

Public

Constraints Collaboration Project (CCP) Webinar

Quarterly update

25 June 2026



Introduction

Agenda

Timings

Speaker

<u>Agenda</u>	<u>Timings</u>	<u>Speaker</u>
Introduction and house keeping	09.30 – 09.35 (5 mins)	Qi Zhong
Topic 1: Boundary flow smoothing	09.35 – 09.55 (20 mins)	Anthony Simpson Jack Dowell (Frazer-Nash)
Topic 2: Storage behind constraints	09.55 – 10.05 (10 mins)	Ben Noone
Topic 3: Constraint management market	10.05 – 10.30 (25 mins)	Saskia Barker
Topic 4: Constraints management measures in RNP delivery plan	10.30 – 10.40 (10 mins)	Simon Rickenbach (DESNZ)
Q&A and next steps	10.40 – 11.00 (20 mins)	Alifa Starlika

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Housekeeping

Key asks for the session



Today's webinar focuses on the **Constraint Collaboration Project**. Please submit questions through Slido (code: #CCP) and state your name. You can find the QR code in the chat and on each page of the PPT.



For questions on any other topics, please submit via box.market.dev@neso.energy.



Please be mindful that we may not have all the answers but will take things away if needed, and publish Q&A along with the slides and recording.



Please ensure cameras & microphones are disabled to protect the bandwidth quality.

Webinar Norms

*Listen to
each other*

*Engage in
the
process*

*Know what
to let go*

*No
question
too stupid*

*Defer
judgement*


*Seek
clarity*





Overview of Constraints Collaboration Project


1. Constraints Management Markets (CMM)


1A. Demand for Constraints / Long-term CMM


 Increasing demand for power in constrained areas for electrification of heat


 Constraints management markets (CMMs)

 Flex PtX to produce green H₂ and related derivatives


 Long-term contract to manage a portion of the forecast constraint volumes


 Pre gate closure constraint management product using schedule 7 trade


 Demand signal product


 Competitively allocated season ahead constraint management availability contracts


 Competitively allocated short-term constraint management contracts (D-7)


 Incentivising new discretionary demand (H₂ production and electricity storage)


 Long-term auction of excess wind

 Discounted demand turn up

 'COOLER HEATING' – commercial heat loads as responsive assets

 Weekly generation turn down market

 Long-term constraint management contracts (incentivising new demand)

 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)

 Extended intertrip scheme


 Grid booster


2C. Boundary flow smoothing: Pre-fault


 Transfer booster

 Intertrip scheme utilisation

 Paired storage systems across key boundaries

 Enhance utilisation of transmission network

 Flexibility for Active Network Management (ANM) zones and Generation Export Management (GEMS)

 Battery for constraints: Reducing the line rating from 10 to 3 mins



Overview of Constraints Collaboration Project

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1A. Demand for Constraints / Long-term CMM

1B. Short-term Constraints Management Markets

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

2C. Boundary flow smoothing: Pre-fault

Increasing demand for power in constrained areas for electrification of heat	Constraints management markets (CMMs)	Extended intertrip scheme	Grid booster	Transfer booster
Flex PtX to produce green H ₂ and related derivatives	Long-term contract to manage a portion of the forecast constraint volumes	Pre gate closure constraint management product using schedule 7 trade	Intertrip scheme utilisation	Paired storage systems across key boundaries
Demand signal product	Competitively allocated season ahead constraint management availability contracts	Competitively allocated short-term constraint management contracts (D-7)	Enhance utilisation of transmission network	Flexibility for Active Network Management (ANM) zones and Generation Export Management (GEMS)
Incentivising new discretionary demand (H ₂ production and electricity storage)	Long-term auction of excess wind	Discounted demand turn up	Battery for constraints: Reducing the line rating from 10 to 3 mins	
'COOLER HEATING' – commercial heat loads as responsive assets	Weekly generation turn down market	Weekly generation turn down market	Battery for constraints: Reducing the line rating from 10 to 3 mins	
Long-term constraint management contracts (incentivising new demand)	The 'Big Friendly Battery' for ~8 hours duration			



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 Increasing demand for power in constrained areas for electrification of heat

 Constraints management markets (CMMs)


 Extended intertrip scheme

 Grid booster

 Transfer booster

 Flex PtX to produce green H₂ and re...

 Long-term contract

 Pre gate closure constraint management



 Paired storage systems across / boundaries

- **Demand for constraints (DfC) service development – material is available [here](#):**

- Technical & dispatch webinar on 5 March 2026,
- Commercial design webinar including delivery plan update on 24 June 2026,

- **Constraint management intertrip service (CMIS) Scotland:**

- Now completed the consultation & Express of Interest (EOI) stage. Currently assessing EOI submissions.
- Service planned to go live in Q4 2027.

- **CMIS EC5 enduring service:**

- The transmission owner (NGET) is currently working on completing the upgrade to the East Anglia Operational Tripping Scheme (EAOTS).
- Plan to start the service from Q4 2026 once EAOTS upgrade completed.

For CMIS, please find monthly update on [Electricity Markets Delivery Plan](#), under “Thermal” tab.

Project update

Topic 1: Boundary Flow Smoothing

Anthony Simpson (NESO)

Jack Dowell (Frazer-Nash Consultancy)



Agenda

- Why have we looked at this?
- What is Boundary Flow Smoothing?
- Approach to feasibility assessment
- How was flow volatility assessed?
- Defining an implied safety margin
- What smoothing can do well?
- How benefits are calculated and what limits them
- What operational and consumer benefits might be achievable?
- What is the revenue opportunity for providers?
- Conclusions

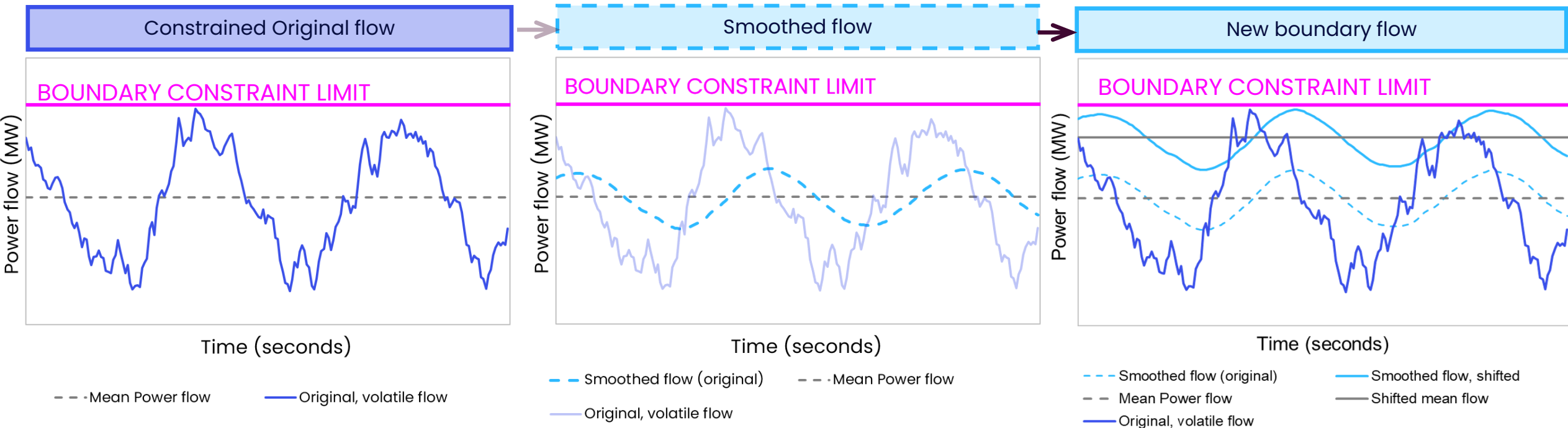


Why have we looked at this?

- Boundary **thermal constraints** are a **major source of system costs**.
- **Constraints Collaboration Project (CCP)** idea proposed to smooth boundary flows (reducing the magnitude of peaks and troughs) using flexible assets. In principle, this could reduce short-term peaks and help operators run closer to limits.
- **Frazer-Nash Consultancy (FNC)** appointed to conduct high-level assessment of potential technical viability and whether the idea could deliver meaningful real-world consumer benefit.
- **Dissemination** – The final report has been published on NESO website – [here](#).
- **Purpose of today's session:** To provide an overview of FNC's final results.



What is Boundary Flow Smoothing?



- High short-term volatility
- Bids are used in the BM to **constrain the flow**
- Peaks of the flow approach the **constraint limit**

- Smoothing reduces **short-term volatility**
- It does not change the mean flow
- It could be delivered by fast-acting, flexible assets

- Smoothing further enables operation closer to the boundary limit
- This would allow **more energy** to flow, **reducing volume & cost** of BM actions



Approach to feasibility assessment



Scope of data analysed and boundaries assessed

Second-by-second
boundary flow data
(Jan 2024 – Mar 2025)

Boundary flow **limit**
data

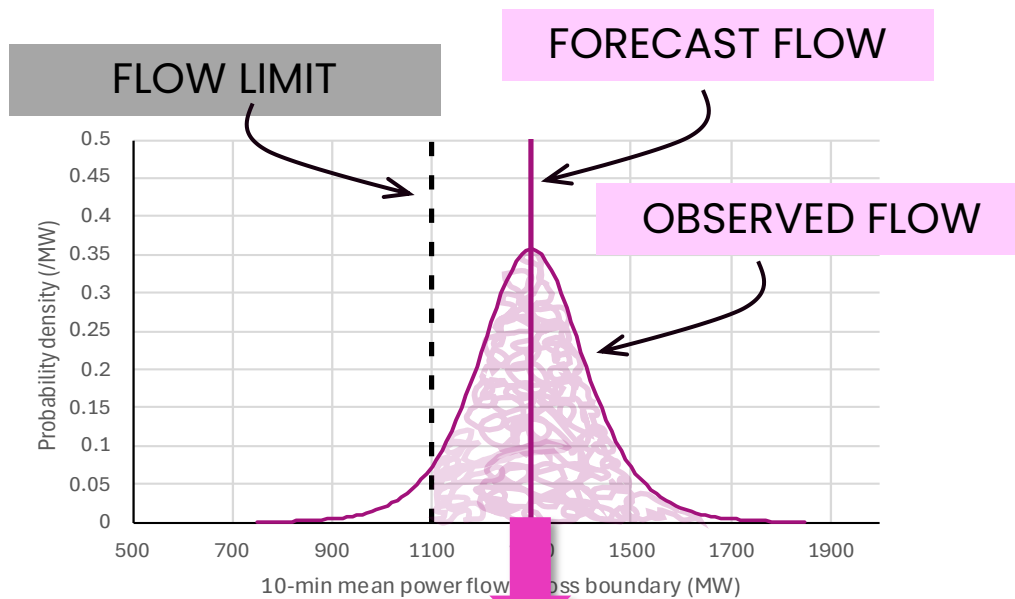
Constraint action filtered **BOA**
data

Limited to a set of **nested boundaries** in Scotland & Northern England

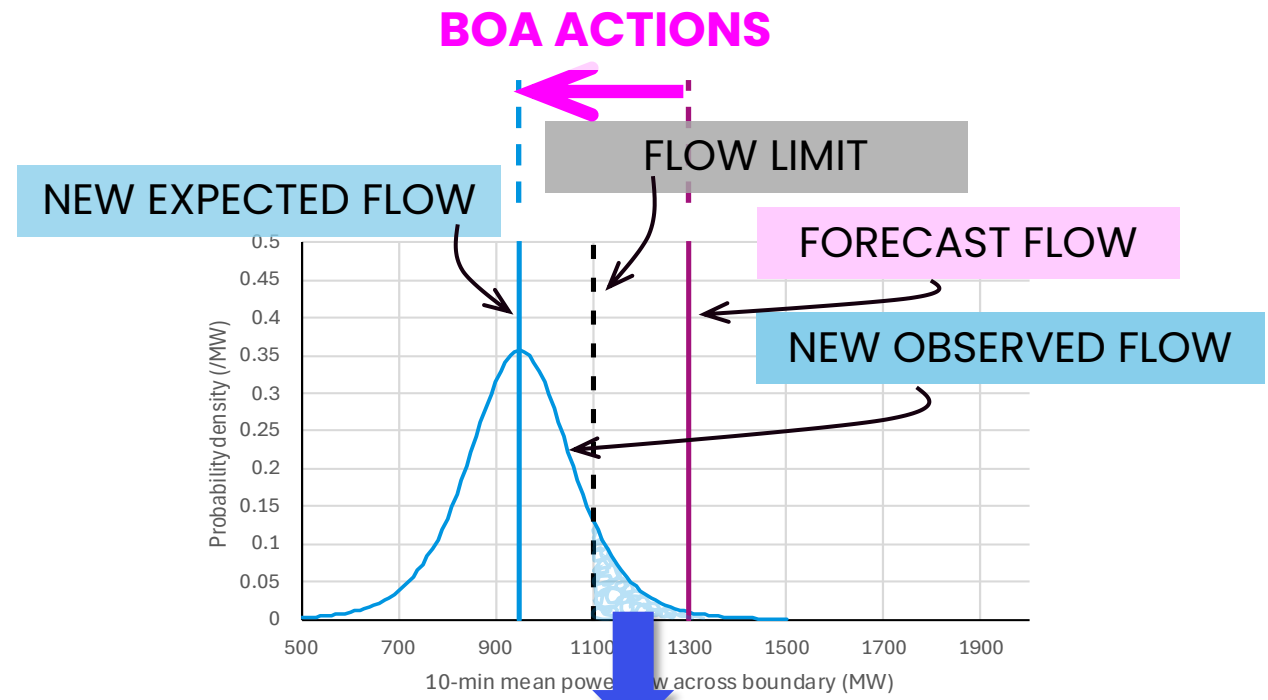


How flow volatility was assessed

- Boundary flow forecasts are updated every **10 minutes**.
- Real-time flow (10min mean flow) changes from forecast form a **bell curve probability distribution**.
- When forecast flow is **too close to or above** the limit, BOAs can **reduce the probability of exceedance** (shaded areas).



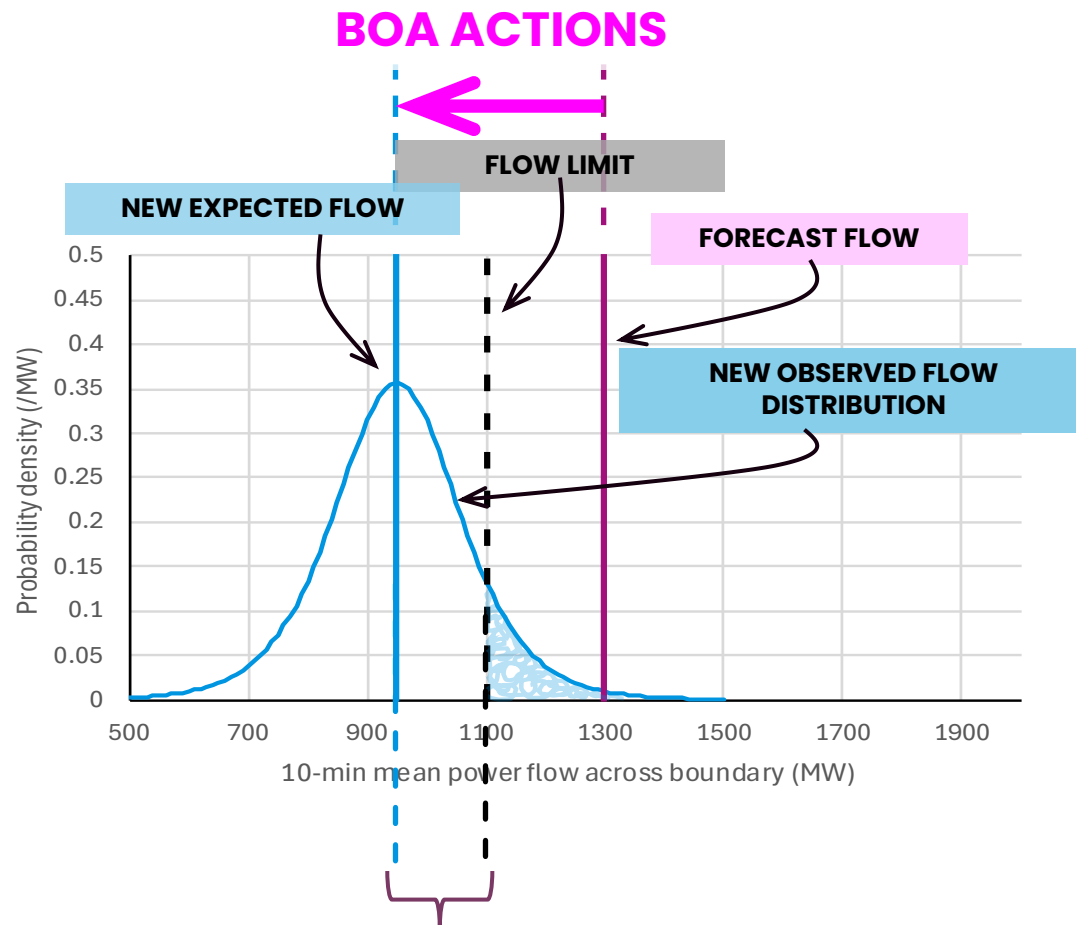
Without BOAs – very **high** likelihood boundary limit will be **exceeded**



BOAs Applied – **reduced** likelihood that boundary limit will be **exceeded**



Defining an implied safety margin



- The implied safety margin explains where do we place the mode of the distribution after BOA actions are taken so that a given fraction of the area beneath the curve lies to the right of the flow limit (light blue shaded area)
- This is based on statistical analysis of historical boundary limit exceedances and volatility.
- This is not a procedurally defined quantity that NESO use.

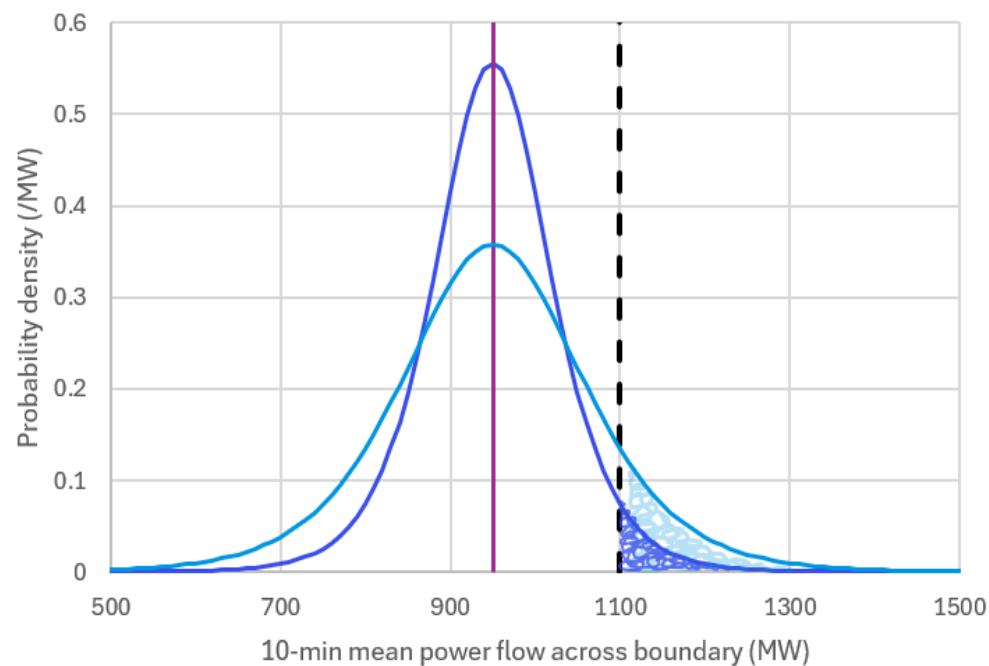
The **implied safety margin** is the gap between the boundary limit and the target expected flow after BOAs have been applied



What smoothing can do well

In this case, smoothing reduces:

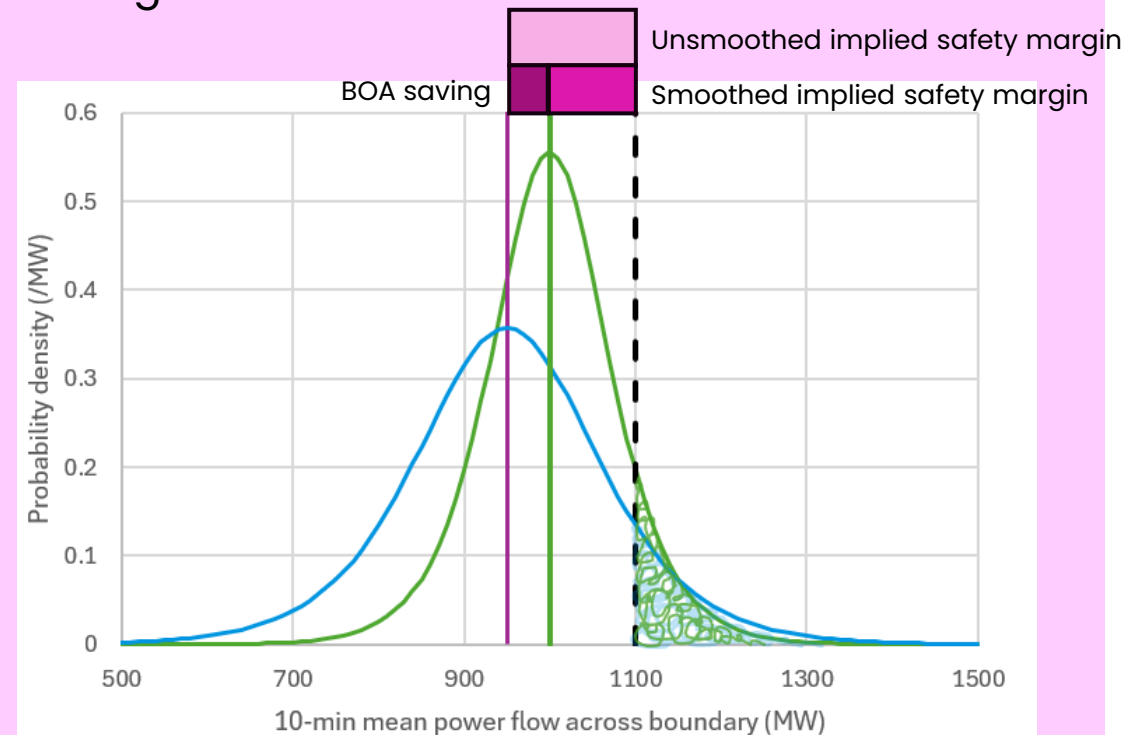
- short-term flow volatility and narrows the bell curve of 10-minute first differences.
- the incidence and severity of boundary flow limit exceedances.



— Smoothed flow distn - - Flow limit
— Target flow — Unsmoothed flow distn

In this example, smoothing further allows:

- the flow target to operate closer to the boundary whilst retaining a comparable probability of exceeding the boundary limit target.



— Smoothed flow distn - - Flow limit
— Target flow (old) — Unsmoothed flow distn
— Target Flow (new)



How benefits are calculated and what limits them



How are benefits calculated?

- For the same probability of boundary limit exceedance, smoothed flow can reduce the number of BOA actions needed in the BM.
- Economic benefit calculated as the **reduction in BM bids & offers**.



What could limit the benefits?

- Unlocking additional useful capacity depends on:
 - **Downstream constraints** in a nested boundary system, and
 - **Location & availability of BOAs**.



What operational and consumer benefits might be achievable?

Annualised figures	Benefits range
Additional boundary flow	~5 GWh to 28 GWh
Hours of increased flow	~300 hrs to 1,900 hrs
Average increased flow	~15 MW to 27 MW
BM cost savings*	~£0.7M to £4M
CO2 saved	~1,200 to 6,000 tonnes

- The range covers 3 deployment cases for benefits estimation, depending on how close to the boundary limit the service is activated.

- **Note:**

* The cost reductions are **before** accounting for the costs of: establishing and operating the service; paying flexibility service providers.



What is the revenue opportunity for flex providers?

	Revenue per (peak) MW installed capacity / year	Revenue per (10-min mean) MW installed capacity / year	Revenue per MWh installed capacity / year
Best Benefit Deployment Case	£404 (£75 - £921)	£1377 (£359 - £6,427)	£1,254 (£265 - £5,041)

- **BM cost reductions provide ceiling prices to pay flex providers by NESO. This is before covering the costs of developing, establishing and operating the market; *not* reflective of a market price.**
- The opportunity cost is low compared to existing revenues for providers. e.g. typical BESS revenues:
 - ~£57k per MW-year (power)
 - ~£42k per MWh-year (energy)
- **Smoothing revenues are orders of magnitude lower.**
- To achieve a modest increase in flow via smoothing, disproportionately large capacity (energy and power) requirements are needed to deliver the service – leading to high asset utilisation and cycling.



Conclusions



Weak Operational Feasibility

- Boundary flow smoothing does reduce short-term volatility however, that does not reliably translate into meaningful additional usable flow in a nested system.
- The additional energy transfer is limited, ranging from ~5 to 28 GWh, in comparison to the total amount of constrained energy of ~5800 GWh.
- If the boundary flow limit is already targeted in operation then possible flow increases are small.
- The operational delivery effort required by flex assets is high (~3.3 GWh and ~2.9 GW of capacity)



Weak Commercial Viability

- The estimated BM savings are limited, ranging from ~£0.7M-4.0M - in comparison to the constraints costs of ~£1.4 bn (for 2024)
- The aforesaid savings have not factored in implementation costs (>£1M) needed to deliver the service. This further undermines the potential benefit, making this service unlikely to present value for money to consumers.
- Additionally, high opportunity costs to participate make this market less attractive.

Overall, we did not find a strong practical case for boundary flow smoothing.

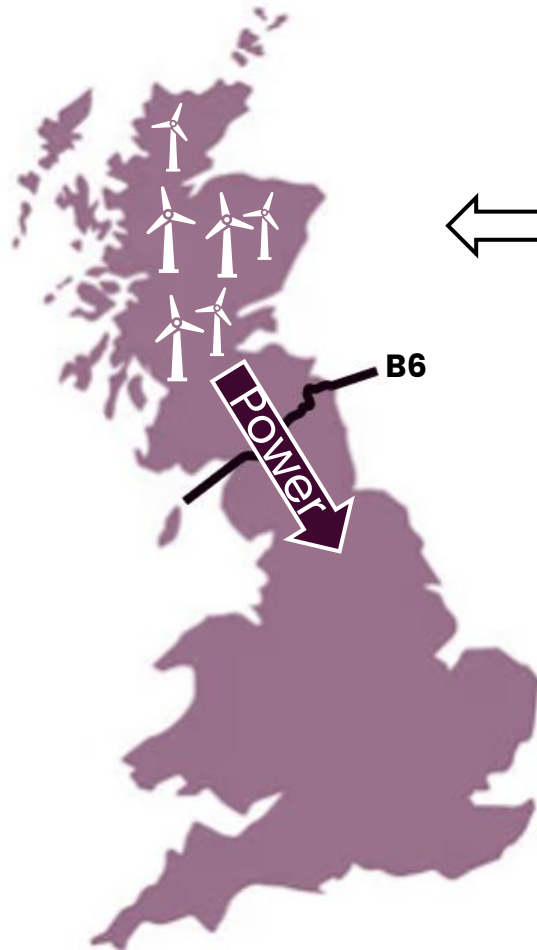
Project Update

Topic 2: Storage Behind
Constraints

Ben Noone



Background: Export and Import Constraints



Export constraints

- Limit the power that can flow **out** of a region
- Surround areas of high generation and low demand

- ## Import Constraints
- Limit the power that can flow **into** a region
 - Surround areas of high demand and low generation





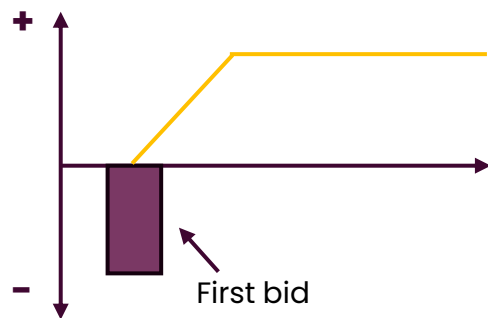
Operability challenge: repetitive retrading

Overview of this workstream

Storage scheduled to generate during export constraints can increase congestion. NESO dispatches in merit order, but behind constraints this can create a feedback loop that increases balancing actions and costs

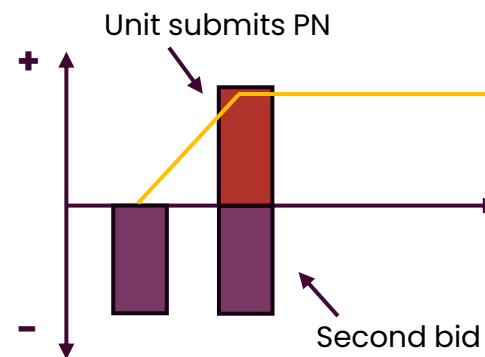
1

- Consider a storage unit which has a SoC of 0% and is located behind a constraint.
- To resolve the constraint, a bid is sent to charge the unit, increasing its SoC for the subsequent periods.



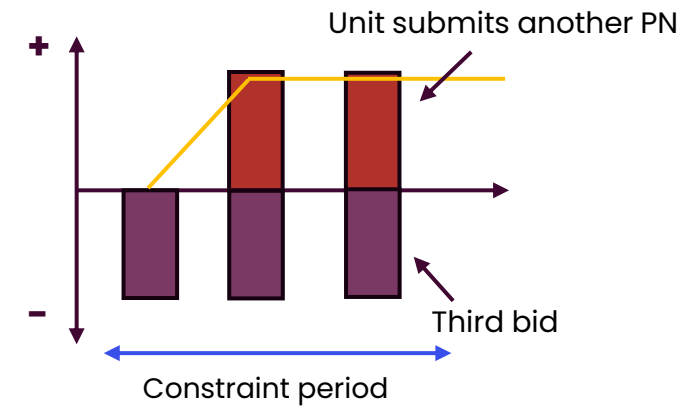
2

- With its new SoC, the unit now wants to sell the energy, and so it submits a PN.
- However, the constraint is still active so the energy cannot be physically delivered.
- A second BOA is sent to the unit to prevent the energy being discharged.



3

- This dynamic repeats itself for future periods and can continue for the entire constraint period.
- As a result, a higher volume of actions are required to resolve the constraint, increasing consumer costs.



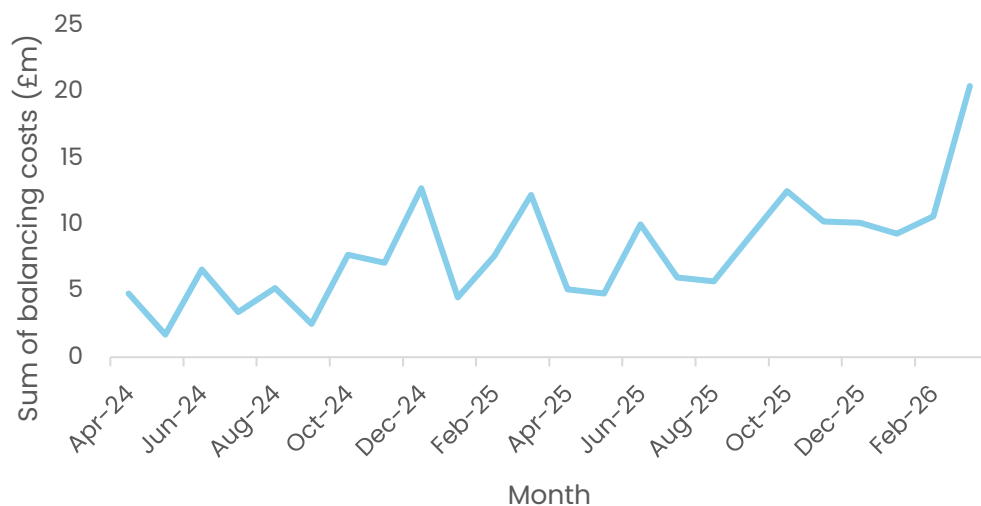
The cycle is a commercially rational response, not malicious behaviour. The overarching issue is the incentive structure of the market design



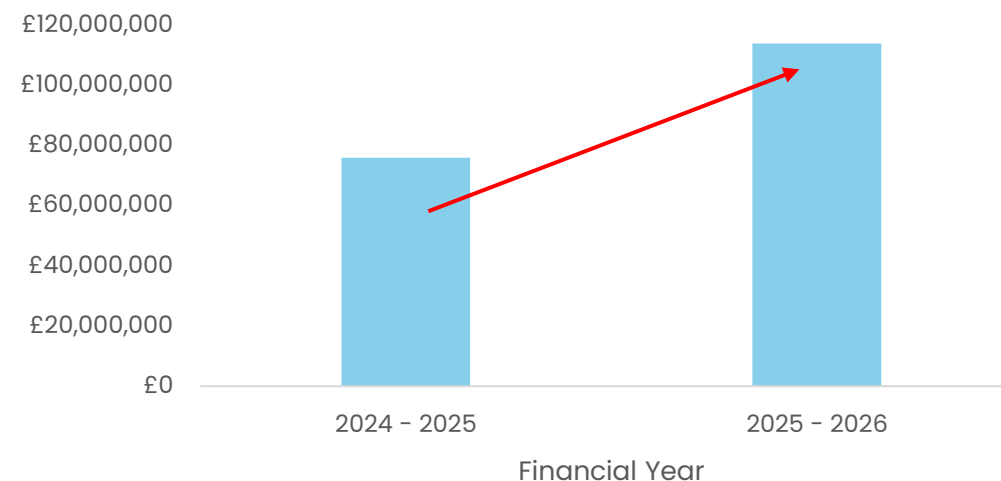


The balancing cost impact of RRT increased by 50% between FY25 and FY26

Monthly Sum of Balancing Costs due to RRT (in £m, 12 hrs search window)



Financial year sum of RRT balancing costs (12 hrs search window)



- NESO and DESNZ have defined RRT by agreement to only cover **the cycling of energy already bid off**
- The sum of the balancing costs due RRT was between £58.2m (3 hours search window) and £97.9m (12 hours search window) for the 2025 calendar year. Pumped storage is the key fuel type

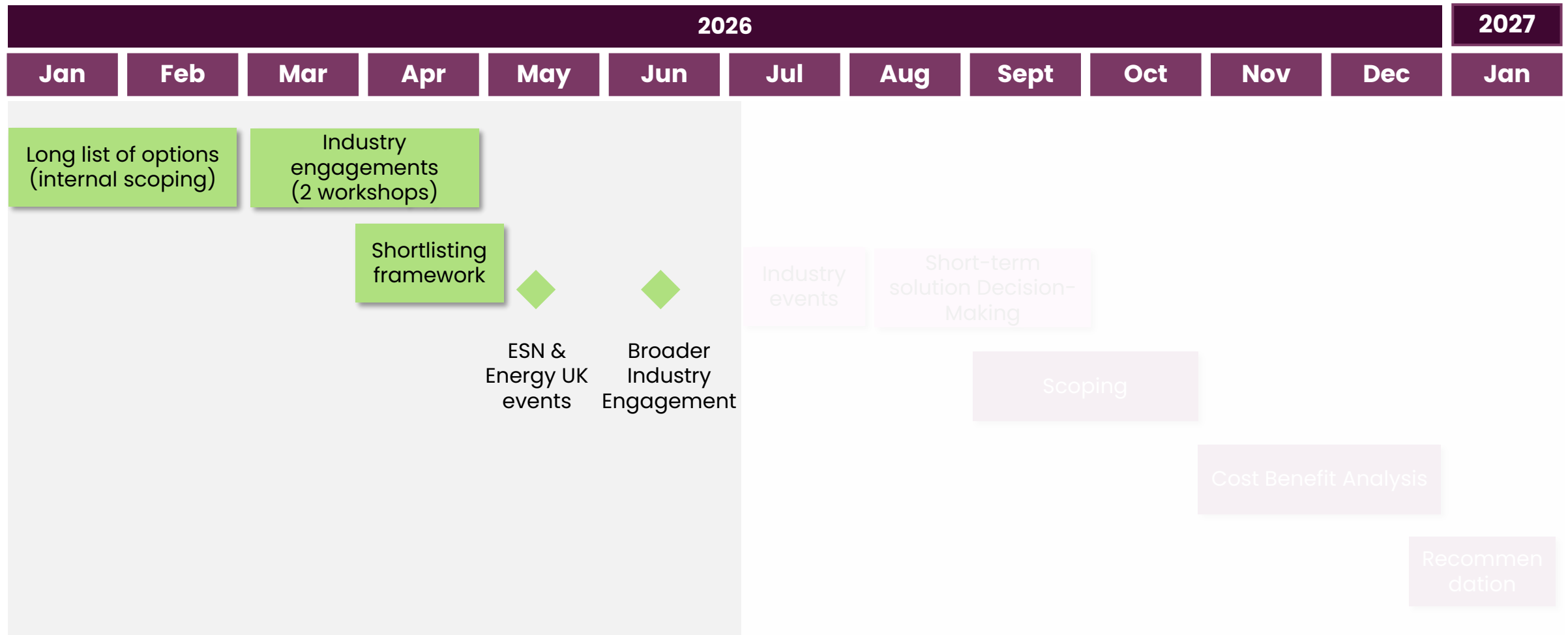
- **Trend of growing costs** with a calculated increase of 50% from FY2024-2025 and FY2025-2026 using 12hr search window results
- From March 2026 results may be influenced by higher gas prices following the Iran conflict; however, **March 2026 was also the peak month for volume**

Costs appear to be rising while storage deployment is still increasing. This conflicts with NESO's license obligation to operate the network economically and efficiently





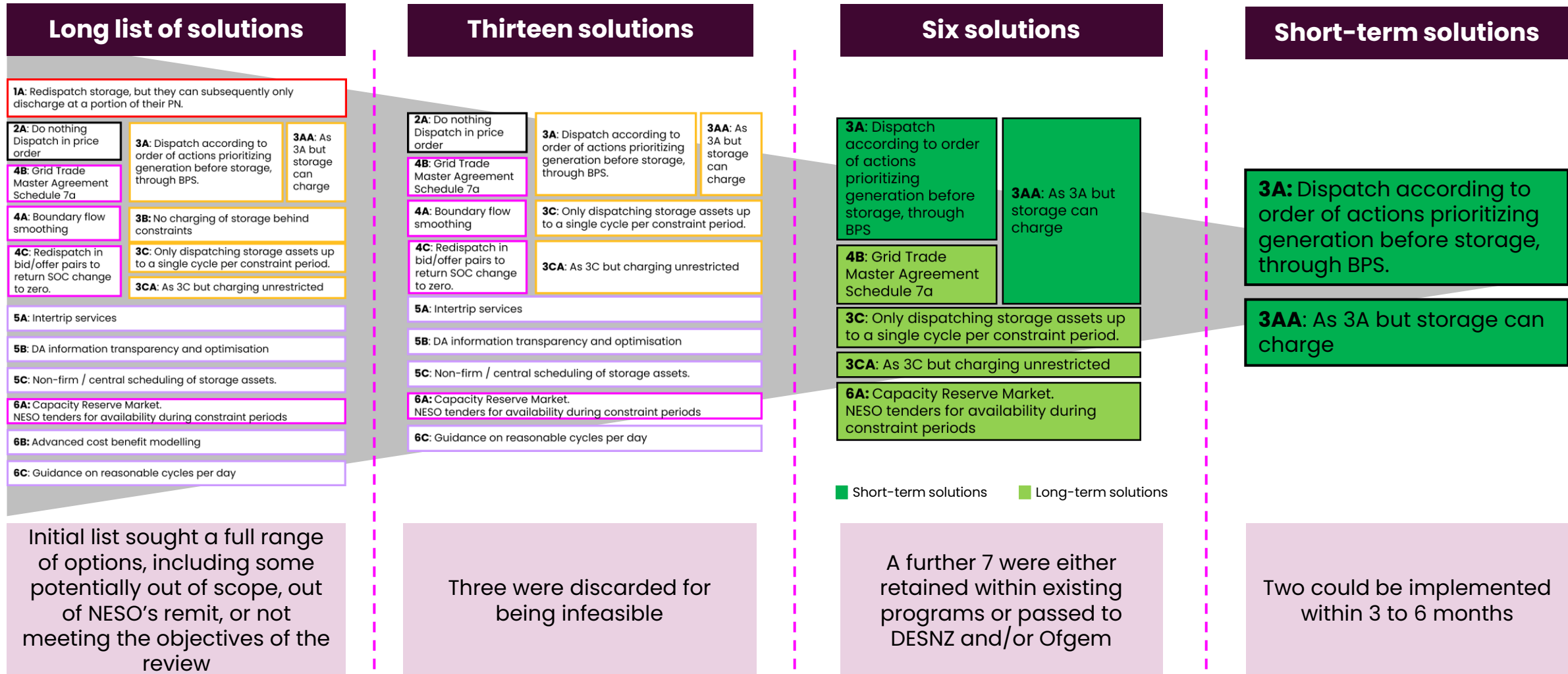
Long list of options have been assessed in 1H 2026





Shortlisting framework

Our aim is to retain the benefits of having storage on the system while reducing the unintended consumer cost impact





Shortlisted options have been produced

SHORT TERM (3 – 6 months to implement)

Option 3A

Change NESO's balancing rules; Prioritise redispatch actions on generation before storage behind export constraints.

- ✓ Breaks the repetitive retrading loop.
- ✓ Removes the cost externality without removing storage from wholesale or ancillary markets.
- ✓ Resolves tension between merit order and NESO's economic dispatch obligation.
- Short term option that does not fully resolve the issue

Option 3AA

As 3A but enables in-merit charging behind constraints without curtailing discharge.

- ✓ Preserves storage activity in BM
- ✓ Storage absorbs cheap or excess renewable energy mid-congestion.
- Does not remove the feedback loop; potential for more unwanted dispatch behind constraints with limited decarbonisation benefit.
- More complex to implement than 3A.

ENDURING (1 – 2 years)

Options for Cost-Benefit Assessment

3C: Single dispatch per constraint period

NESO would call on a storage asset to reduce output once per constraint period.

3CA: 3A, with charging unrestricted

No limits on charging during congestion but can only bid back a single discharge.

4B: GTMA Schedule 7A Expansion

Extend current trading platform to agree positions with BMUs before gate closure.

6A: Capacity Reserve Market

A competitive market where storage bids to be available during congestion periods.

Project Update

Topic 3: Constraint
Management Market

Saskia Barker



Background: Short term constraint management markets (CMM)

Short-term CMMs were assessed and not taken forward under the CCP in 2024



Given the decision to rule out zonal pricing last summer, there has been renewed focus on efforts to reduce constraints costs



As part of the Reformed National Pricing Programme, NESO is in the process of considering short term CMMs again

Last summer, the proposals brought forward by industry were focused on making savings on the 'replacement energy' NESO needs to procure when generation behind a constraint is instructed to turn down. Since most of these costs are driven by actions on gas units, there was a particular focus on trying to reduce the prices paid to gas for these actions.



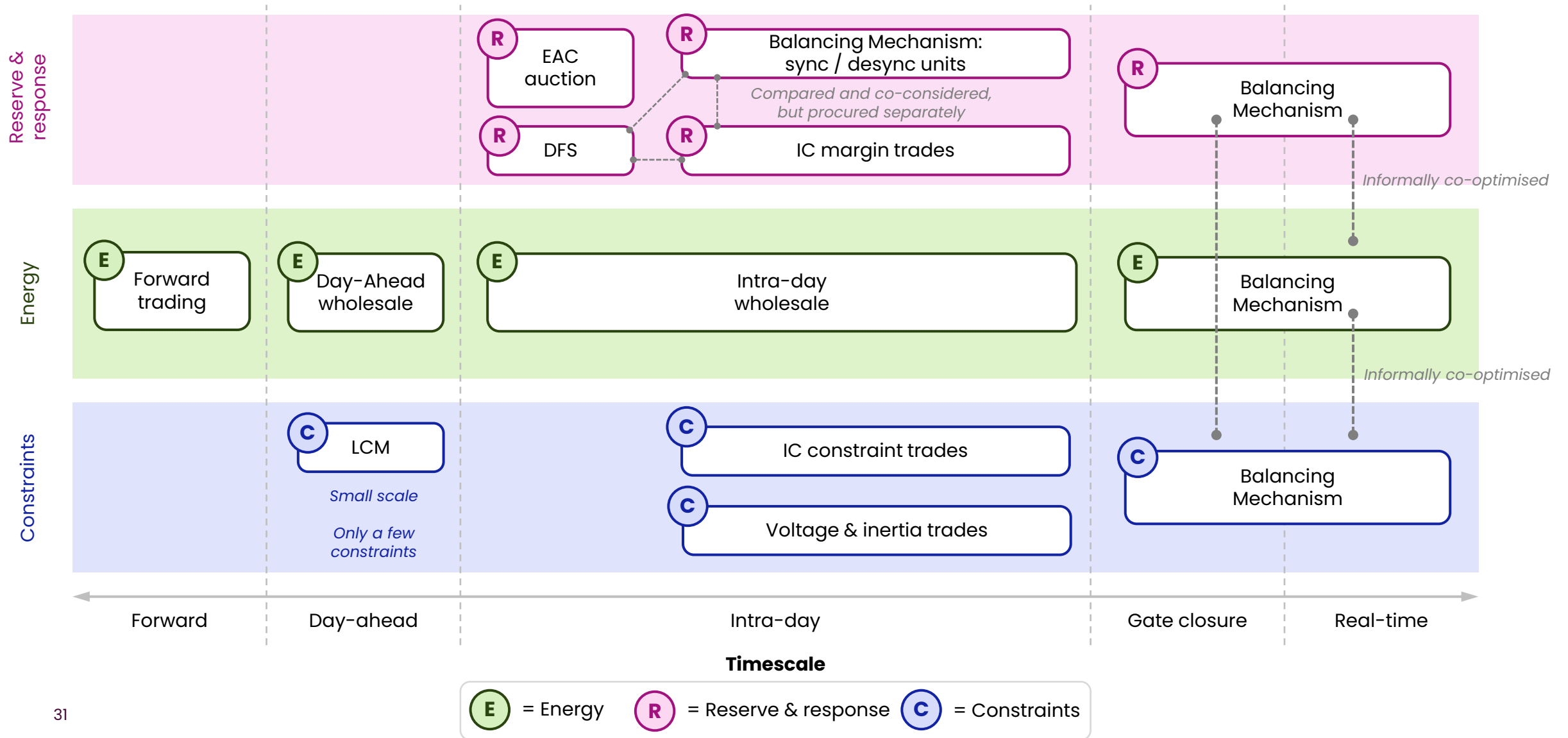
Previously, we set out that the risks associated with introducing additional CMMs outweigh the proposed benefits



Key: ■ Proposed benefits ■ Risks

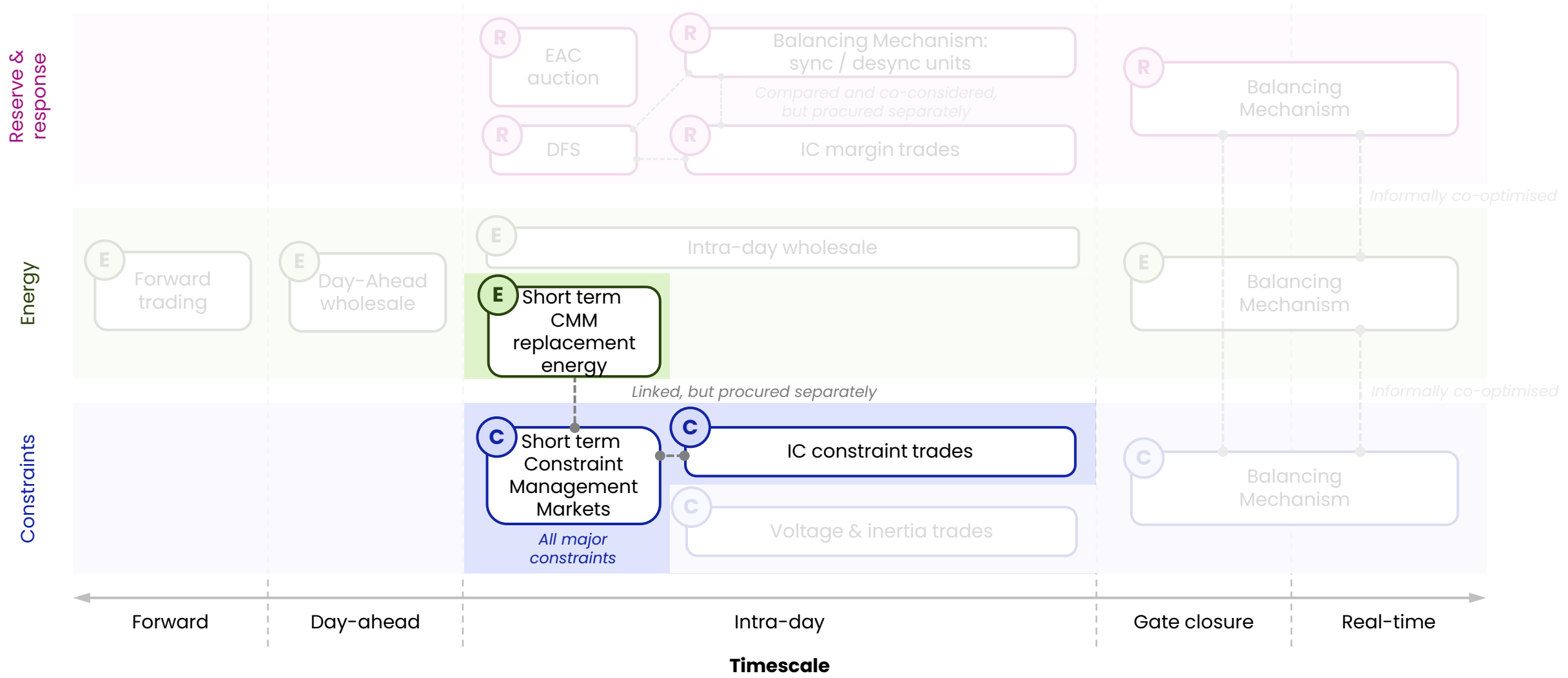


Status Quo





Short term Constraint Management Markets



(E) = Energy **(R)** = Reserve & response **(C)** = Constraints



Pros and cons of a new short-term CMM

Pros

- Could deliver reduced constraint costs (assuming units in front of constraints are able to provide lower price in exchange for certainty)
- Could deliver operability benefit for NESO if it reduces the number of redispatch actions required after gate closure

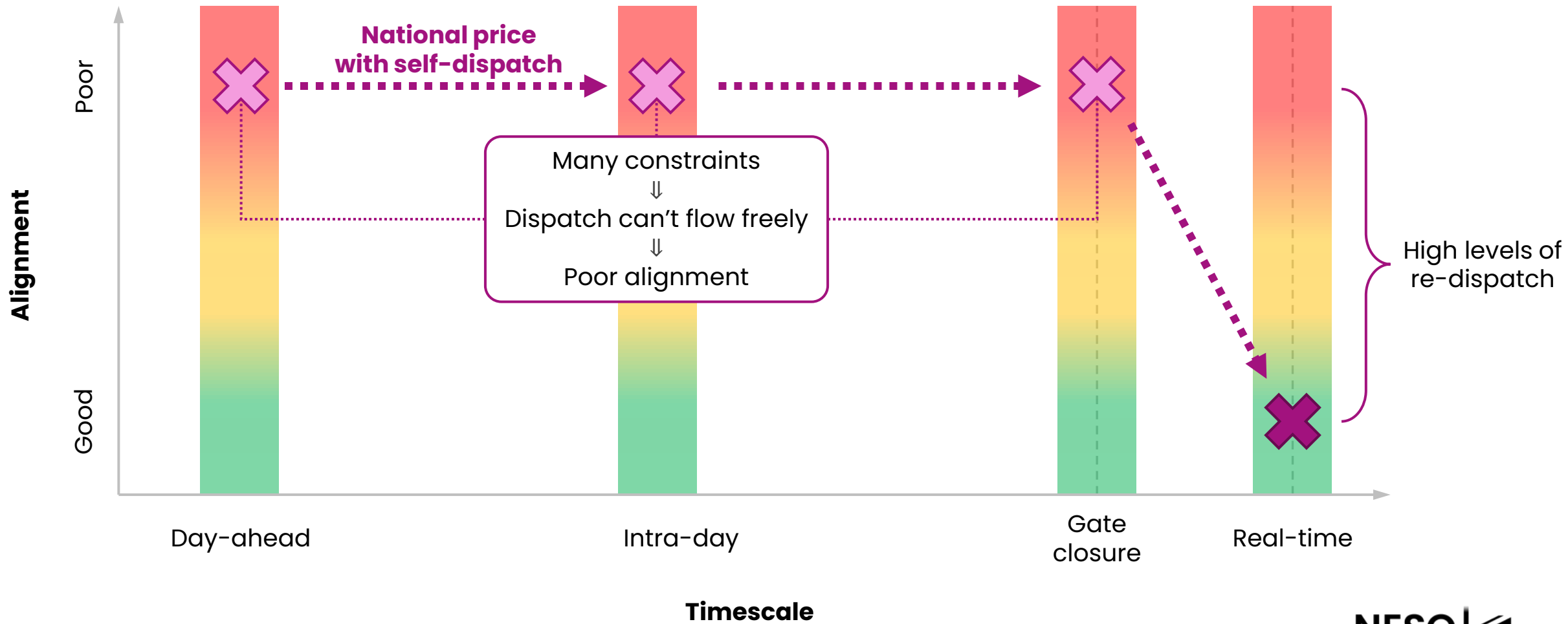
Cons

- Because the wholesale market is still open, parties could trade away positions agreed with NESO leading to extra consumer cost
- Potential impact to drive up wholesale market prices



National Price

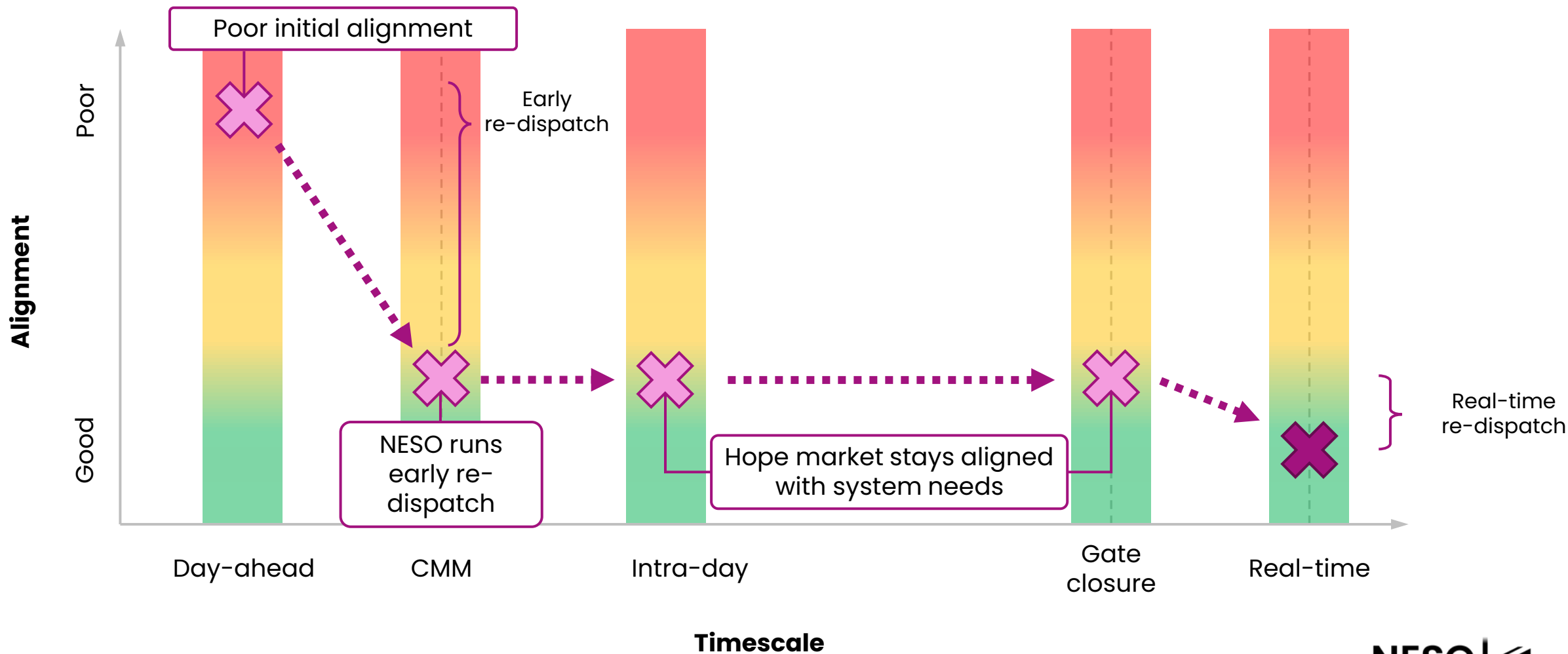
No market incentives to align dispatch to network capability, nor restrictions to do so



Short term CMM (in theory)

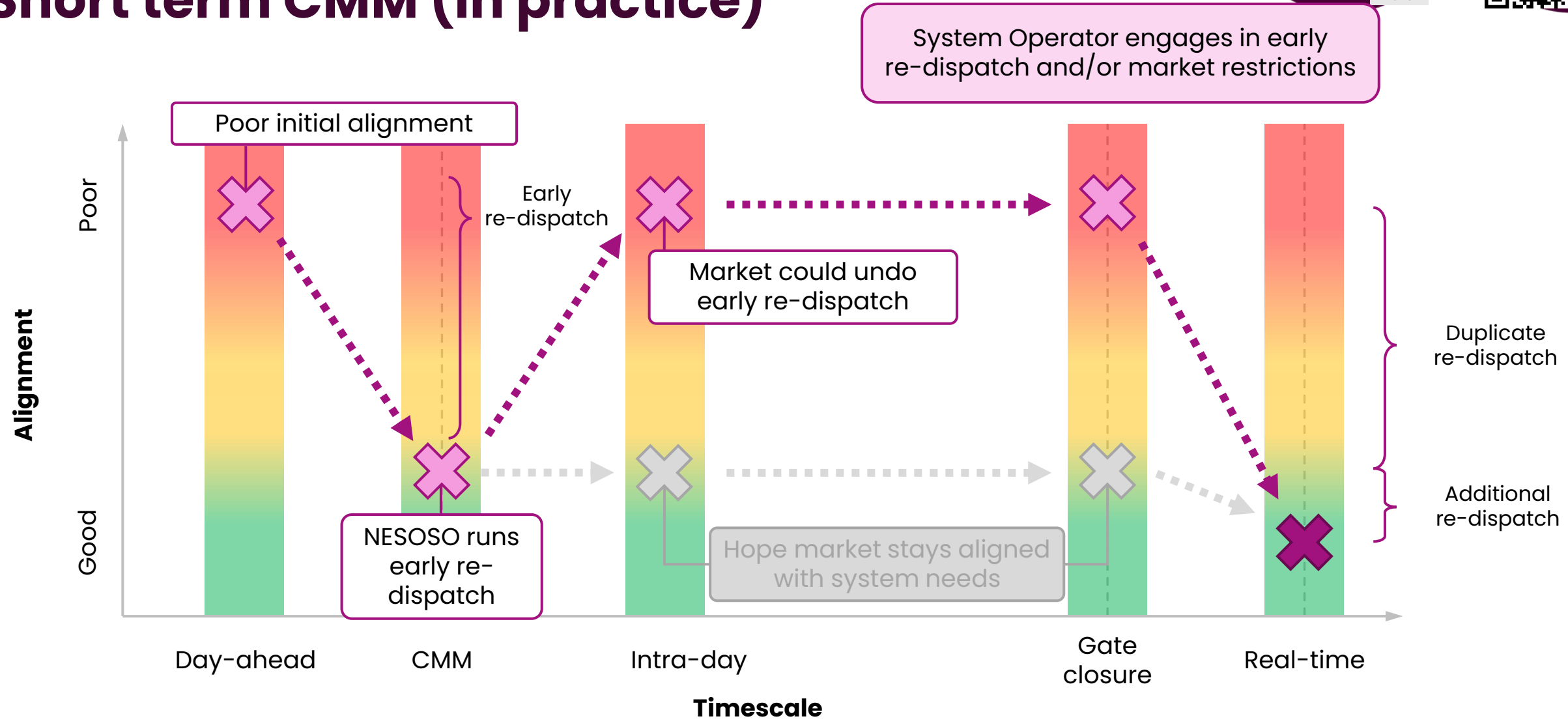
System Operator engages in early re-dispatch and/or market restrictions

Slido code: #CCP



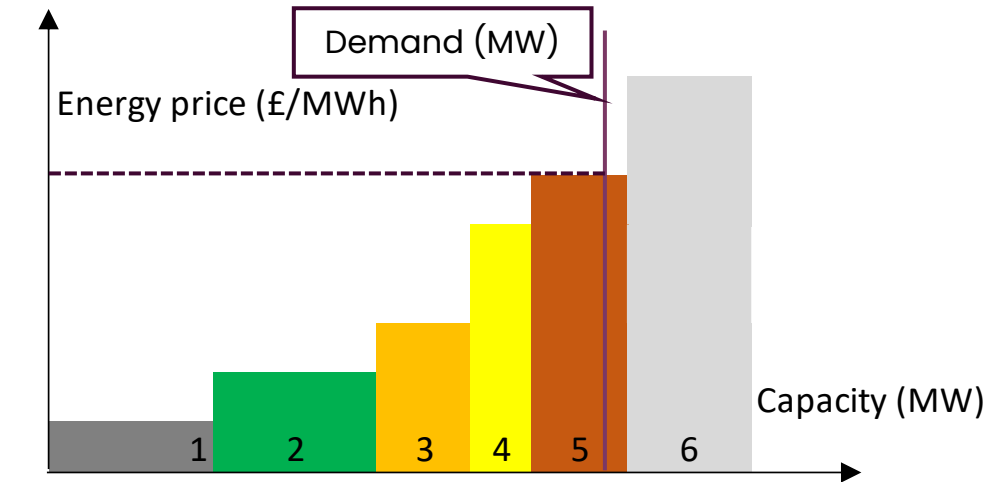


Short term CMM (in practice)





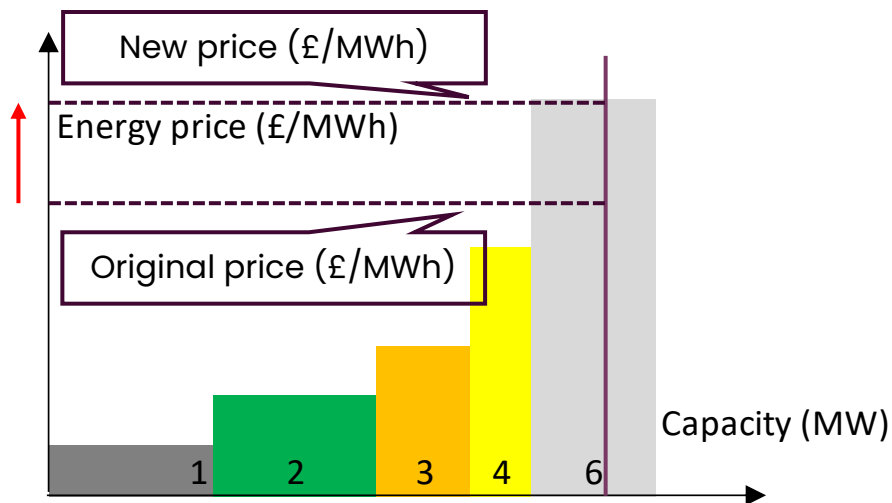
An illustrative example of CMM impact on the wholesale market



Status Quo

Wholesale market (without CMM running in parallel) –

- Generation units 1~5 are cleared in the day-ahead wholesale market auction, while unit 6 is out of merit.
- Generation unit 5 is the marginal plant and sets the wholesale price (e.g. £50/MWh)



CMM

Wholesale market (with CMM running in parallel) –

- Generation unit 5 chooses to participate in the CMM rather than the wholesale market to achieve a higher price
- Generation unit 6 is now the marginal plant, and sets the wholesale price (e.g. £60/MWh)
- Wholesale prices increase, impacting consumers



Risk and Design Mitigations

Risks

- Because a short-term CMM would involve NESO taking energy actions while the wholesale market is open, there is a risk that NESO takes an action in the CMM, and then that party trades with someone else in the wholesale market, undoing NESO's action.
- To reduce balancing costs, the CMM would require parties to submit lower prices than the current alternatives (e.g., Balancing Mechanism) because of the certainty they gained from being instructed earlier. If instead generating units who would have cleared in the wholesale market decide to participate in the CMM, this could increase wholesale market prices, and therefore potentially increase overall consumer costs

Potential Mitigations

- Require parties who participate in the CMM to fix their positions, preventing them from trading in the wholesale market within-day
- Require parties who participate in the CMM to provide unit-level wholesale market data to enable wholesale market interactions and consumer costs to be understood ex-post. This is in line with the RNP balancing reform proposals.

Have we identified the right risks? Do you think these are appropriate mitigations?



Next Steps

Cost Benefit Analysis

- NESO have reviewed previous analysis on CMMs (including the work Baringa did for ESO as part of CCP and work industry has completed independently)
- All of these assessments have quantified benefits and not costs
- NESO is now undertaking modelling to understand the potential wholesale price impact of the proposal where a CMM is targeted at reducing the cost of gas replacement energy
 - We will quantify the impact of a portion of the CMM volume coming from the wholesale market, rather than purely earlier BM instruction

Other forms of short term CMM

- NESO will continue to assess other forms of short-term CMM
- This includes participation from demand-side and flexible assets, and will consider proposals such as expanding the Demand Flexibility Service (DFS)

Are there other significant costs and benefits that must be captured for an accurate CBA?

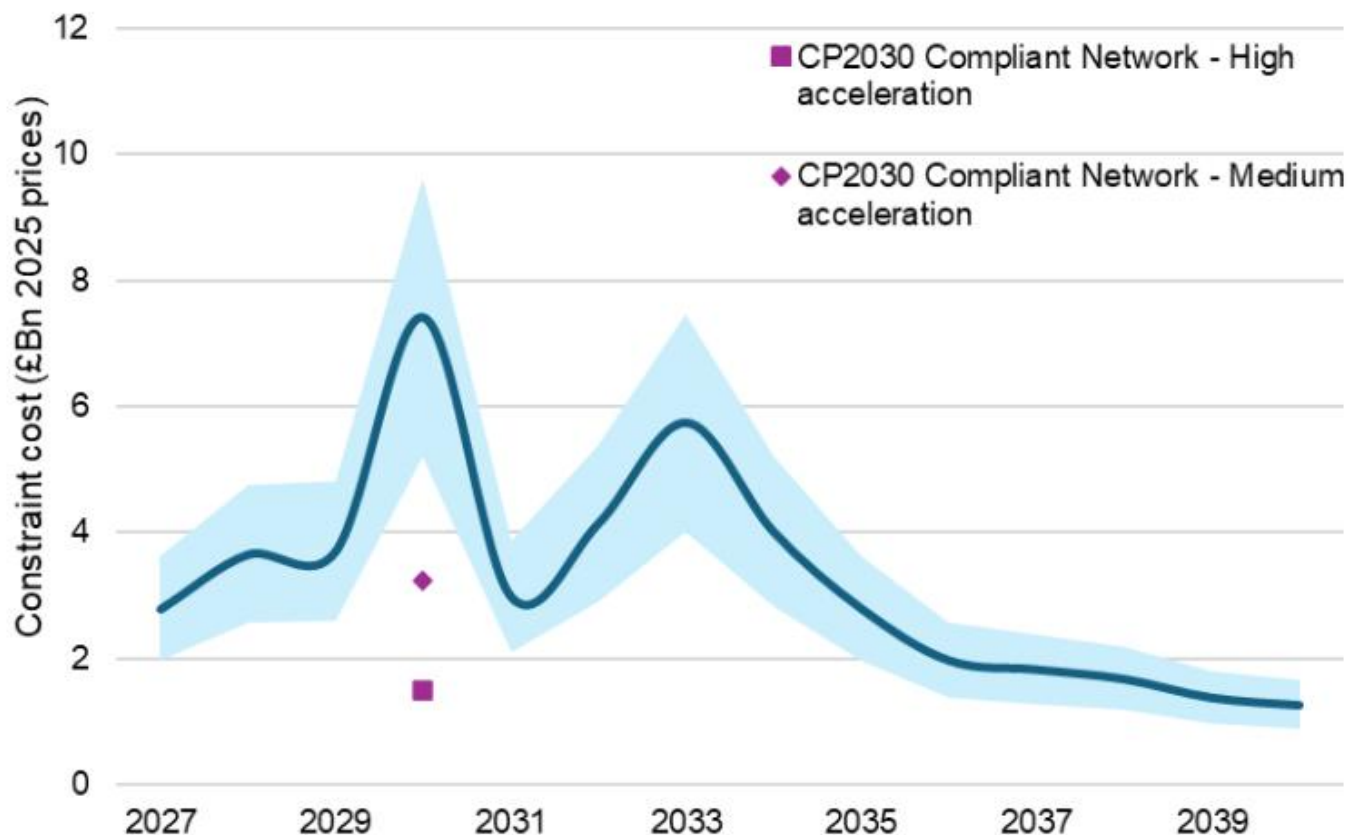
Project Update

Topic 4: Constraints
management measures in
RNP delivery plan

Simon Rickenbach (DESNZ)



Current network constraint costs and projections



- Constraints are forecast to **increase in the short-term**, due to the historic mis-match between generation and network build.
- The correct level of constraints in an efficient system is **not zero**.
- The single most impactful measure to reduce constraint costs is **delivering the network build** required for clean power.
- At a high level, the actions in the plan seek either to **reduce the volume** of constraints, or to **reduce the cost** of managing constraints when they arise.

Figure 1. Projected thermal constraint costs (£Bn 2025 prices) with an uncertainty range. Data points in 2030 relate to variations of how constraint costs could materialise with different network capacity/build scenarios



Measures we are implementing

Measures we are implementing	Reducing Volume or Cost	
	Volume	Cost
<p>Accelerating network build</p> <p>Government, NESO and Ofgem are driving urgent reforms to support network companies to deliver a transformational network expansion required for a Clean Power system by 2030, building on the Clean Power 2030 Action Plan</p>	✓	
<p>'Smart grid' measures</p> <p>Accelerating delivery of further dynamic line rating technology to maximise the use of network based on real time conditions.</p>	✓	
<p>Better coordination of system access</p> <p>Better planning + co-ordination of system access (the process by which parts of the network are taken out of service to allow maintenance, upgrades and connection of new projects). Including NESO and TOs making recommendation for a 6 year access plan. And an end-to-end review of the system access process by the end of 2026.</p>	✓	
<p>Making better use of flexible demand</p> <p>Through our trail which removes final consumption levies from demand turn up in constrained areas.</p>	✓	✓



Measures we are exploring

Measures we are exploring	Reducing Volume or Cost	
	Volume	Cost
Accelerating construction schedules for transmission projects Encouraging Transmission Owners (TOs) to pursue more ambitious construction schedules	✓	
Improved incentivisation of storage This includes both taking action against undesirable bidding behaviour and making better use of grid-scale batteries and LDES.	✓	✓
Equip NESO with additional 'day ahead' dispatch tools Giving NESO greater power pre-gate closure to reduce pre-2030 constraint costs, which could reduce the costs of turn-up		✓
Strategic planning of demand behind constraints Using the SSEP to plan the location of energy demand to maximise system efficiency	✓	
Improved interconnector redispatch Evaluating the potential impact of expanding NESO's ability to limit interconnector flows via NTCs and working to enhance co-operation with TSO's in connected countries		✓

Discussion and Q&A

Alifa Starlika



Slido code:
#CCP

Next Steps

Alifa Starlika



Next Steps

Boundary Flow Smoothing

- NESO is open to engaging with industry stakeholders to discuss the report and its findings—you can contact us at box.market.dev@neso.energy.

Constraint Management Market

- Continue with the analysis, quantifying the impact of a portion of the CMM volume coming from the wholesale market, rather than purely earlier BM instruction
- Assess other forms of short-term CMM (including demand focused markets like the potential to expand DFS)

Storage Behind Constraints

- Consult on and implementing short-term solution in coming months
- Start work on CBA for long-term solution to produce a recommendation in the Q1 2017

CCP is working alongside the RNP constraints workstream at the moment and we are still actively assessing ways to reduce constraint costs. We're always open for more suggestions or ideas in future

Thank you!

To keep in contact and to keep sharing your ideas, please visit our [website](#) or email us at

box.market.dev@neso.energy