Public

Enhancing Storage in the Balancing Mechanism

7 November 2024

LCP Delta

NESO
National Energy System Operator

Introductions

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NESO Actions

1. **Release of new dispatch algorithm 22 October 2024**

2. **Critical new resource started in control room from November**

3. **Introduction of Dispatch Efficiency Monitor by the end of November**

4. **Publish the LCP Delta methodology and full report by end November**

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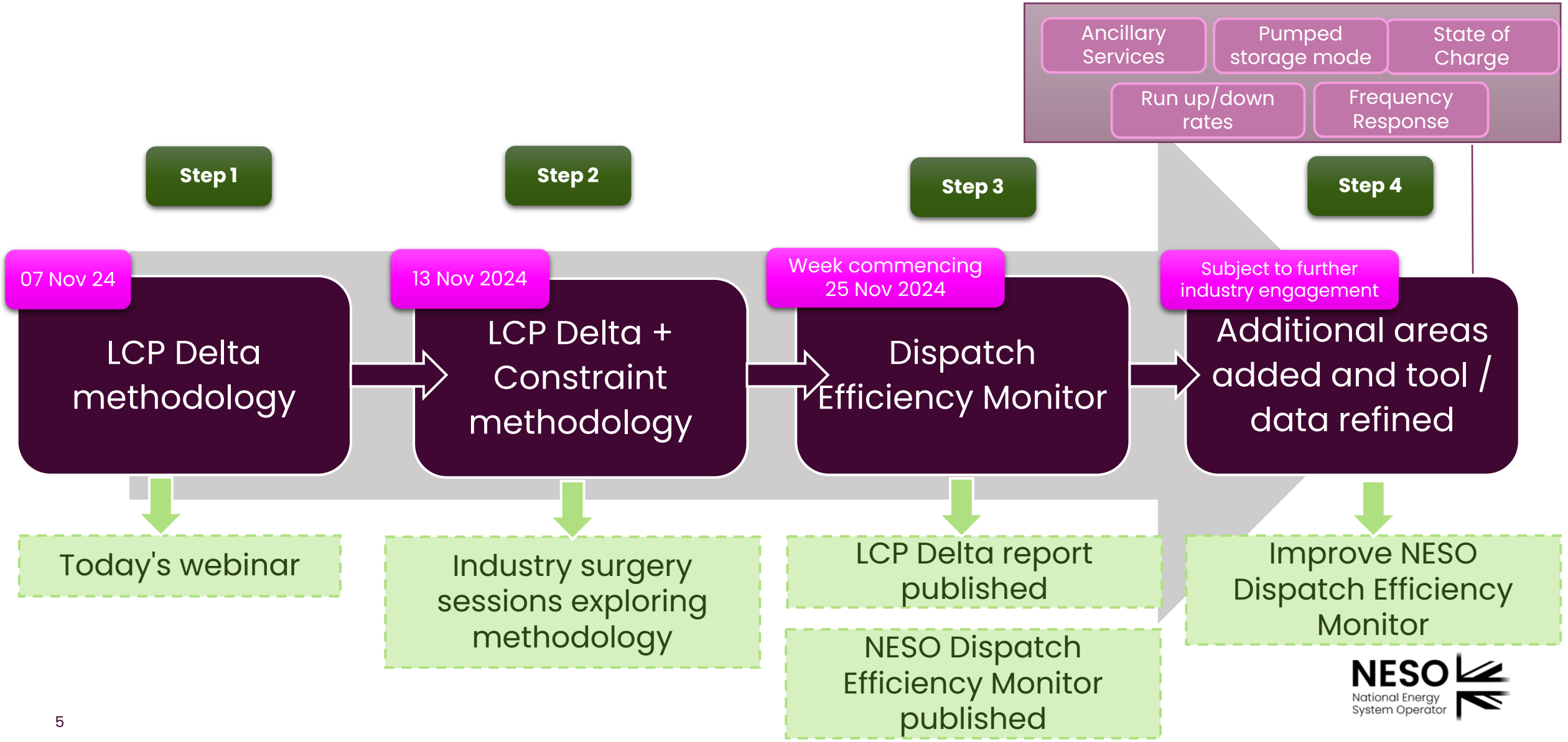
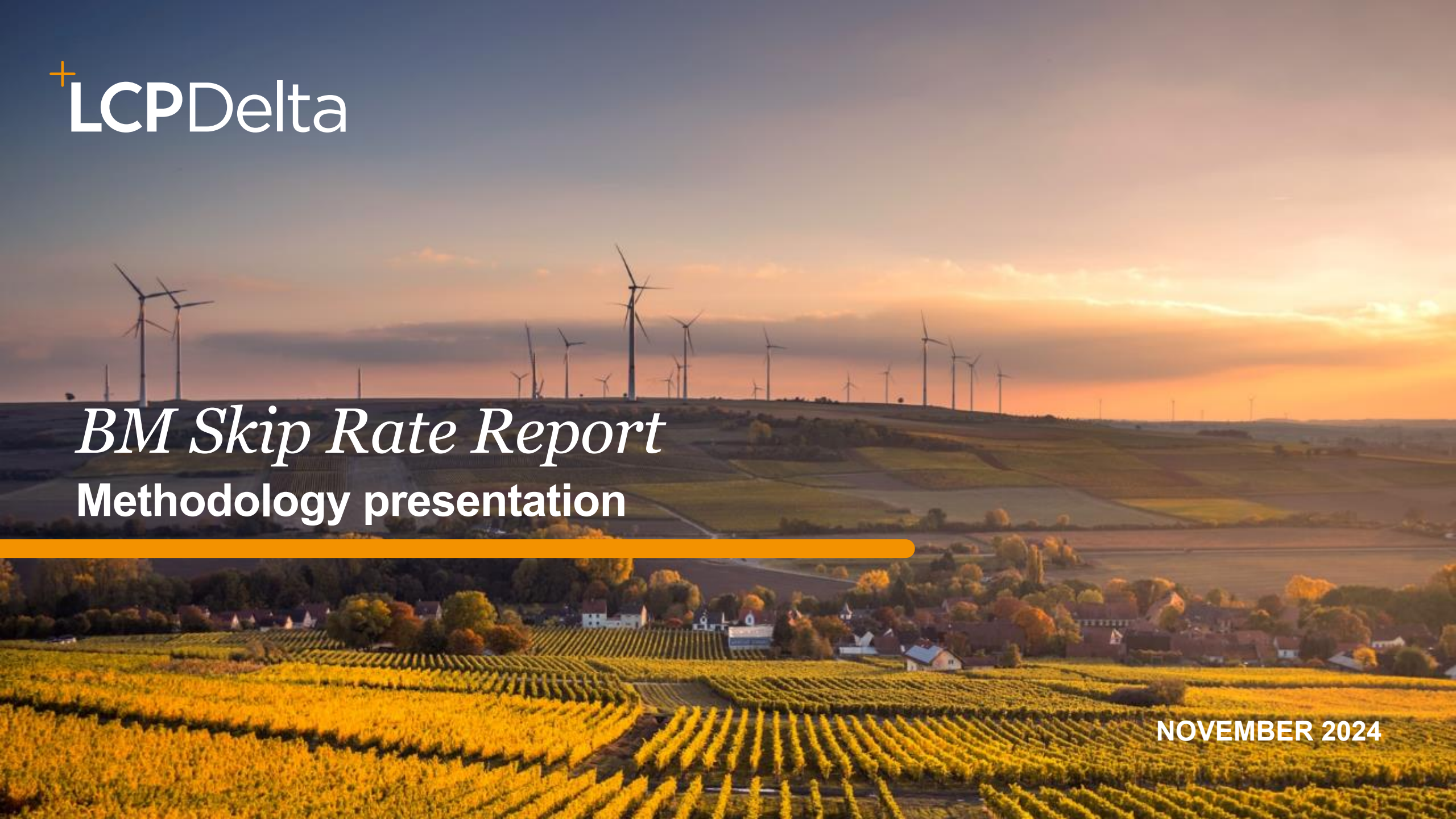
Agenda

Introduction	Craig Dyke
LCP Delta • **Methodology:** calculating skip rates (redefined as uneconomic dispatch)	Chris Matson
Next Steps	Cathy Fraser
Q&A	Cathy Fraser, Jean Hamman & Chris Matson

Please post your questions regarding the methodology into the meeting Q&A during the session.

Timescales & Webinar Content





LCPDelta

BM Skip Rate Report

Methodology presentation

NOVEMBER 2024

Introduction

In October 2023, LCP Delta was engaged by the ESO (now NESO) to carry out a review of "skip rates" in the Balancing Mechanism (BM).

In Q4 2023, LCP Delta delivered a review of skip rates in BM to the ESO. This included:

- A report on the stakeholder engagement carried out including how it impacts stakeholders
- In consultation with industry and the ESO, establish and present a methodology
- Provide the ESO with skip rate calculations for the preceding 12-months using this methodology
- Review the practice of ESO skipping BMUs, why it happens and how it could be improved going forwards

Following the delivery of this report, the ESO engaged LCP Delta to further build on this work. This would present an evolved skip rate calculation considering the total energy requirement and more granular observation periods (5-minute granularity). The methodology for which we present today.

Phase 1 Methodology

Phase 1: Methodology

30-minute granularity, compare to most expensive action

The "Phase 1" methodology is similar to analysis adopted elsewhere. This approach was presented to industry in October 2023.

Compares all other viable actions with the most expensive action taken over a 30-minute settlement period

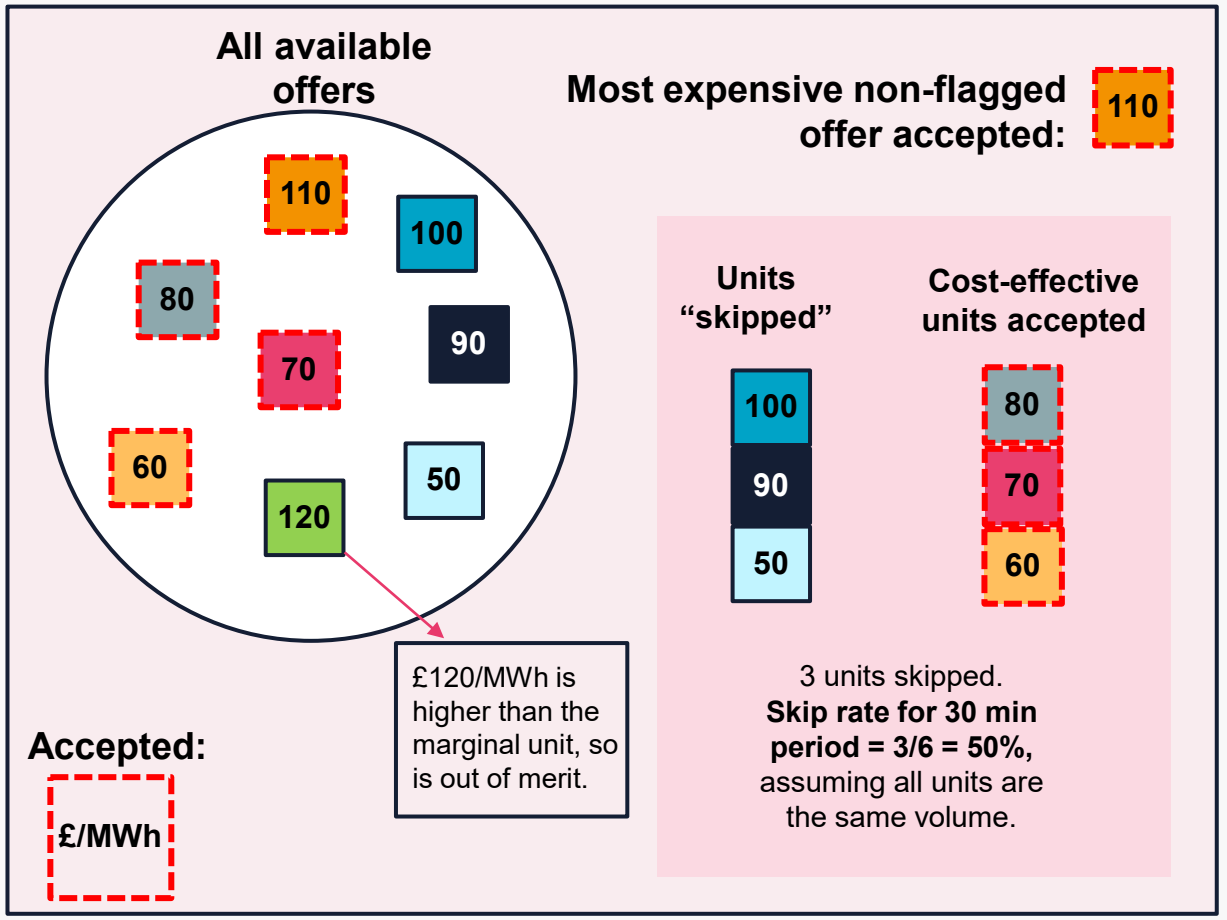
If an action was not accepted in a settlement period but was cheaper than the marginal action in that period, this would be classified as a skipped action.

Figure

The diagram to the right illustrates how the phase 1 methodology works.

In the circle, there are a number of available offers with the number assigned to each action being the offer price (in the examples, we assume each action is equal volume of 1MWh for ease). The offers that were accepted by NESO are indicated by a dashed red outline.

In this example, the most expensive action taken (the marginal action) was £110/MWh. There were three skipped actions that were seemingly cheaper than this £110/MWh action – a £100/MWh, a £90/MWh, and a £50/MWh action. A bid/offer is strictly only in-merit if it is cheaper than the marginal accepted unit.



$$Skip\ Rate = \frac{Total\ volume\ of\ skipped\ in\ merit\ bids/offers}{Total\ volume\ of\ in\ merit\ bids/offers}$$

Phase 1: Methodology

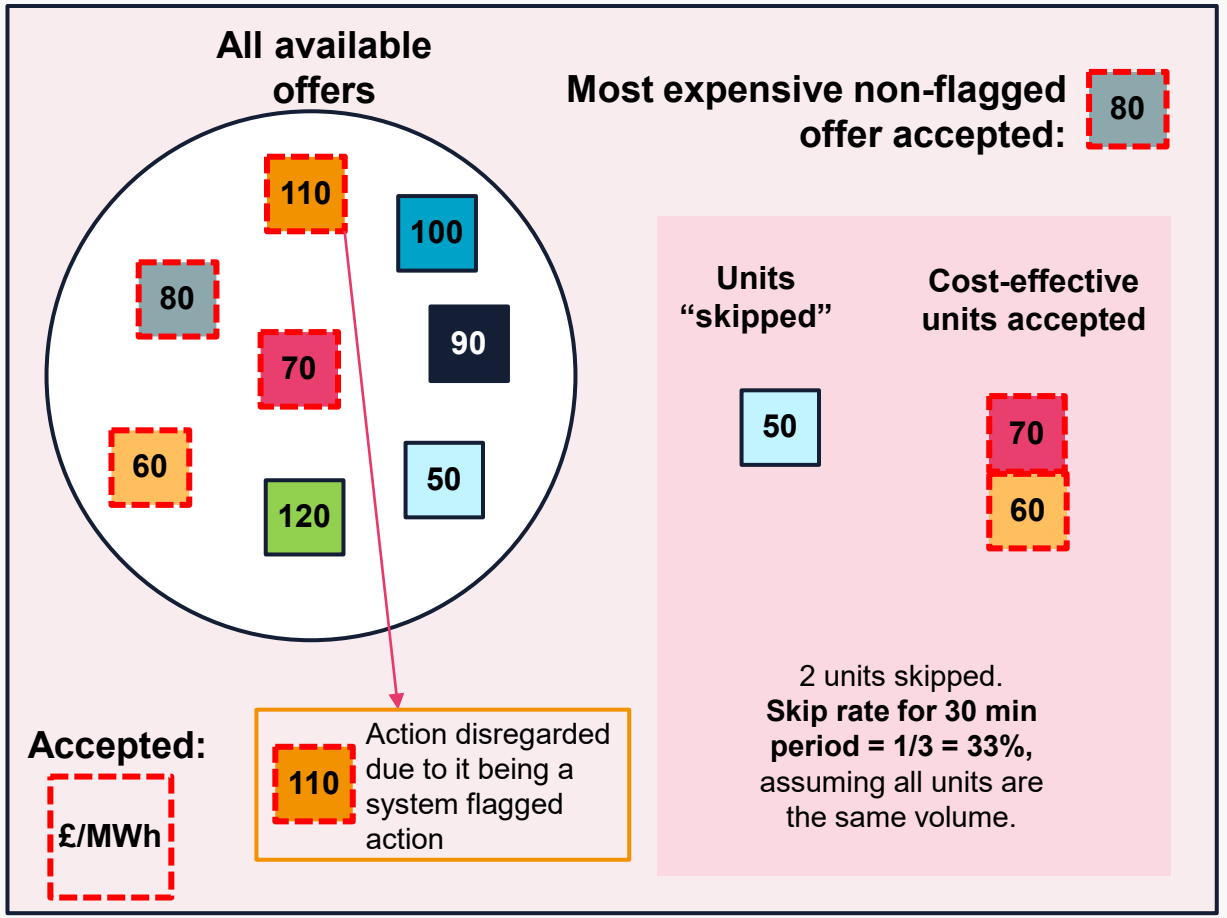
Exclusions based on suitability of actions within merit

Not all skips are unexplainable. Due to the limitations of the BM, there are viable reasons why NESO must take actions out of merit order. To account for these, we make a number of exclusions.

We exclude from the calculation any units that were accepted but were either **system flagged** or **frequency tagged**. Reasons include:

- System need;
- Geometry limitation;
- Loss risk;
- Unit commitment;
- Response;
- Merit;
- Frequency of flexibility needs; and
- Incomplete.

The example to the right shows how the skip rate decreases from 50% to 33% due to the £110/MWh action being system flagged and therefore excluded from the calculation.



Phase 1: Methodology

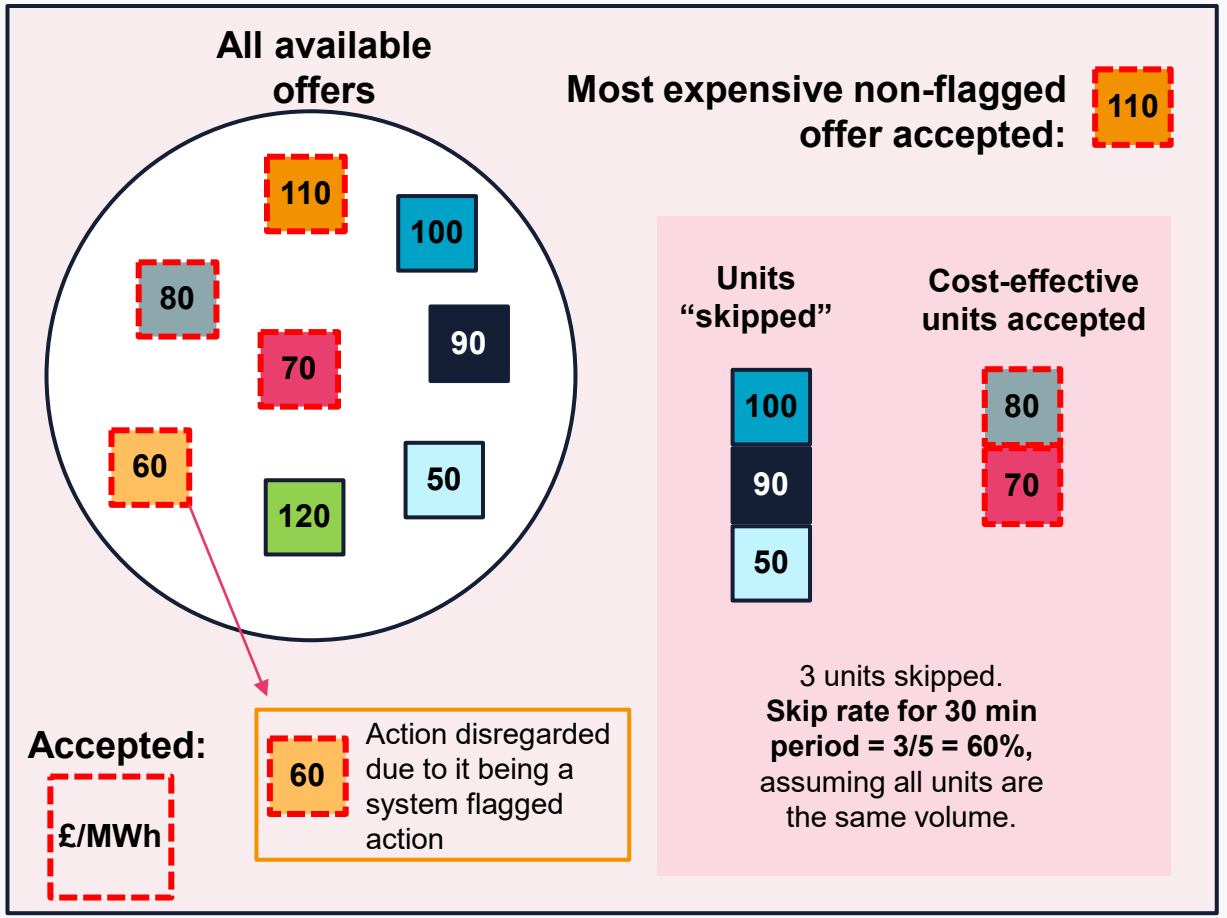
Exclusions based on suitability of actions within merit

Exclusions can also increase the skip rate.

For example, if the was the £60/MWh offer was system flagged and excluded (rather than the £110/MWh offer), then the £110/MWh offer would remain as the most expensive accepted action.

3 offers would still be skipped, but only 2 cost-effective units were accepted for energy reasons (excluding the marginal unit), reasons so the skip rate would increase to 60%.

The example to the right shows how the skip rate increases to 60% due to the £60/MWh dispatched action being system flagged and therefore excluded from the calculation.



Phase 2 Methodology

Phase 2: Updated Methodology

Constructing a merit stack for each 5-minute period in price order

Key phase 2 updates	
5-minute granularity	Analysing over a shorter observation period minimises erroneous results from averaging shorter actions over a full 30-mins.
Considering all bid-offer pairs separately	The ESO considers all BOD price bands separately. In phase 2, we consider all price band pairs rather than just the initial price band.
Consider the BM energy requirement	Determine the energy requirement in each 5-minute period, based on the total bids/offers accepted.
Determine the most cost-effective combination of bid/offers	Across 5-min observation periods construct an alternative stack of available bids/offers in price order to satisfy the requirement in that period. This is then compared to the ESO's actual acceptances.

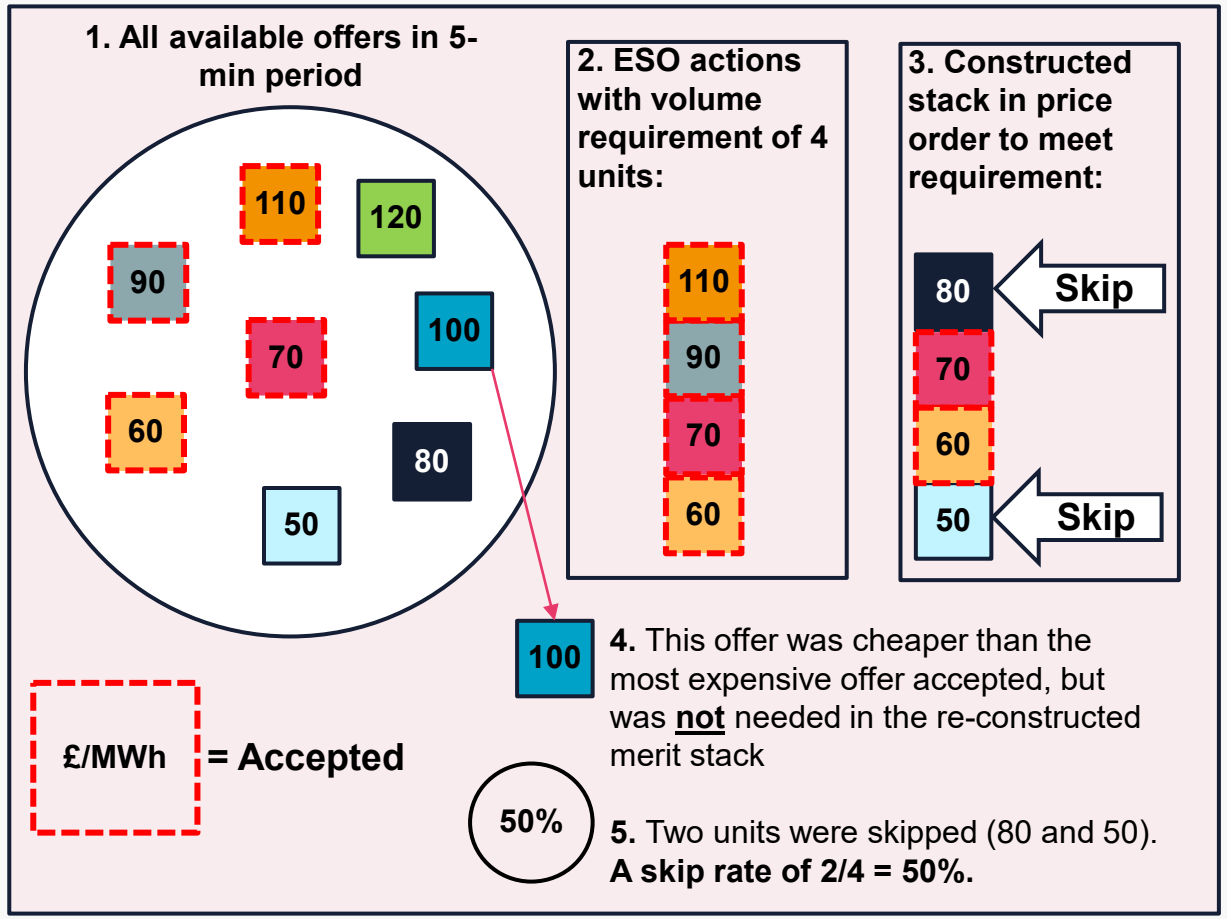
Example: Under the phase 1 methodology if 500MW of accepted actions and 750MW of unaccepted actions were cheaper than the most expensive unit accepted, the skip rate would be 750/(750+500) = 60%. Under the phase 2 methodology a merit stack is constructed in price order to satisfy the 500MW requirement. If this stack contained 250MW of accepted bids/actions and 250MW of skipped volume the skip rate would be 50%.

Phase 2: Updated Methodology

Constructing a merit stack for each 5-minute period in price order

The figure on this page provides an illustrative example of the analysis that we carry out for every 5-minute period.

1. All available bids/offers in a 5-min period	In this 5-min period there are 8 offers available to the ESO, with their prices shown in £/MWh. In this example, we assume that they are equal volume.
2. ESO acceptances used to determine volume requirement	Using the offers accepted we construct the actual stack dispatched and use this to calculate the BM energy requirement. In this example, the requirement is for a volume of 4 units.
3. Construct an "in-merit" stack to meet the requirement	We then construct a new stack in price order to determine the most cost-effective way to meet the requirement. In this example, that is the 50, 60, 70, and 80 £/MWh offers.
4. Unrequired bid/offer	In this example, when reconstructing the stack we find that the accepted 90 and 110 £/MWh and the unaccepted £100/MWh actions are not needed to meet the requirement and not included in the skip rate calculation.
5. Determine units skipped and skip rate	From the constructed merit stack, the 80 and 50 £/MWh actions were not dispatched by the ESO, but should have been – i.e. were "skipped". Therefore, there is a 50% skip rate in this scenario.

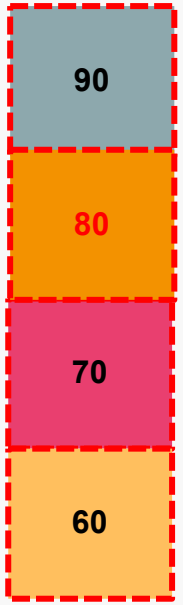


Phase 2: Tie breaking rules

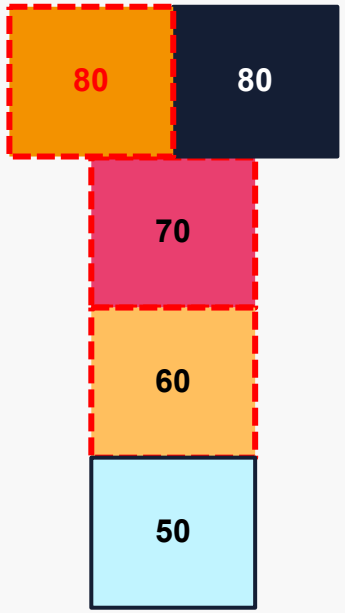
What happens when a potential skip and an acceptance have the same price?

In this example both a potential skip and acceptance have a price of £80/MWh

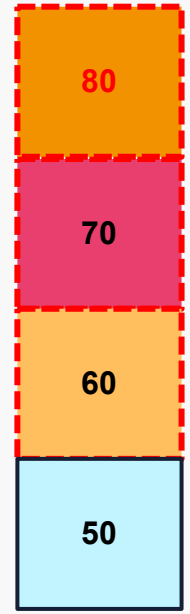
What was accepted:



Phase 2: What "could" have been accepted



Phase 2: What "should" have been accepted



£/MWh = Accepted

Tie-break rule: If an acceptance and a skip have the same price **the acceptance will always be prioritised, this minimises the skip rate.**

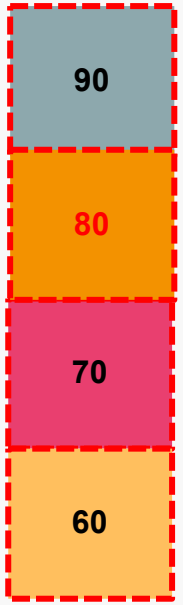
Phase 2: Tie breaking rules

What happens when two potential skips have the same price?

In this example two potential skips (assumed to be from differing technologies) are price at £80/MWh.

= Accepted

What was accepted:



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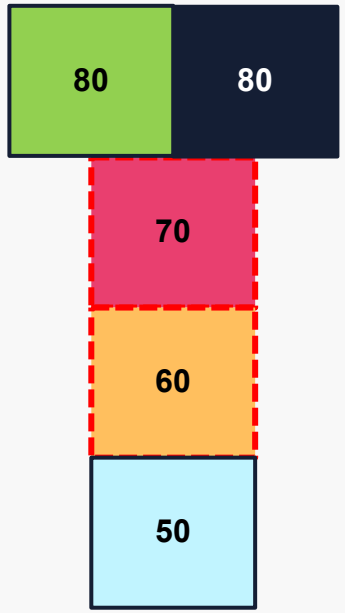
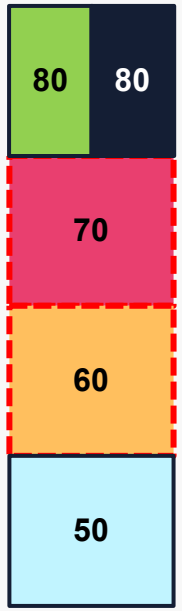


Phase 2: What "should" have been accepted



Tie-break rule: If two potential skips are on the margin their skip volume is assigned on a volume weighted basis **to prevent bias in favour of one asset (and technology)**

Scope of the analysis in our report

Overview:

The analysis seeks to quantify the efficiency of dispatch decisions undertaken by NESO in the BM across the observation period.

We calculate an **overall "skip rate"** for bids and offers based on the proportion of in-merit actions that were not accepted.

In addition, we also calculate **technology-specific skip rates** using the same methodology.

We also estimate the **total consumer cost impact** associated with skips.

Time Period:

Skip rates have been analysed for the period between **1st January 2023 to 31st July 2024**.

Granularity and averaging:

In-merit volumes and skip rate volumes are determined at **5-minute granularity.**

Skip rates reported at the annual or monthly level are the "volume-weighted" average of these 5-minute skip rates (based on the volume requirement in each period). This ensures that the calculation is not distorted by periods with very small volumes.

Technologies:

All major technologies which participate in the balancing mechanism are considered in this analysis:

- Battery storage
- Biomass
- CCGT
- Gas reciprocating engines
- Hydro
- OCGT
- Pumped storage
- Wind

Exclusions presented in a staged approach:

We present skip rate results in 5 stages, with each stage building on the previous with further exclusions. This allows for understand the impact of each type of exclusion. ***Covered in next section***

Phase 2 exclusion rules: step-by-step application

Step-by-step guide

Stage 1

Remove volumes that are procured outside of the balancing mechanism

BSADs:

The prices and volumes of balancing services procured outside of the Balancing Mechanism are shown in the Balancing Services Adjustment Data (BSAD).

Because these volumes have been procured outside of the Balancing Mechanism they are excluded from this analysis.

Wind Offers:

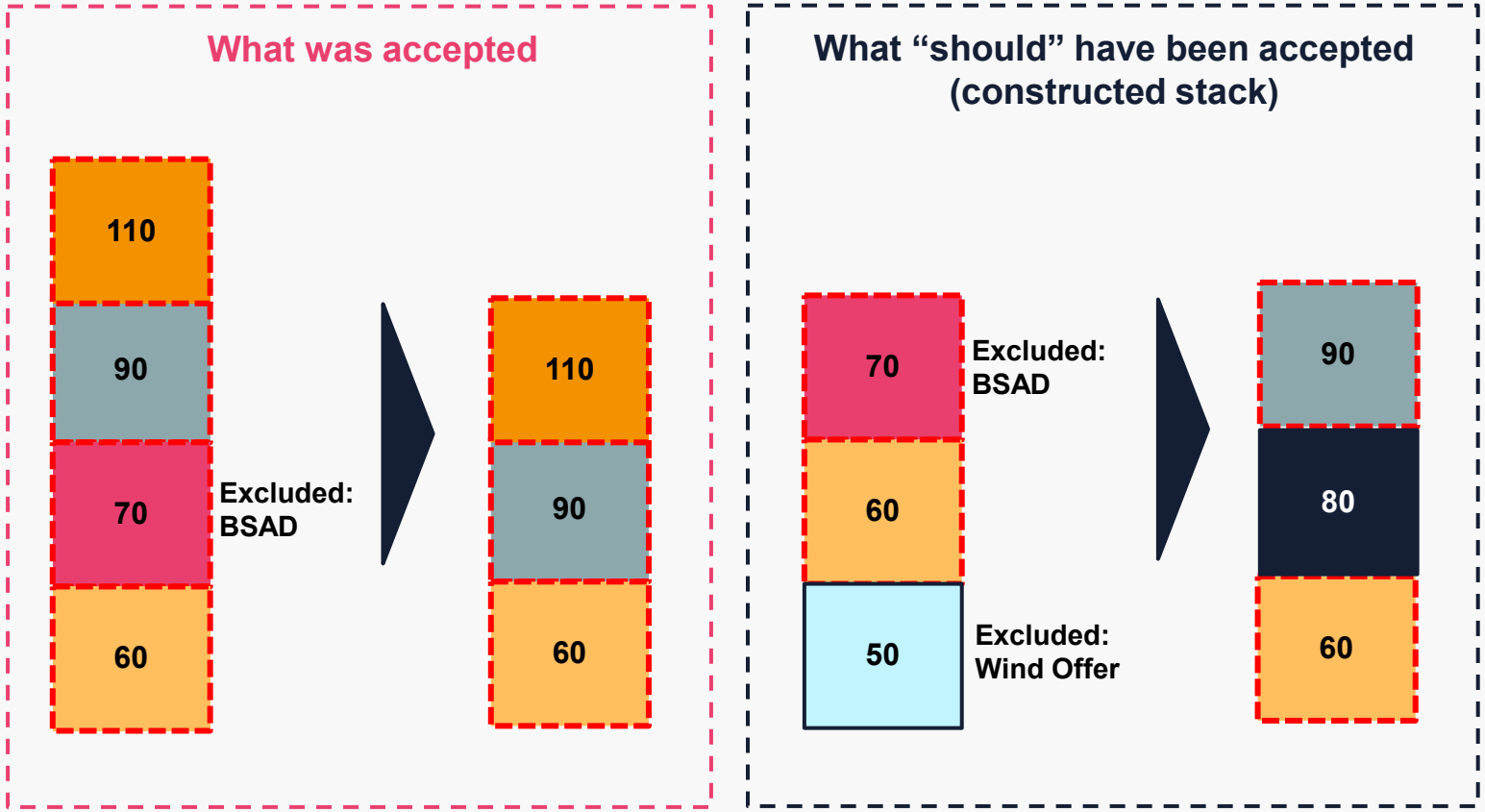
Wind technology is dependent on weather conditions. In many cases, to enable an offer on a wind unit, the weather would need to change.

Winter Coal Contingency Contracts:

Coal contingency contracts were put in place between 1st October 2022 and 31st March 2023 for five coal units (T_RATS_1, T_DRAXX-5, T_DRAXX-6, T_WBUPS-1 and T_WBUPS-2).

These units received payments for remaining available across the winter period but were not available to the market and would be dispatched if required by the ESO through the Balancing Mechanism or a trade priced at £0/MWh.

This low price in the BM would distort the skip rate analysis and so these volumes are excluded.



Step-by-step guide

Stage 2

Remove volumes that are infeasible or that cannot be accessed within balancing mechanism timescales

MNZT / MZT:

Volumes from units which have a Minimum Non-Zero Time (MNZT) or Minimum Zero Time (MZT) of greater than or equal to 12 hours are excluded.

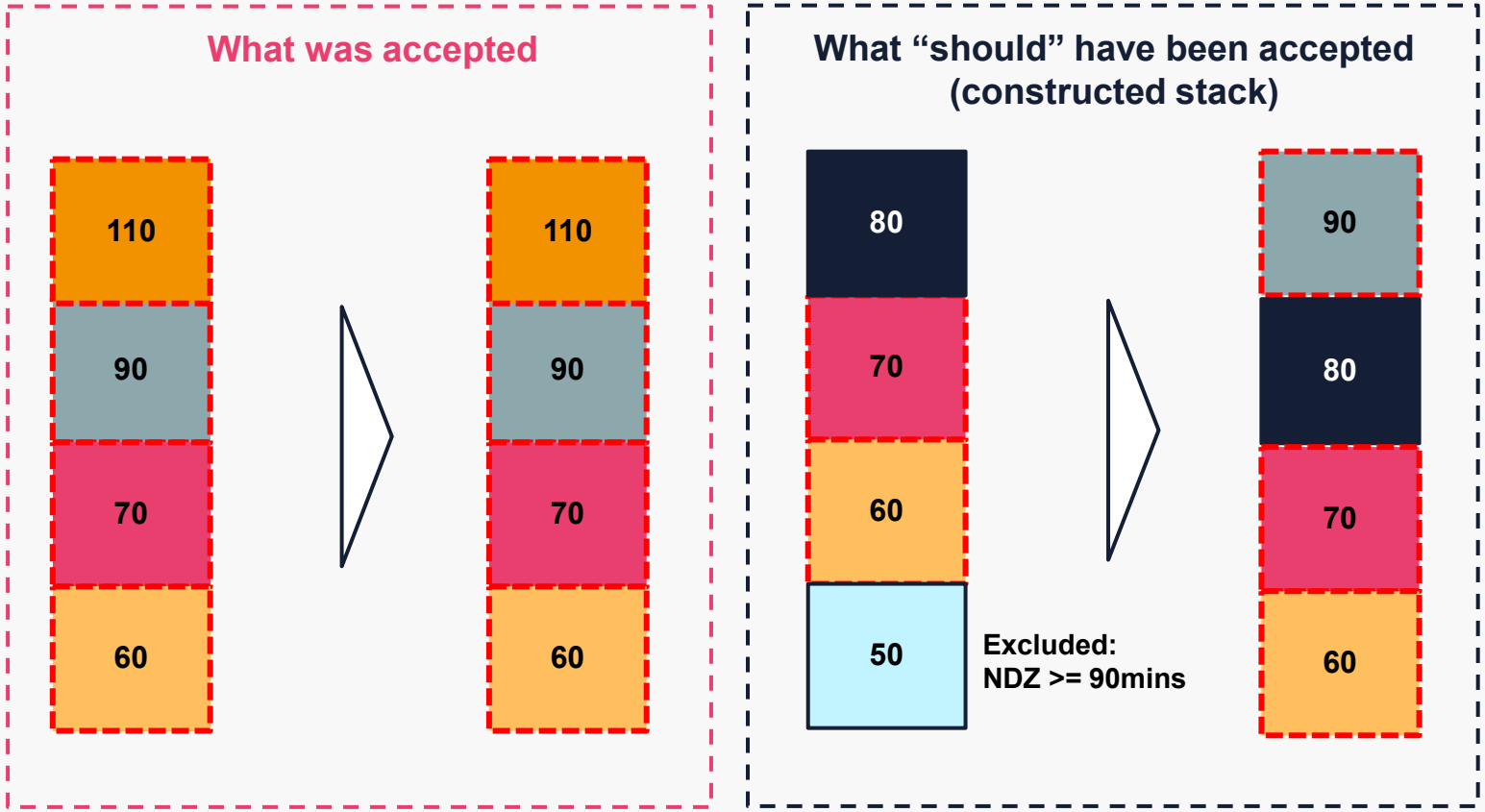
NDZ:

Volumes from units which have a Notice to Deviate from Zero (NDZ) of greater than or equal to 90 minutes and have a post BOA output of 0MW at the end of the previous 5-minute period are excluded.

This excludes volumes that could not be access by the ENCC within Balancing Mechanism timescales (gate closure of 60 mins from the end of the current settlement period means the earliest an instruction can be sent is 89 minutes prior to delivery).

SEL / SIL:

Where accepting a potential bid or offer volume would place a unit between zero and SEL or zero and SIL potential skip volumes are capped to SEL or SIL respectively. Note that units can be instructed to zero and these volumes are included.



Step-by-step guide

Stage 3

Remove volumes that were not taken for Energy balancing only

System Flagged:

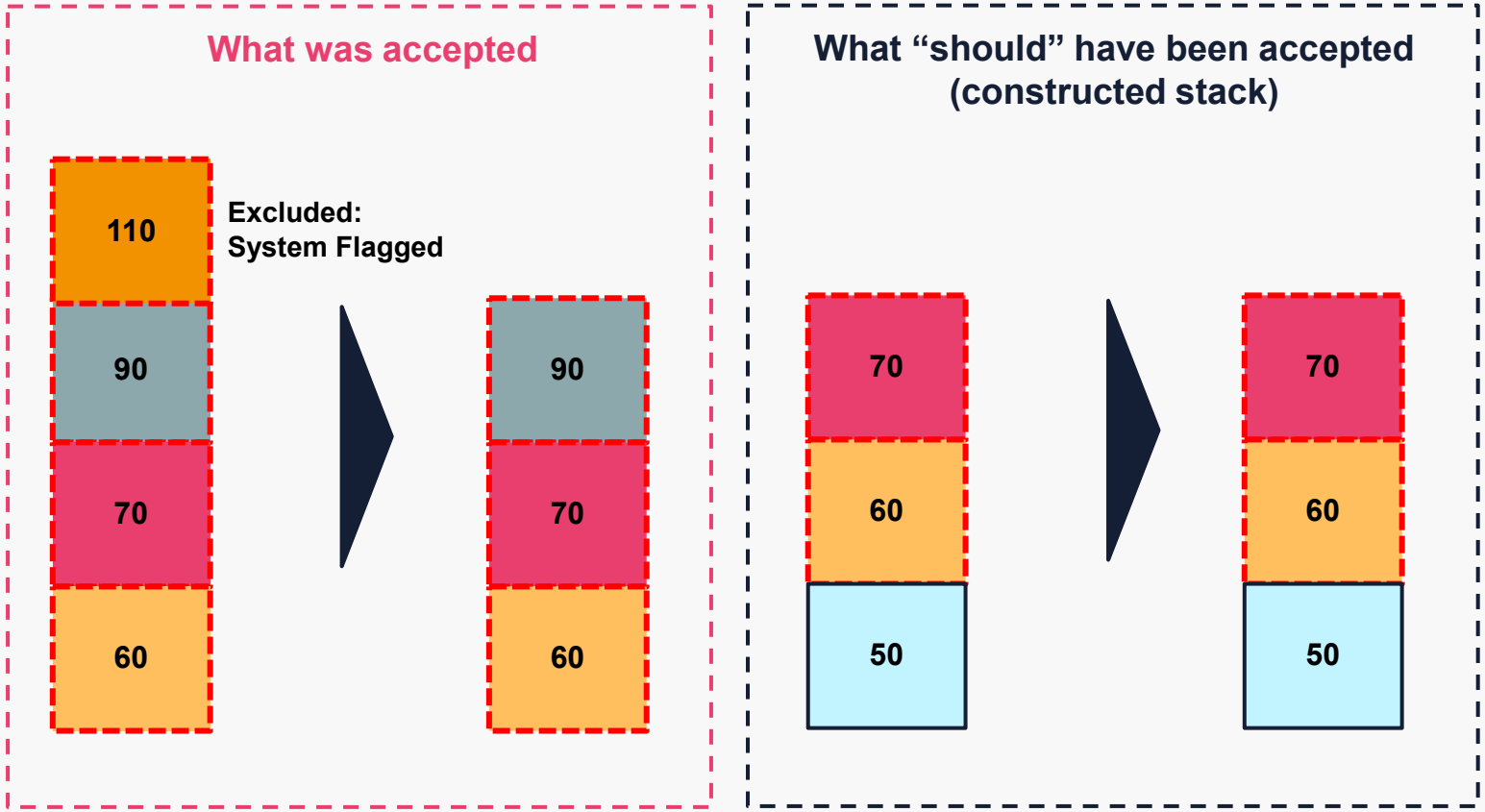
Acceptances which have been flagged as being taken for System balancing reasons are excluded. These actions are taken to alleviate transmission constraints in specific regions (so only a subset of assets located in that region can be utilised) and / or for system security.

This analysis focusses on the Energy balancing requirement that can be met by all assets.

Note: When applying this exclusion any acceptance which is system flagged is excluded. In addition, if a higher bid-offer pair is flagged but the lower pair remains unflagged the lower pair is also assumed to be flagged and is excluded.

Frequency Response:

Acceptances which have been flagged as being taken for Frequency Response in the Dispatch Transparency Data published by ESO are excluded.



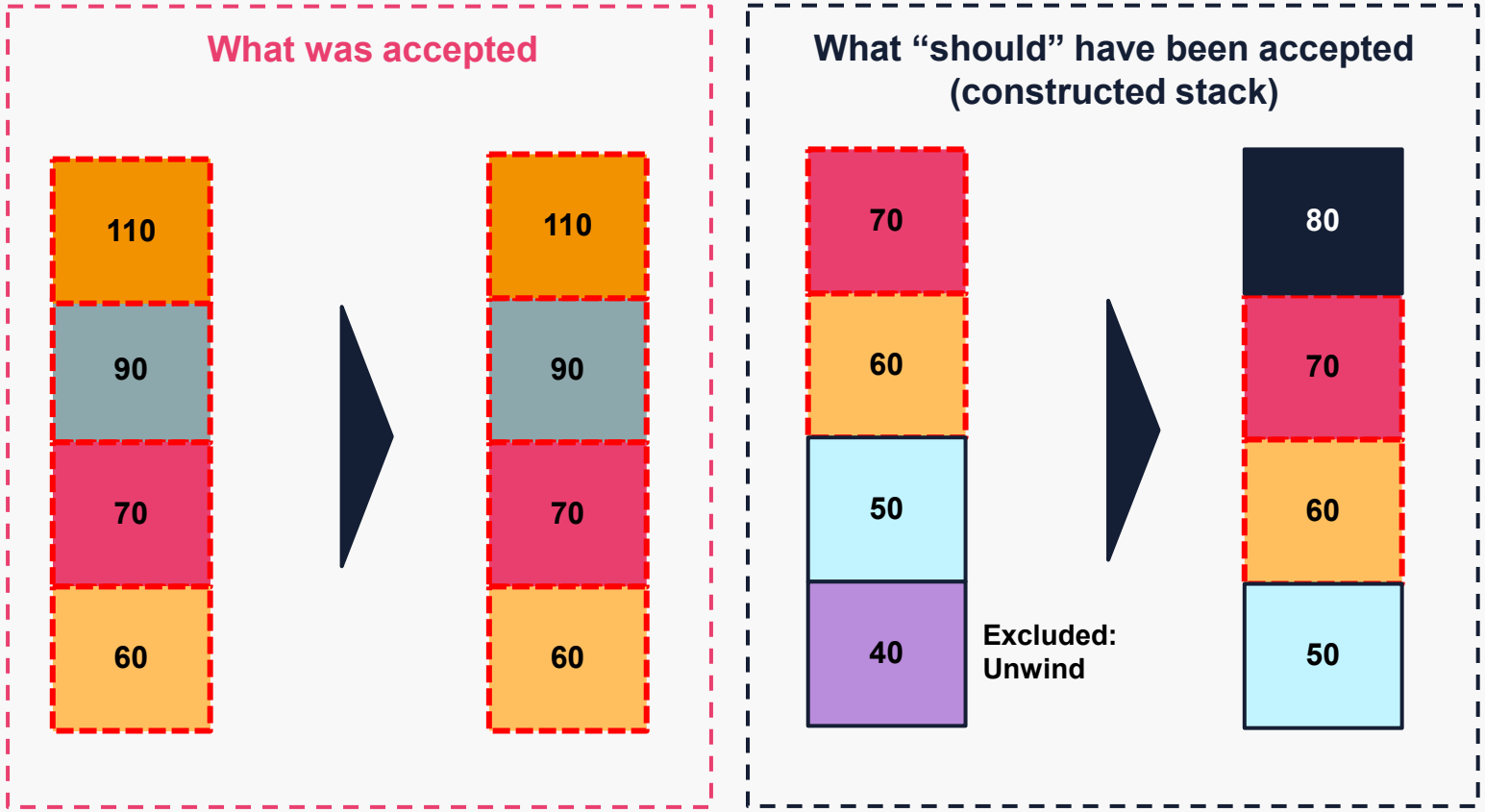
Step-by-step guide

Stage 4

Remove volumes that are contingent on an opposing bid or offer action to be accepted.

Unwinds:

Unaccepted actions to unwind previously accepted bids or offers are excluded. These actions only become available upon the acceptance of a bid or offer in the opposing direction, otherwise they do not appear in the list of available bids and offers to ESO.



Step-by-step guide

Stage 5

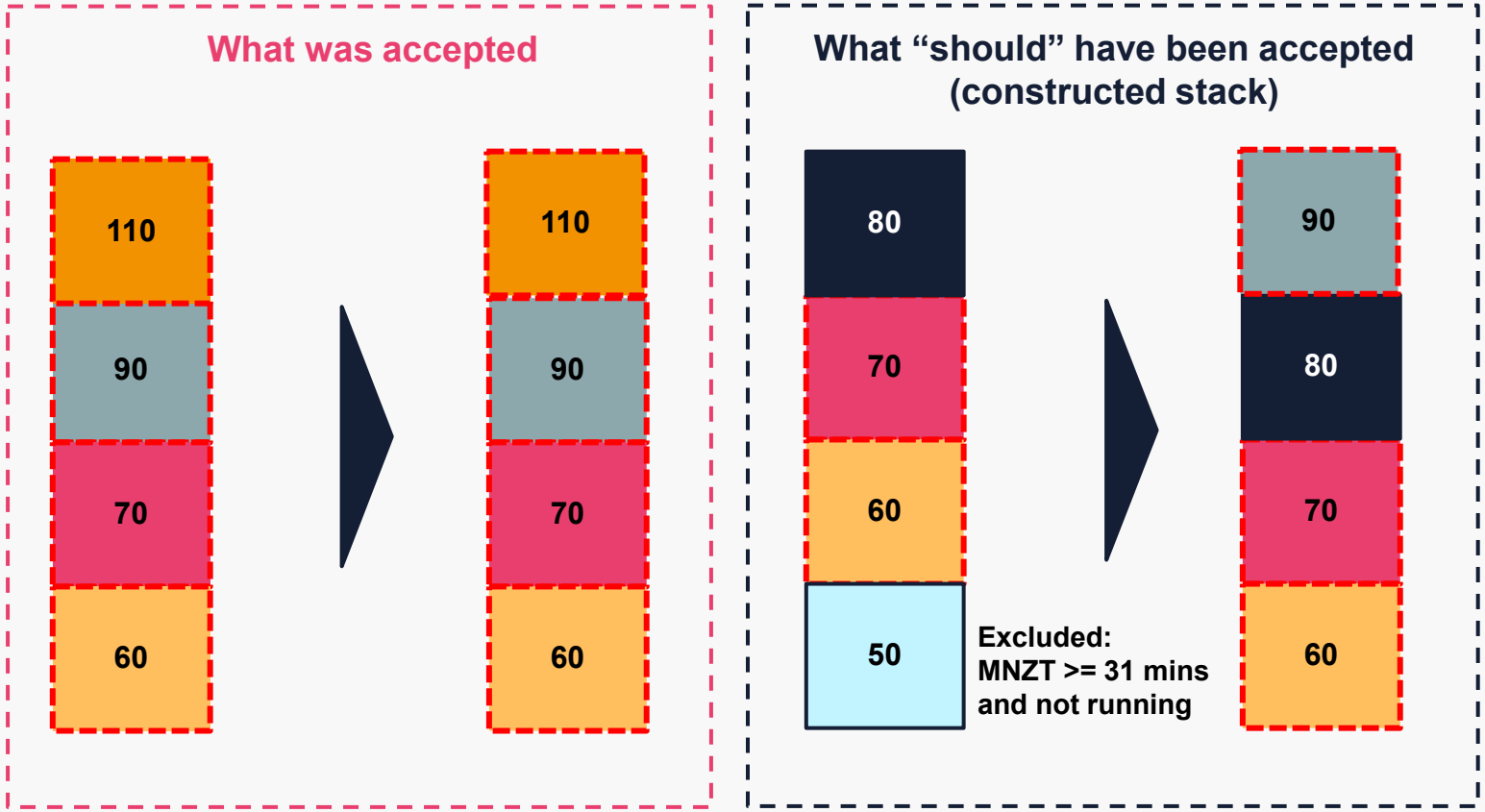
Remove volumes that could not be accessed by the Balancing team in the Control Room.

MZT / MNZT / NDZ:

- Exclude actions that would sync a unit with an MNZT or NDZ of greater than or equal to 31 minutes.
- Exclude actions that would desync a unit with an MZT of greater than or equal to 31 minutes.

Desync:

Exclude actions that would delay the desync of a unit with MZT or MNZT of greater than or equal to 31 mins.



Exclusion Rules

Volumes are excluded for the following reasons

Stage	Exclusion	Application
1	**Wind Offer**	Offers from wind assets are excluded
	Balancing Services Adjustment Data (BSAD)	Actions in BSAD dataset are excluded
	Winter Coal Contingency Contracts	Volumes from coal assets which received winter coal contingency contracts are excluded
2	**Minimum Zero Time (MZT)**	>= 12 hours
	Minimum Non-Zero Time (MNZT)	>= 12 hours
	Notice to Deviate from Zero (NDZ)	>= 90 minutes (unless already running or has warming contract)
	Stable Export Limit (SEL) / Stable Import Limit (SIL)	Excluded if action results in final position breaching SEL/SIL (units can go to 0MW)

Stage	Exclusion	Application
3	**System Flagged**	Exclude acceptances from assets that have a system flagged acceptance
	Frequency Response	Exclude acceptances from assets that have a frequency flagged acceptance
4	**Unwinds**	BOAs to reverse out (unwind) a previously acceptances are excluded.
5	**Minimum Zero Time (MZT)**	Exclude actions that would desync a unit with an MZT of >= 31 mins
	Minimum Non-Zero Time (MNZT)	Exclude actions that would sync a unit with an MNZT of >= 31 mins
	Notice to Deviate from Zero (NDZ)	Exclude actions that would sync a unit with an NDZ of >= 31 mins
	SEL to MEL range / SIL to MIL range	Remain between SEL and MEL or SIL and MIL (unless MZT is less than 31mins and unit is running)

Limitations of the analysis

Run-up/down Rates:

Feasible volumes are not constrained by run-up and run-down rates.

State of Charge:

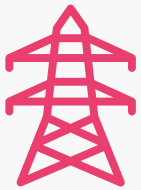
Each 5-minute period is assumed to be independent and the state of charge of storage assets is not tracked.

Tracking state of charge would introduce additional complexity to the analysis (would need to decide in which periods it is optimal to dispatch these assets) and in turn introduce additional assumptions around cycling limits, round-trip efficiency and state of health.

Each 5-minute period is assessed independently of any preceding and successive period. This will limit the exposure of efficiencies that the ENCC could have accessed by dispatching assets across multiple 5-minute periods.

Data Availability:

Dispatch Transparency data is incomplete, this data is used to retrieve which units were utilised for Frequency Response.



Thermal Constraints:

Accounting for thermal constraints (beyond the exclusion of system tagged actions) would introduce additional complexity to the calculation of the skip rate metric making it less transparent and difficult to reproduce.

It would entail the calculation of locational merit stacks to ensure actions taken behind thermal constraints were efficient.

Ancillary Services:

Assets held back by ESO in readiness to provide other ancillary services (Reserve, Response) are not excluded.

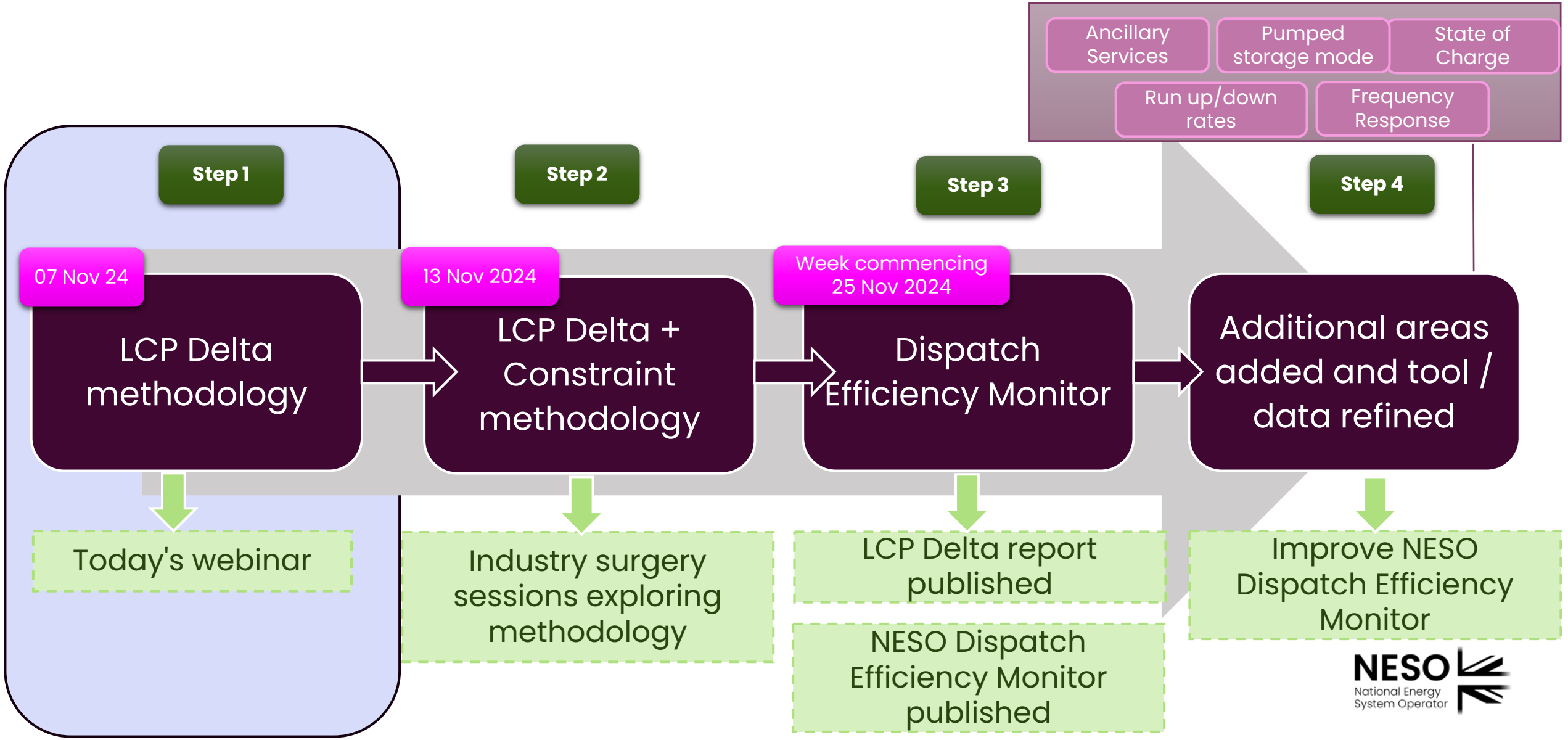
Pumped Storage:

Data is not available to show when pumped storage units are in ‘Spin Pump’ or ‘Spin Gen’ modes which would impact the feasibility of providing balancing actions.

Next Steps

Cathy Fraser

Timescales & Webinar Content



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Q&A

We will use this opportunity to answer questions on the LCP Delta methodology.

We will be taking questions in up-voted order.

If there are further questions after this, we will be running surgeries for technical experts with an existing understanding of battery storage to answer specific questions on the methodology.

For more general questions please contact us at:

Box.NC.Customer@nationalenergyso.com