Public

Constraints Collaboration Project Webinar

31 March 2025

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Introduction

Agenda	Timings	Speaker
Introduction	2 mins	Becky Hart
Project Update	5 min	Alifa Starlika
Topic 1: NESO's strategic approach to managing constraints	15 mins	Becky Hart
Topic 2: Boundary flow smoothing (formerly transfer booster)	15 mins	Anna Rita Cosi
Topic 3: Demand for Constraints	20 mins	Alifa Starlika
Discussion and Q&A	30 mins	Ridwan Ibrahim
Thank you	1 min	Becky Hart

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Objectives

Objectives of this session

1. To share NESO's strategic approach to managing constraints and updates on the Constraints Collaboration Project

2. To share findings from 'Demand for Constraint' Cost-Benefit Analysis and present an update on Boundary Flow Smoothing Innovation Project

3. To provide industry the opportunities to ask questions and share insight

Project update: delivery plan and timeline

Activity	2025: March	April – July
Demand for Constraints	Options assessment and CBA; ◆ Decision on Demand for Constraints	Review CBA results and develop mitigation plans to address NESO risks
Constraints Management Markets	Final stakeholder input; ◆ Decision on CMM	Continuous improvements of existing markets
Intertrip	B6 intertrip system studies	Progressing the development of Intertrip schemes and continuing to investigate technical options relating to Intertrip
Boundary flow smoothing	Project set up and contract finalisation	◆ Commencement of innovation project; Innovation project – 6 months, from April to October 2025
Stakeholder engagement	● Today 31/03	Ongoing engagement

Key ◆ Milestone ● Webinar

Disclaimer: These dates are indicative, and we reserve the right to alter these timelines at any stage in the process.

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Project Update

Topic 1: NESO Strategic Approach to Constraint Management

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A year ago, we asked for your ideas about how to reduce constraint volumes, actions and associated costs

We were looking for new market solutions to help:

Reduce volume of constraints
- Increase effective network capacity: enable more green electricity to flow through the wires
- Reduce overall volume of NESO actions: send signals to reduce volume of curtailment required

Reduce the cost of managing constraints
- Reduce overall costs to consumers: lower cost of balancing actions in terms of £/MWh

Feasible – within the NESO's scope

Quick – can be introduced < 5 years

Effective – reduces constraints costs

These solutions were intended to complement the work already underway to reduce constraint costs

Our 2024 Balancing Cost Strategy outlined the activities already underway to reduce constraint costs

The Balancing Cost strategy, published for the first time last year, looks at forecast balancing costs and the underlying causes of any changes.

For thermal constraint costs specifically, the report highlighted the impact of:

- Accelerated Strategic Transmission Investment
- Eastern Green Link and Western Link HVDC
- Changes to interconnector ramp rates
- Local Constraints Market
- Constraint Management Intertrip Service
- Outage optimisation
- Code changes

The Balancing Cost strategy will be updated and published again this year.

Figure 11. Potential thermal constraint costs avoided through network build

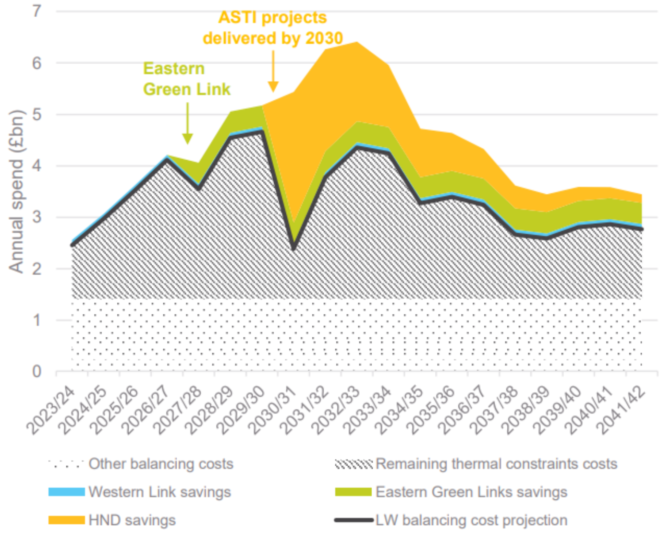
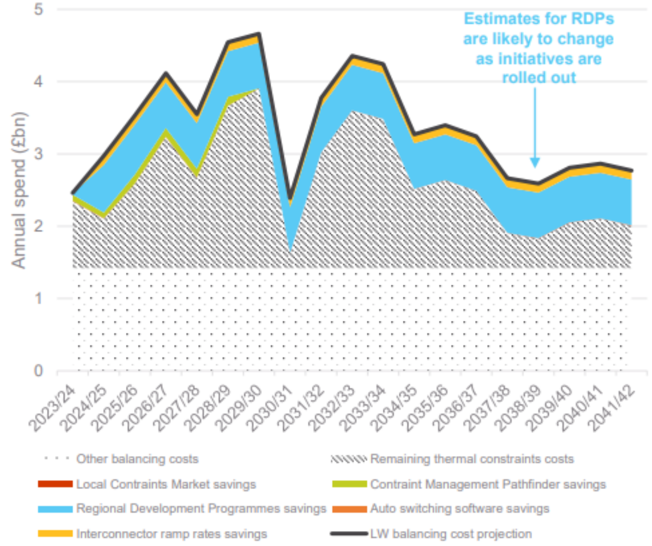


Figure 12. Potential thermal constraint savings achieved through initiatives



Through CCP, NESO's strategic approach to constraint management has developed

Long-term solutions (2030+)

- **Network build-out** to bring transmission capacity in line with more remote generation capacity
- **Wholesale market reform** to avoid curtailment of renewables behind constraints

Medium-term (2028-2030)

- **Reformed connections process** to enable connections able to help with operability challenges
- **Reformed BM** to allow more flexibility assets to participate in the BM
- **SSEP and CSNP** provide framework for strategic infrastructure and forecast of network needs
- **Clear route to market** for anything that can't access the BM

Short-term (now – 2027)

- CCP outcome: continue to **investigate technical options** relating to Intertrip
- CCP outcome: continue to develop **Demand for Constraints** (long term CMM)
- CCP outcome: Focus on **existing short-term CMM** for non-BMUs
- Develop our **battery storage strategy**, as well as reducing skip rates
- Work on **enabling access to our markets** for demand-side flexibility
- **Outage optimisation**, including Transmission Acceleration
- **Continue with CMIS expansion, 300MW derogation, operational metering review**

Project Update

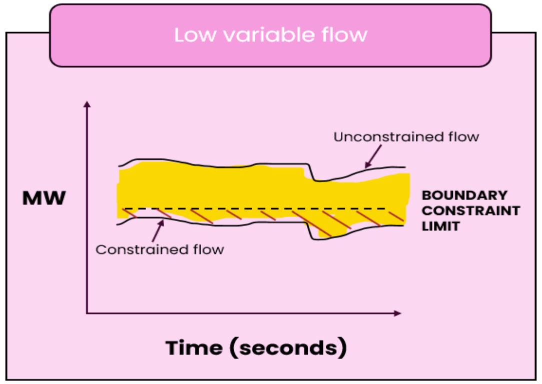
Topic 2: Boundary Flow Smoothing (formerly transfer booster)

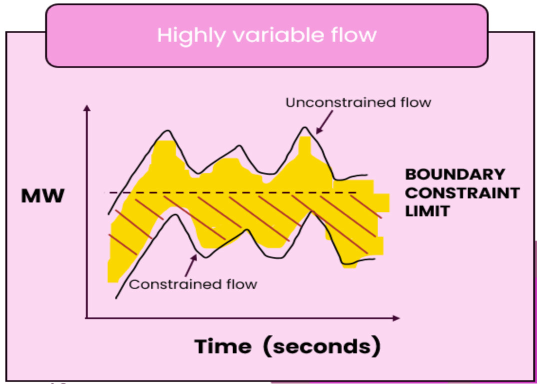
Overview of boundary flow smoothing (formerly transfer booster)

Definition

- **Transmission network boundary transfer capacities** are the safe limits for how much power can flow over a boundary
- **The control room has to keep the flow below the limit** by taking actions to reduce the flow. This often means bidding off wind and accepting offers on replacement gas generation
- Ideally the **flow should be reduced to just below the limit**

Background





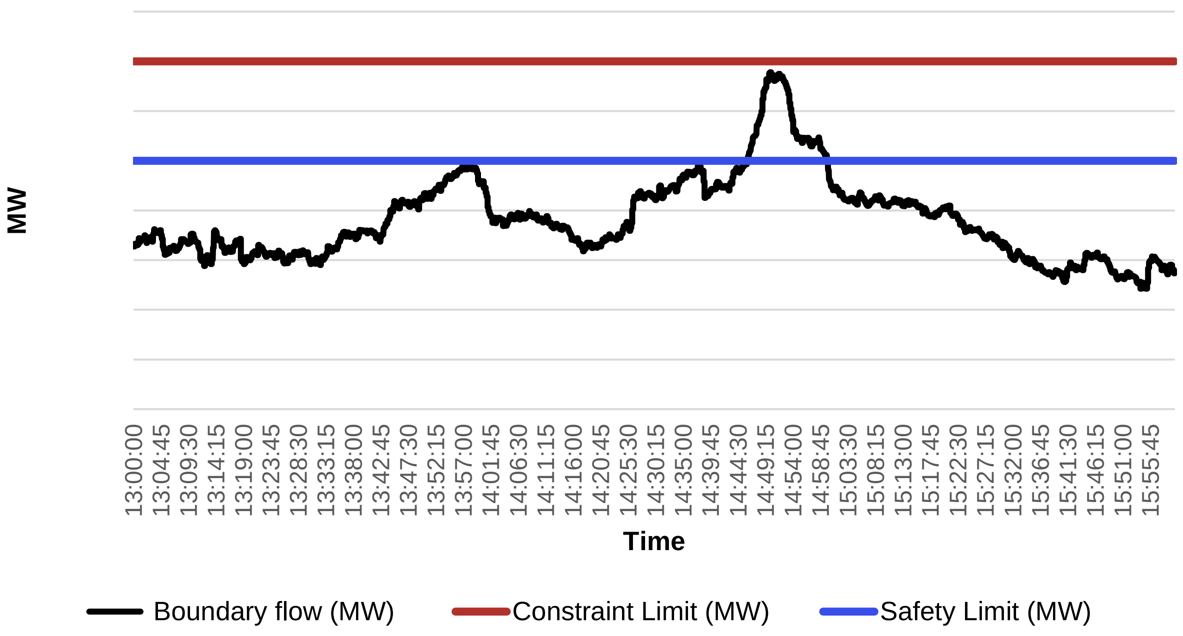
- Power flows over constrained boundaries are often very variable, because of rapid changes in supply and demand on both sides of the boundary (e.g. due to wind gusts)

- 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, creating a buffer or headroom, to reduce the risk of the variability in the flow causing the limit to be exceeded

- If the fluctuation in the boundary flow could be reduced, it might allow the control room to lower the headroom, enabling more renewable power to cross the boundary and thus reducing costs

As-Is: a volatile situation during a windy day; applying a safety margin of 400 MW reduces the flow and maintains safety limit

Graph is for illustrative purposes only



Analysis

What is the issue?

- The graph illustrates the volatility of boundary flow during a windy day with an active constraint, after bid and offer actions
- Around 14:50, rapid changes in wind speed caused the flow to increase by 350 MW in approximately 3 minutes

How do we address this currently?

- Given the high volatility, applying a safety margin of 400 MW in the control room under similar conditions could reduce the flow, maintaining it within a lower operational limit (Safety Limit line)
- This adjustment prevents the flow from exceeding the constraint limit during the wind gust at around 14:50
- However, this means we did not utilise network capacity effectively and this incurred additional costs to the system

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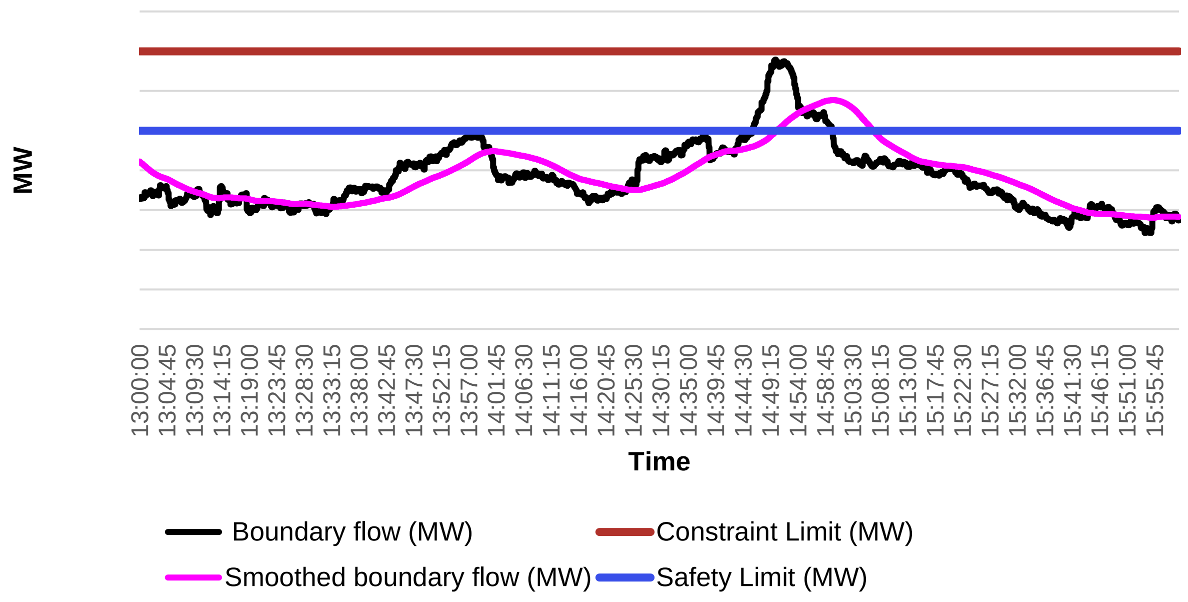
To-be: a flexibility service provider could smooth the boundary flow and reduce peaks and troughs

Graph is for illustrative purposes only



How would the concept work?

1. 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
2. The FSP could adjust its supply or demand to counteract the flow variability
3. The FSP would provide the service whenever instructed, typically when the boundary is constrained
4. From the example explained above, the FSP might be able to respond to a signal by increasing or decreasing its output to oppose the flow, reducing its variability

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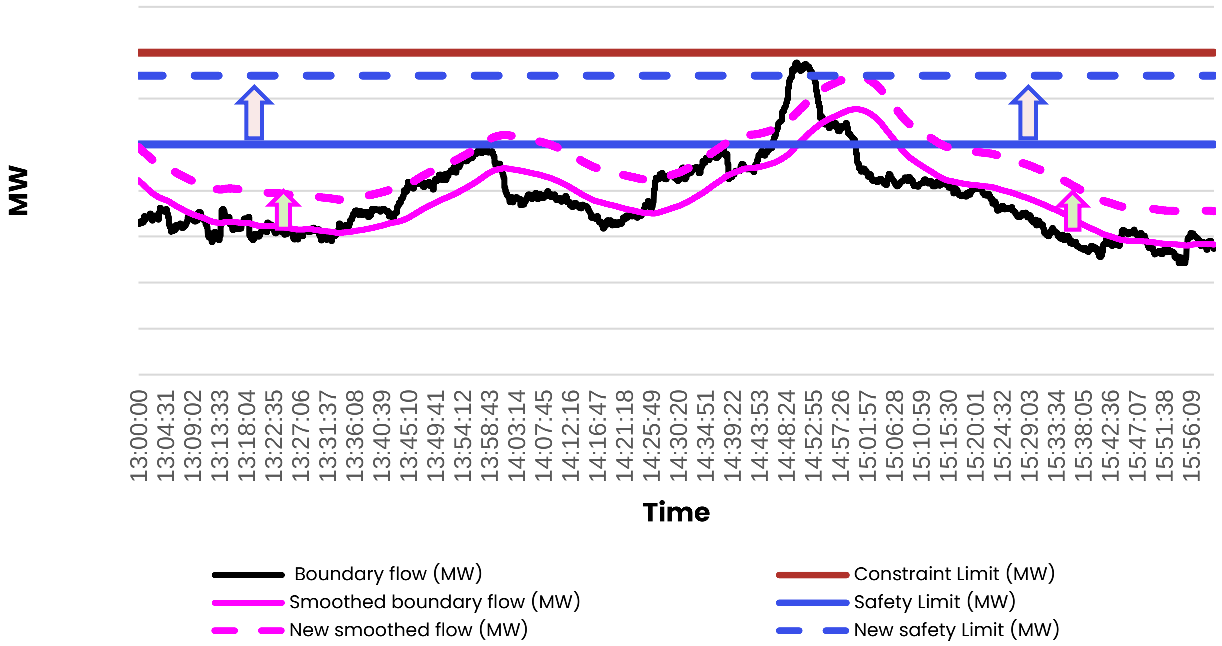
To-be: if boundary flow smoothing is applied, the safety margin could be reduced and more renewable power could flow across the boundary

Graph is for illustrative purposes only



Potential impact

This might **enable control room engineers to reduce the safety margin** (e.g. from 400 MW to 100 MW)

Less power generation needs to be bid off, in this example **freeing up to 150 MW of network capacity**

This allows more renewable power to flow across the boundary, reducing constraint costs

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Overview of work packages

Project update	— Frazer-Nash Consulting has been selected to evaluate the technical feasibility and economic viability of this concept — The project will last ~ 6 months, from April to October 2025
Key Ask of Industry	— **We are keen to engage with industry to gain information on the technical parameters of the technologies that could provide this service** — Information required include ramp rates, response time, duration of the service provision, volumes of flexing up/down

WP1 – Landscape Assessment

Collection of other examples of using storage and flexibility as transmission investments, focusing on those that align with volatility reduction

WP2 - Analysis of Boundary Flow Variability

Analysis of historical constrained boundary flows to derive different volatility metrics

WP3 - Development of Simplified Archetypes

Identification of feasible technology options for providing a volatility reduction service

WP4 - Algorithm Exploration

Exploration of potential algorithms to direct the operation of assets to reduce boundary flow volatility

WP5 - Consumer and Environmental Benefit

High-level insights into the scale of consumer and environmental benefits that could be realized through developing this service

Project Update

Topic 3: Demand for Constraint CBA Findings

Overview of findings

CBA Scope	– We have assessed the value delivered for consumers of a Demand for Constraints service. Two contract types were evaluated: 1) A fixed utilisation tariff (£/MWh for excess electricity consumed), paid from demand facilities to NESO 2) A variable utilisation tariff based on a set discount from spot price, paid from demand provider to NESO – **A counterfactual case and four cases have been modelled** reflecting different levels of demand contracted, boundaries, flexibility and constraint resolution threshold to understand the potential consumer savings under the two contract options
Findings	– **Both contract-types resulted in consumer savings** of between £0.4bn (0.2%) to £1.2bn (1.45%) over the 2028 – 2035 period – **Savings are mainly from avoiding paying the premiums to renewable assets to curtail output in Balancing Mechanism**. This finding gives us the potential to explore alternative contract structures – **If the P462 code modification** (removal of subsidies from bid prices in the balancing mechanism) and an availability payment are introduced **the cost savings would be reduced significantly** – **The inclusion of baseload demand** which is visible at the day-ahead stage **increases the annual average day-ahead wholesale price** in both contract options
Risk and Challenges	– Through our stakeholder engagement, we're aware of **several commercial, technical and regulatory hurdles** to overcome before we can be sure that there will be demand facilities able to participate. These include: o Timely allocation of funding support, including Hydrogen Production Business Model (HPBM) o Availability of wider infrastructure for the demand facility and the alignment of the constraint periods with operational profiles o Availability of grid connections and the associated costs o Application of Final Consumption Levies (FCL) to demand turn-up in balancing services (and constraints market)
Next Step	– Review CBA results and develop mitigation plans to address NESO risks – Review residual risks with DESNZ/others to understand how they can be mitigated before we come to a decision

Detailed findings of cost benefit analysis for Demand for Constraints

A counterfactual representation of the constraint costs between 2025 and 2035 utilising the FES 2024 Holistic Transition pathway has been modelled. The CBA shows that for all cases considered, DFC would reduce the costs consumers face via their electricity bills

Overview:

- **Key boundaries** with constraints are those in Scotland (B0-B1, B3-B4 and B6) as well as East Anglia (EC5)
- **Technologies:** hydrogen, commercial demand (data centre), industrial demand – electrification of industrial process and electric arc furnace, BESS, pumped hydro
- Four cases have been modelled with **varying the level of demand, boundaries, flexibility and constraint resolution** threshold

<table>
<tr><th rowspan="2"></th><th colspan="5">Assumptions</th><th colspan="2">Potential consumer cost savings (2028 – 2035)</th></tr>
<tr><th>Boundaries</th><th>Average annual demand contracted (TWh)</th><th>Flexible Demand</th><th>Baseload</th><th>Min. threshold</th><th>% savings per annum*</th><th>£bn of savings across 8 years period</th></tr>
<tr><td>Case 1</td><td>B0-B1, B3-B4, B6 & EC5</td><td>3.5</td><td>50%</td><td>50%</td><td rowspan="5">200 MWh</td><td rowspan="3">c. 1%</td><td rowspan="3">~£1bn</td></tr>
<tr><td>Case 2</td><td>B0-B1</td><td>0.8</td><td>50%</td><td>50%</td></tr>
<tr><td>Case 3</td><td rowspan="3">B0-B1, B3-4 & B6
B0-B1</td><td>2.8</td><td>50%</td><td>50%</td></tr>
<tr><td>Case 4</td><td rowspan="2">0.7</td><td rowspan="2">100%</td><td rowspan="2">-</td><td rowspan="2"><1%</td><td>~£0.45bn</td></tr>
<tr><td>Case 4a</td><td>~£0.3bn</td></tr>
</table>

*Savings can be achieved for consumers through several elements of the electricity bill. This includes constraint costs, wholesale costs and renewable support costs

Includes annual availability payment

The introduction of an annual availability payment results in a 23% reduction in the savings

Several significant risks impact the potential for consumer savings (1/2)

Risk	Hydrogen	Data Centres	Industrial Demand	BESS	Pumped Hydro Storage
1. Allocation of funding support and potential for windfall - a delay in contract allocation to mobilise funding, getting projects from conceptual to operational phase	Timely allocation of HAR will be critical to enable hydrogen production to deliver at scale		Business case needed for industrial to be electrified, which will likely be underpinned by cost savings		The deliverability of PHS will be reliant on the swift allocation the new Cap and Floor regime
2. Grid connections and the associated reinforcement costs – The technologies at a minimum will require a demand connection, and for storage technologies will require an export connection. Both reinforcement costs and the timely availability of grid connections will be critical to support the business case of demand	Grid costs are a significant part of wholesale electricity price. Any future revenue support mechanisms need to consider grid connection charges that would be incurred by demand.			Securing a grid connection before 2030 will be a challenge for new BESS projects, especially in Scotland	
3. Adequacy of wider infrastructure in constrained areas and development risk – Lack of necessary infrastructure to justify investment and incentivise flexible operation. Delay in process of securing land, permitting and consenting within the designated boundary could halt development of demand projects	Inadequate network & inability to blend H_2 into the natural gas transmission network could disincentivise deployment target	Fibre connectivity infrastructure in Scotland requires further buildout to incentivise data centres to site	If demand is connecting later, it is likely to have a diminishing impact on the savings for consumers ahead of wider network development.		

Legend *Limited or indirect relevance* *High* *NESO* *GOVERNMENT* *PROJECTS* *OFGEM*

A successful Demand for Constraints scheme is reliant on these risks being resolved, within a short timeline, so that investment decisions can be made and so that maximum consumer savings are possible

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Several significant risks impact the potential for consumer savings (2/2)

Risk	Hydrogen	Data Centres	Industrial Demand	BESS	Pumped Hydro Storage
4. Additional barriers for demand turn up in constrained areas – For example, final consumption levies (FCL)	Hydrogen and Data Centres are classified as energy-intensive industries (EIIs) hence eligible for a levy exemption scheme. This creates an unlevel playing field between demand projects		FCL make demand turn up (DTU) actions uncompetitive in constraints markets	FCL are not applied to generation (or storage) so there is an unlevel playing field between demand and storage	
5. Code coordination risk between Elexon, Ofgem, and NESO – Such as but not limited to the development of P462 and CMP440 that could change the level of potential benefits	If P462 (removal of subsidies from bid prices in the balancing mechanism) is implemented, it could affect bidding behaviour of these assets in the BM. By de-coupling bid prices from subsidy reimbursement, it could reduce balancing costs by aligning BM prices with the consumer cost of impact of the action. It does raise challenges for certain industry participants, hence why an independent CBA will test these assumptions. CMP440 has potential indirect impact on siting decision that could affect constraints. If implemented, it could indirectly undermine business case of Demand for Constraints				

Legend *Limited or indirect relevance* | *High* | *NESO* | *GOVERNMENT* | *PROJECTS* | *OFGEM*

A successful Demand for Constraints scheme is reliant on these risks being resolved, within a short timeline, so that investment decisions can be made and so that maximum consumer savings are possible

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Proposed mitigation plans to address NESO risks (1/2)

Risk	Suggested Mitigating Measures for NESO
1. Allocation of funding support and potential for windfall - a delay in contract allocation to mobilise funding, getting projects from conceptual to operational phase	**1. Continue working with DESNZ in reviewing and improving design of hydrogen production business model.** This would ensure any support mechanism is design in a way that avoid windfall and complementary to helping manage constraints
2. Grid connections and the associated reinforcement costs – The technologies at a minimum will require a demand connection, and for storage technologies will require an export connection. Both reinforcement costs and the timely availability of grid connections will be critical to support the business case of demand	**2. NESO's connection reform** could speed up connection queues for projects that are critical to security of supply or system operability
3. Adequacy of wider infrastructure in constrained areas and development risk – Lack of necessary infrastructure to justify investment and incentivise flexible operation. Delay in process of securing land, permitting and consenting within the designated boundary could halt development of demand projects	**3. Continue to support DESNZ on REMA** to ensure our market is competitive and can send price signals **NESO Regional Energy Strategic Planner (RESP)** would ensure energy projects are regionally coordinated across fuel vectors, with the right level of local input **The Government's planning reforms** could facilitate the rapid deployment of demand projects

How do you feel about this risks? Do you have any other ideas how NESO can mitigate these risks?

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Proposed mitigation plans to address NESO risks (2/2)

Risk	Suggested Mitigating Measures for NESO
4. Additional barriers for demand turn up in constrained areas – For example, final consumption levies (FCL)	**4.** As part of the Low Carbon Flexibility Roadmap development with DESNZ and Ofgem, **NESO is highlighting challenges for "Demand Turn Up" flexibility, such as FCLs, as part of the action setting process** **Investigate with Elexon whether the BSC has the ability to take any action on FCLs** (for balancing services etc), or whether wider legislative or regulatory changes are required
5. Code coordination risk between Elexon, Ofgem, and NESO – Such as but not limited to the development of P462 and CMP440 that could change the level of potential benefits	**5. Maintain regular, structured communication channels** between Elexon, Ofgem, and NESO to ensure timely information exchange

How do you feel about this risks? Do you have any other ideas how NESO can mitigate these risks?

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Discussion and Q&A

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Thank you!

To keep in contact and to keep sharing your ideas, please visit our website or email us at box.market.dev@uk.nationalenergyso.com

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