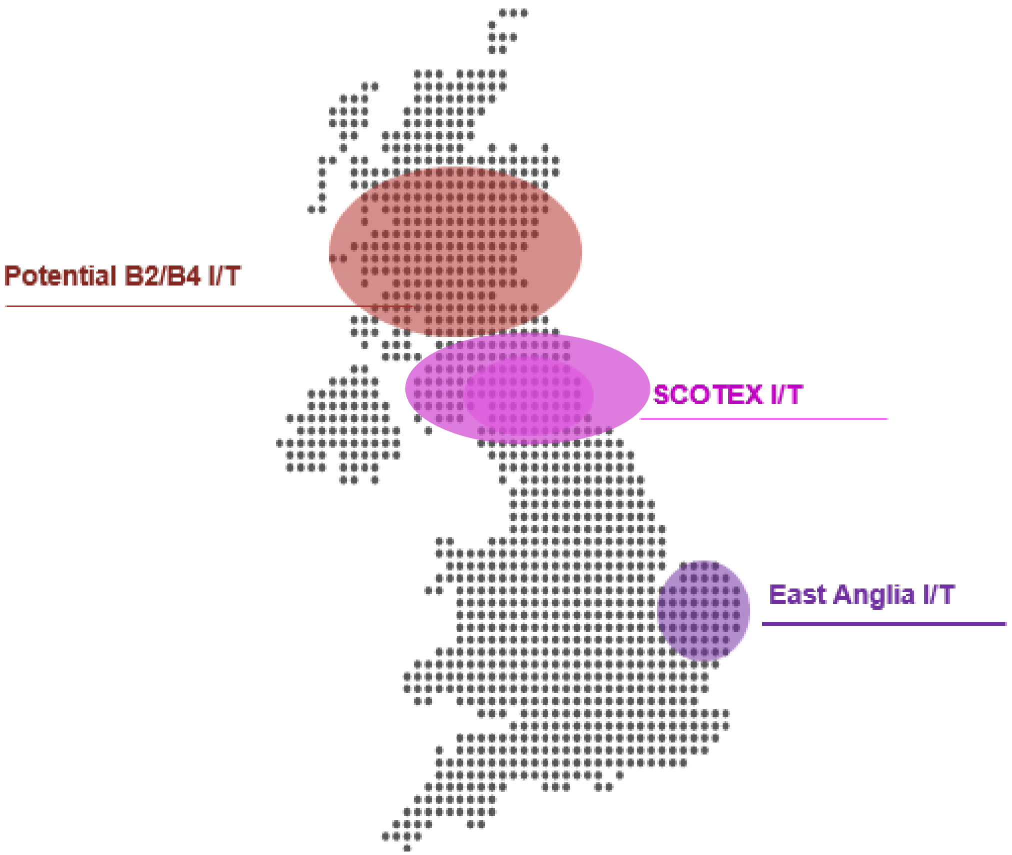
Based on previous success, we are expanding the rollout of Intertrips

Procurement Map



CMIS Scotland (multiple boundary areas):

- NESO is working with both Scottish TOs to explore options for a Constraint Management Intertrip Service (CMIS) at the B2, B4 and B5 boundaries.
- This work includes assessing whether to integrate the B6 boundary or pursue a separate solution, with all services targeted for **mid-2027.**

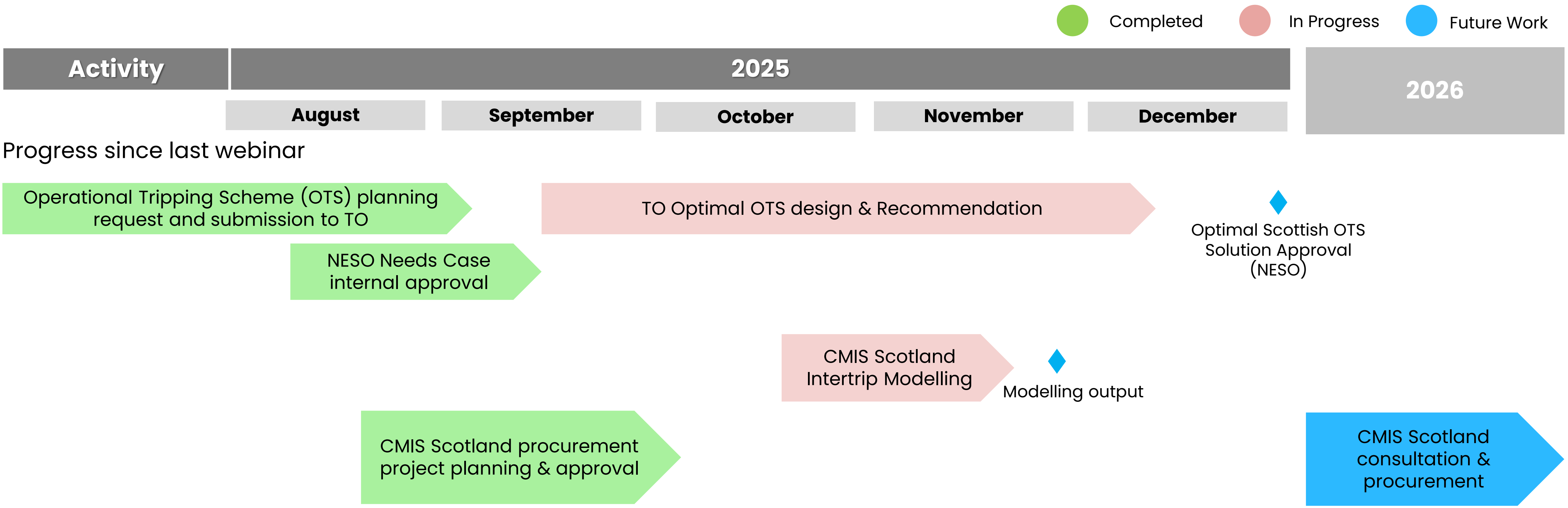
SCOTEX B6 - CMIS:

- Extension of the into B7a by National Grid Electricity Transmission (NGET) to include circuits in North England where the constraints can be managed by generators who are part of CMIS B6.
- Discussions underway with NGET and expected to complete **late 2026.**

East Anglia EC5 - CMIS:

- An enduring commercial CMIS for the EC5 boundary region.
- Introduces 200ms Stability Trip alongside the existing Thermal (10 second de-load), with increased number circuit monitoring.
- Tender outcome letters have now been sent to all bidding parties. Results published here.
- Expected go live in **July 2026,** replacing the current Interim EC5 service.

Extended Scotland CMIS project plan and timeline



Description

Extended Scotland CMIS project now focusing on delivery:

- **Operational Tripping Scheme (OTS) technical design by TOs & CMIS procurement development by NESO**
  - TO OTS technical design target completion by Dec 2025.
  - as more details emerge potential market participants will be notified.

- **CMIS Consultation and EOI** aims to start from early Q1-2026, finishes at end of Q2-2026.
- **Tender** aims to start from the beginning of Q3-2026, and ends Q4-2026.

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Potential future development for intertrip scheme

We captured input - both from your feedback and internally, to apply to the future development of our Intertrip solutions

	What we've learned	What we aim to consider in future development work
Use of the scheme	The current use of the B6 intertrip and how we might better understand root causes of low usage	In the July and December webinars, we answered specific questions about the current use of the intertrip scheme. Looking ahead, we want to understand better the factors that limit use; developing our plans for further studies to inform ongoing procurement.
Expected frequency of use	Can NESO clarify expected frequency of use for external stakeholders?	Exploring potential to do this; could we take better account of later years outage plans; challenge of uncertain system changes over longer term.
Boundary interaction	Interactions between boundaries a key factor - nesting effect where a +200MW flow at B4 may then be constrained at B6	Our updated modelling of integrated CMIS in Scotland will now consider the outage plans and limits across all boundaries together, helping to determine and improve this procurement and delivery in 2027.

Project Update

Topic 2: Boundary flow smoothing

Anthony Simpson

Jack Dowell (Frazer-Nash Consultancy)

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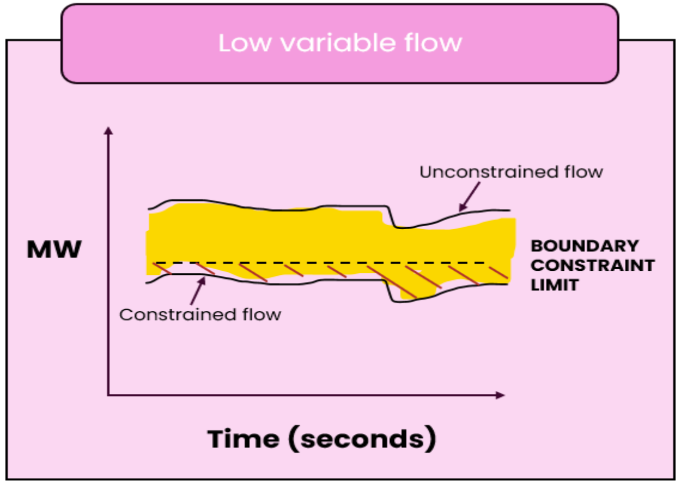
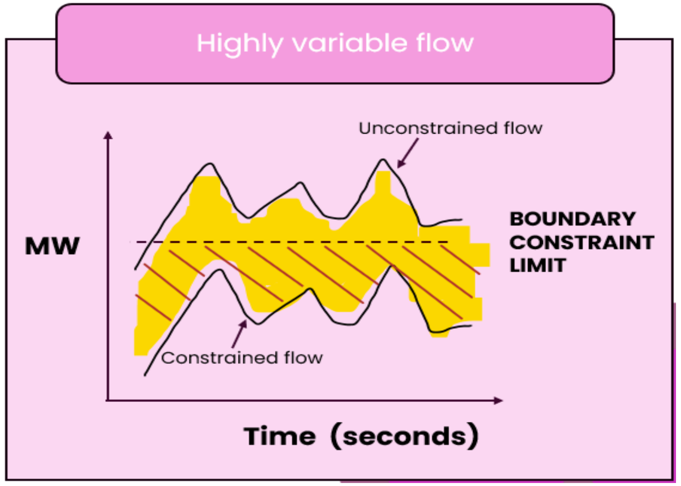
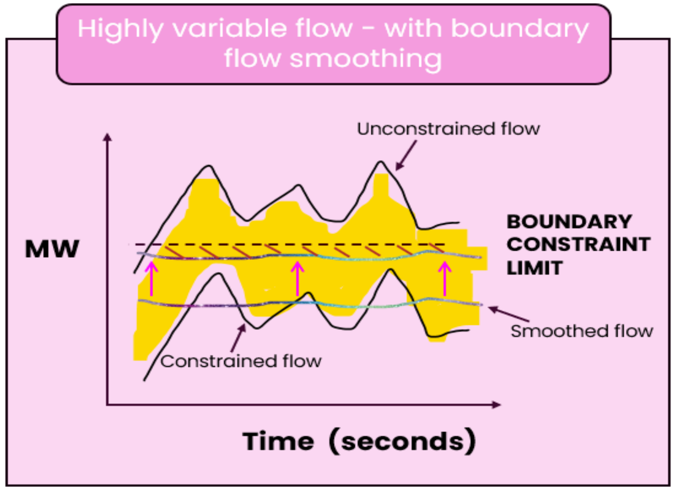
Project overview - Boundary flow smoothing







- **Power flows over constrained boundaries are often very variable,** due to rapid changes in supply and demand on both sides of the boundary
- **This variability can make it harder to keep the constrained flow to just below the limit,** therefore when variability is high, ENCC may choose to reduce the flow a bit further below the limit, to reduce the risk of the variability in the flow causing the limit to be exceeded
- **With a smoothing service, a flexibility service provider (FSP), located near a constrained boundary, could receive a high-resolution, low-latency data feed of the flow over the boundary**. The FSP could adjust its supply or demand to counteract the flow variability, and it would provide the service whenever instructed, typically when the boundary is constrained

Potential implication

- **If the fluctuation in the boundary flow could be reduced, it might allow the control room to take less actions,** enabling more renewable power to cross the boundary and thus reducing constraint costs

Structured approach to assess the potential of boundary flow smoothing

Data Analysis

Analyse concurrent historical data on boundary flows and tagged BM constraint actions

1. What constraint actions were taken?
2. Calculate the statistics of the flow conditions on constrained boundaries.
3. What KPIs are appropriate for determining the success of smoothing?

Technology Characterisation

Understand the characteristics of technologies that could be used to smooth boundary flows.

1. What are the characteristics of the technologies that could provide smoothing?
2. What are the requirements important for assets and other important considerations?

Will be covered in today's webinar

Algorithm Development

Oct – Nov

Devise algorithms that smooth the observed flows and analyse the results.

1. What are the statistics of the smoothed flow using suitable algorithms?
2. Estimate how much additional power flow could be achieved with a smoother flow while not worsening exceedance occurrence.
3. What assets can meet the smoothing requirements?

Cost Benefit Analysis

Nov

Understand whether the smoothing can be commercially viable

1. Estimate the reduction in constrained energy volumes and redispatch resulting from applying smoothing.
2. Might this be attractive to the owners of suitable technologies? – i.e. How does this compare to other revenue streams?

Reporting

Nov – Dec

Bring together the results and the findings from all the work streams to conclude on the feasibility of boundary flow smoothing.

Completed
In Progress
Future Work

Impact of balancing actions on boundary flow

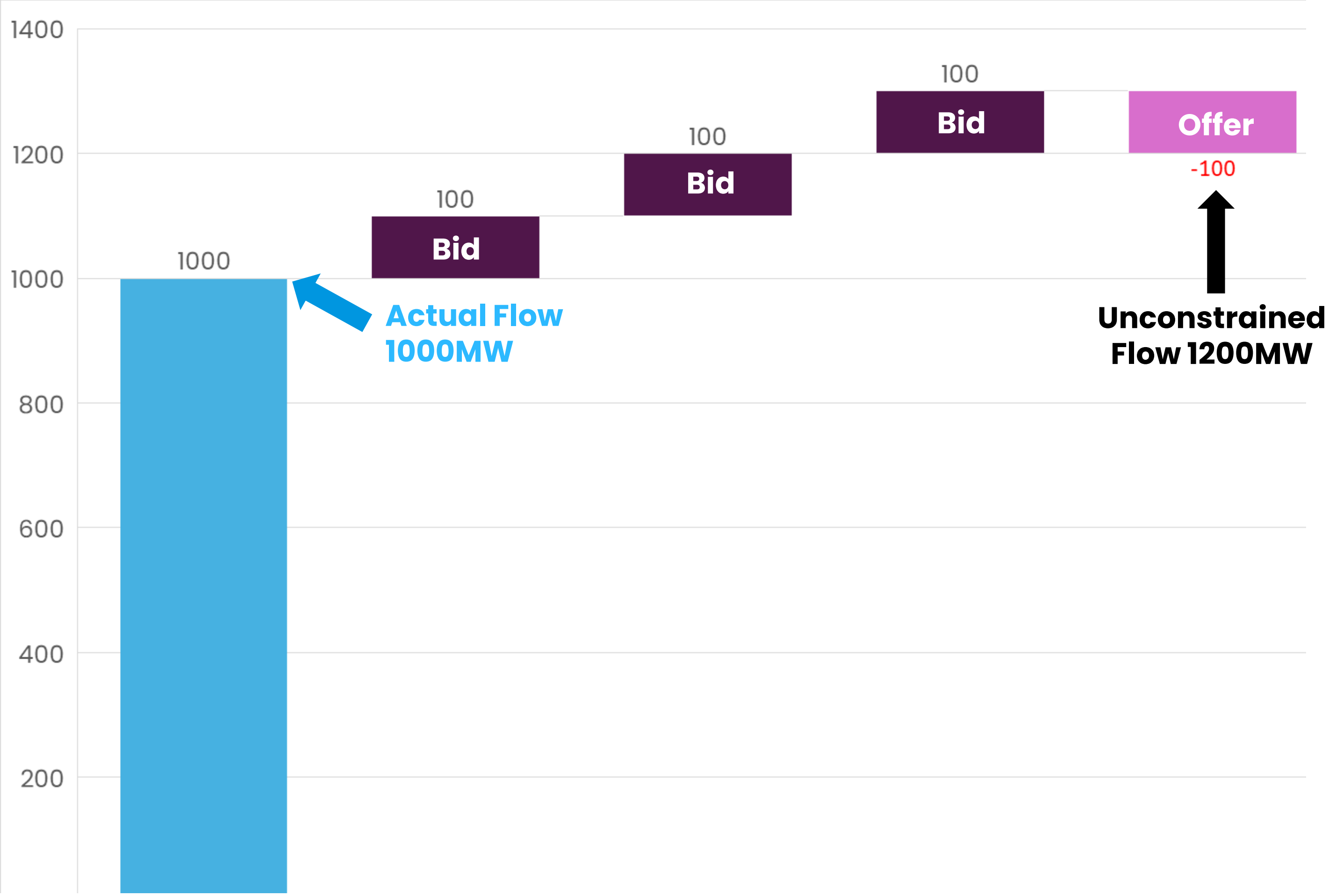
Data Analysis | Technology Characterisation | Algorithm Development | Cost Benefit Analysis | Reporting

Analysis

- Flows were analysed to determine how much power is crossing boundaries and how long boundaries are constrained for.
- Unconstrained flows were analysed to identify which boundaries were constrained before Balancing Mechanism (BM) actions were taken.
- **Actual Flow + Bids - Offers = Unconstrained Flow**
- Constrained periods were identified by the unconstrained flows being above the constraint limit.

Can we understand the behaviour of flows?

- With the scale of the flows and constraints defined we have developed an approach to quantify the variability and volatility of the flows.



Note: ***Bids*** *are taken in the BM to decrease generation (or increase demand),* ***offers*** *are taken to increase generation (or decrease demand)*

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Boundary flow changes in successive 10-min periods can be estimated

Data Analysis | **Technology Characterisation** | **Algorithm Development** | **Cost Benefit Analysis** | **Reporting**

The analyses we have developed here allow us to compare the smoothed and unsmoothed flow to assess the impact of smoothing. The analysis methodology is being outlined, and we will be able to share the results of smoothing in the next update.

We have analysed the statistics of actual flows across the SSHARN-3 (B7a) and SSE-SP2 (B4) boundaries assessing:

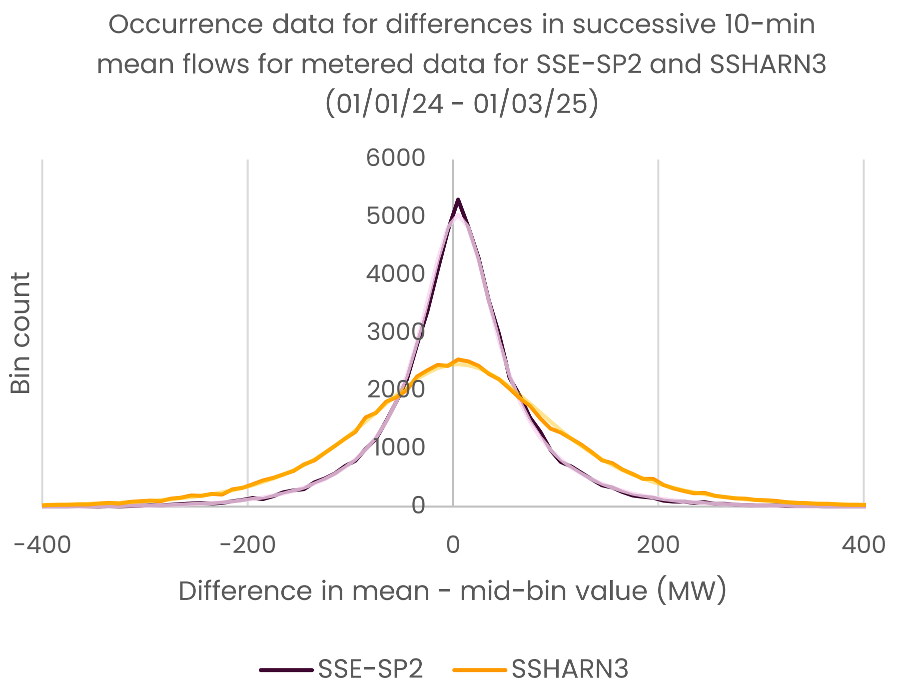
1) How mean flows evolve over successive 10-minute periods.

Findings

– Historical flows across boundaries change in a way that can be modelled by definable statistical distributions. The characteristics of these distributions change depending on whether periods are constrained or not

Implications

– This means for any flow data, we can produce statistics on the likelihood that smoothed or unsmoothed data will exceed a limit within a certain timeframe



Boundary flow *peak* values in 10-minute periods can be simulated

We have analysed the statistics of actual flows across the SSHARN-3 (B7a) and SSE-SP2 (B4) boundaries assessing:

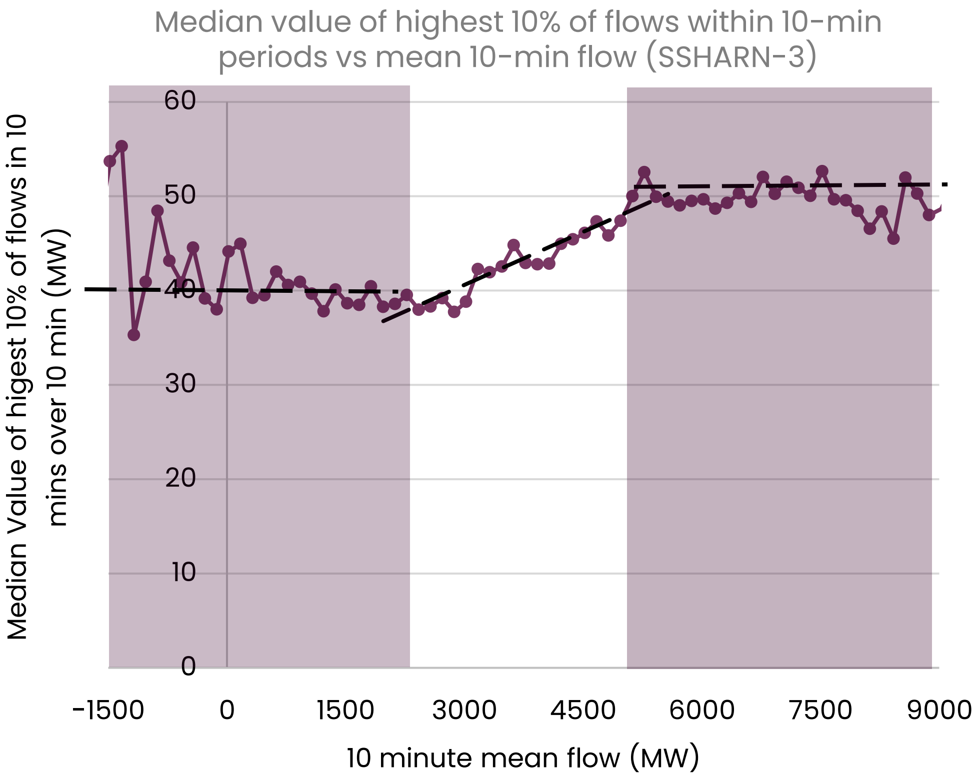
2) How the highest values within 10-minute periods depend on mean flows and constraints.

Findings

- At low and moderate levels of flow, the mean size of the upward fluctuations in flow increases as the flow increases.
- However, when flows are high, there is no relationship between flow and high fluctuations.

Implications

- This means we can simulate the statistics of the peak value that flows reach within each 10-minute period.



NEXT STEP: Undertake the same analysis approach with smoothed flows. Compare the distributions to determine whether smoothing has achieved a reduction in variation and volatility. Estimate the reduction in constraint actions that could be possible.

Smoothing feasibility criteria are outlined below

Data Analysis | **Technology Characterisation** | **Algorithm Development** | **Cost Benefit Analysis** | **Reporting**

We have outlined the statistical analysis we will use to measure the success of smoothing from a statistical point of view.

To measure the success of smoothing from an operational point of view we have developed a set of feasibility criteria to characterise the smoothing. The best performing smoothing algorithm will score the best against the criteria and the results will be used to determine whether there is an operational and commercial benefit.

Criteria	Description	Reason to measure
Balancing Cost Savings	The amount that can be saved through fewer bids and offers until the flow is closer to the constraint limit.	Provides an economic justification for implementing smoothing or control measures.
Number of Constraint Limit Exceedances	Has the number of constraint limits exceedances changed with the smoothed flow.	Tracks whether smoothing or control strategies improve compliance with system constraints.
Total Energy	Total import and export energy (MWh) required for assessed period.	Captures the overall energy exchanged, providing insight on the amount of energy needed to provide the smoothing.
Operational Runtime	Algorithm must run quickly enough for real-time operational implementation.	Validates that the solution can be used in live system operations without delaying decisions.
Peak Power	Peak MW import and export value for assessed period.	Captures the power requirements needed to provide smoothing as an indication for the asset requirements.
Technical Feasibility	Must be deliverable by a technically feasible asset.	Confirms that any proposed changes or control actions can be physically implemented by existing grid assets.

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Data analysis key findings

Data Analysis | **Technology Characterisation** | **Algorithm Development** | **Cost Benefit Analysis** | **Reporting**

A Statistical analysis methodology has been developed to understand how flows change and how volatile they are. This will be used to analyse the effect of smoothing on flows and whether it has provided a benefit.

The Smoothing Feasibility Criteria will be used to determine the most viable smoothing technique and whether it is technically and economically feasible.

The ultimate success of a smoothing service will be determined by whether it realises a cost saving. Therefore, this is the most important feasibility criterion. The concept will not progress without this being achieved.

Number of Constraint Limit Exceedances will be a key criterion for the control room as they have indicated that reducing the number of volatile power spikes would be beneficial.

An overview of the approach taken to technology characterisation

Data Analysis | **Technology Characterisation** | Algorithm Development | Cost Benefit Analysis | Reporting

OBJECTIVES

To produce a list of smoothing service technology archetypes, classified according to characteristics that are likely to be important for providing a flow smoothing service.

APPROACH

- Identified a comprehensive list of flexibility technologies
- Performed an initial technology characterisation to understand asset capabilities.
- Undertook stakeholder engagement meetings to be able to better characterise asset technical and operational behaviour, as well understand the pool of assets that could provide a boundary flow smoothing service in reality.
- Fed the insight from the stakeholder engagement into the technology characterisation.
- Generalised the smoothing asset capabilities into asset archetypes.

KEY ASSET CAPABILITIES

- Power rating
- Energy capacity
- Power direction
- Response time
- Ramp time
- Duration of sustained action

Multiple potentially suitable technology options following assessment

Data Analysis → **Technology Characterisation** → Algorithm Development → Cost Benefit Analysis → Reporting

The suitability assessment identified technologies for archetype development and these technologies will be evaluated against smoothing service requirements.

The criteria

- Technical Capability (Power rating, Energy capacity, Power direction, Duration of sustained action, Response time, Ramp rate).
- Technology Maturity (ready to go | needs some development | not deployed at scale).
- Asset Availability (pre-existing / close to commissioning | in development with connection | not yet planned).

The technologies have been given a Red Amber Green (RAG) rating

- Green indicates the technology performs well against the criteria.
- Amber indicates the technology has potential to meet the criteria.
- Red indicates the technology currently performs badly against the criteria.

Technologies taken forward for more detailed archetype development

Technology	Participating stakeholders[1]	Technical Capability	Technical Maturity	GB Asset Availability
Batteries	10			
Flexible Data Centres	2			
Hydro	1			
Aggregated Electric Vehicle charging	3			
Industrial Demand & District Heating	1			

Technologies considered but not taken forward

- Liquid Air Energy Storage
- Compressed Air Energy Storage
- Flow batteries
- Supercapacitors
- Flywheel Energy Storage
- Power-to-X (e.g. hydrogen production)

GB asset availability is a key factor across these technologies due to timescales of the CCP

[1] *In total 12 organisations participated in the stakeholder engagement with some organisations covering multiple technology types.*

Conclusions from technology characterisation

Data Analysis | **Technology Characterisation** | Algorithm Development | Cost Benefit Analysis | Reporting

Valuable insights were gained through stakeholder engagement. The need for clarity on service requirements at an early stage was clear.

Key takeaways	Detailed findings
Potential technologies for smoothing have been identified	• The technology options suitability assessment qualitatively classified which assets were favourable for smoothing and these have been taken forward to develop into asset archetypes. • Batteries, Flexible Data Centres, Hydro, Aggregated Electric Vehicle charging, Industrial Demand & District Heating technologies should be most promising for a smoothing service.
Some technologies were less promising due to low availability in the short term	• Liquid Air Energy Storage, Compressed Air Energy Storage, Flow batteries, Supercapacitors, Flywheel Energy Storage, Power-to-X (e.g. hydrogen production) technologies were identified as less promising or unsuitable through a comprehensive review of flexibility service providers.
Further work on algorithm development will define the service technical requirements	• Required technical capabilities for a service will be fully defined upon the completion of the algorithm development when feasible optimal smoothing algorithms are defined. • With the service technical requirements defined the asset list can be refined to determine which asset capabilities are best aligned to the service requirements.

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Covered in today's webinar

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Reporting (Nov – Dec)

Bring together the results and the findings from all the work streams to conclude on the feasibility of boundary flow smoothing.

Completed

In Progress

Future Work

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Project Update

Topic 3: Demand for Constraints

Alifa Starlika

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We are developing the detailed design of Demand for Constraints (DfC) through CCP stakeholder engagement

	Initial Design of Demand for Constraints
Definition	Demand for Constraints is a long-term contract whereby NESO can ask a demand source to increase its consumption of electricity at times of constraints
Possible Contract Lengths	Multi-year contract. The longer the duration of the contract, the stronger the investment signal for flexible demand to be located behind constraints
Possible Contract Structure	- Availability payments - Utilisation payment (in £/MWh) * - Stackable with other services
Who Could Participate	**- New:** Asset that is not operational now, not connected to the system, or an asset with new capability to flex* **- Strategic:** Large demand (BMU) which can provide sufficient scale to reduce constraints and aid NESO to unlock new flexibility needed for Clean Power 2030 **- Flexible:** Ability to turn up their consumption of electricity at times of constraints with short notice from NESO
Where It Would Be Active	Scotland (B0-B1, B3-B4 and B6) and potentially East Anglia (EC5)
When would we contract?	Tender in 2026 (e.g. first tender in 2026, for phased delivery in 2028 (T-2) or 2030 (T-4))*

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* To be confirmed

NESO reserves the right to alter these at any stage in the process

Key takeaways from the DfC Expert Group session (1/2)

Key themes	Implications	What we have been doing
Eligibility: 'New' project requirement	**Low uptake:** Limiting eligibility to new projects may shrink the participant pool, reducing market volume and diminishing the contract's ability to alleviate constraints. **Delay in project delivery:** Certain market participants expressed their facility has long lead time and are unlikely to get new asset connecting before DfC target delivery year.	**We are exploring a potential dual-track pathways for Demand for Constraints**, accommodating existing assets by adding flexible MW capacity that can be operational in the near term as well as new assets with a later commercial operation date. This approach provides tailored market access for each asset type, taking into account their specific development lead times and financial profiles. The aim is to reduce costs and enable smooth project execution.
Possibility to include existing assets Could developer use DfC service as a basis for expansion or refurbished assets that were due to close?	**The risk of allowing existing demand** is that it could lead to perverse outcomes – such as incentivising existing demand to reduce demand temporarily, only to be compensated for increasing it again. **The value for money offered to consumers:** How can it be justified when consumer money are allocated to assets that are already operational?	

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Key takeaways from the DfC Expert Group session (2/2)

Key themes	Implications	What we have been doing
Expected constraint hours across the different boundaries	**Uncertainty over hours of constraints** per year **present challenges** for developers like electrolysers or large industrial customers switching from gas to electricity.	**Power system studies are being undertaken to determine the MW requirements of demand in target boundaries**. However, accurate boundary flows and limits could be highly volatile, and are highly sensitive to wind conditions, actual demand levels and transmission system typologies, all of which could be complex to forecast prior to real time. **We will also incorporate these complexities and uncertainties into the service design, requirement setting, payment structure, and dispatch mechanism.** This will support potential service participants in evaluating the feasibility of Demand for Constraints within their business case.
DNO engagement to ensure coherency between NESO and DNO markets	**Risk of uncoordinated service designs.**	**We will continue actively engaging with DNOs throughout the detailed design phase of Demand for Constraints.** **1. Short term** - we will consider distribution network operability implications introduced by DfC service and ensure the design and dispatch of the service is coordinated with DNO system need. **2. Long term** - we are working with Primacy framework and Market Facilitator to build additional data and system capability to ensure coherency with DNO markets. UK Power Networks · SP Energy Networks · Scottish & Southern Electricity Networks

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Discussion and Q&A

Elliot Leighton

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Next Steps

Alifa Starlika

Next Steps

NESO will continue the Boundary Flow Smoothing innovation project, advancing both the algorithm exploration work package and the cost-benefit analysis, which is scheduled for completion by December 2025.

NESO will continue progressing with CMIS modelling and exploring the development of intertrip schemes beyond B6, TOs OTS technical design and CMIS procurement development, scheduled for December 2025.

For Demand for Constraints, NESO will be progressing with the detailed design and will look to engage with industry stakeholders.

Appendix: List of Abbreviation

ANM – Active Network Management

BM – Balancing Mechanism

CCP – Constraints Collaboration Project

CMIS – Constraint Management Intertrip Scheme

CMM – Constraints Management Market

DfC – Demand for Constraints

DNO – Distribution Network Operator

FSP – Flexibility Service Provider

GB – Great Britain

MW - Megawatt

MWh – Megawatt-hour

NESO – National Energy System Operator

NGET – National Grid Electricity Transmission

OTS – Operational Tripping Scheme

RAG – Red, Amber, Green

TOs – Transmission Owners

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Thank you!

To keep in contact and to keep sharing your ideas, please visit our website or email us at

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