The Curious Case of Batteries Flip-Flopping:

How the Current GB Wholesale Market Design Fails to Make Best Use of Flexible Assets

Flexible assets connecting to Great Britain's ("GB") power system, such as interconnectors, batteries and pumped hydro storage, should be hugely beneficial to consumers and to achieving net zero in the energy system. They can provide crucial flexibility at both the national and local levels – either by making up shortfalls in periods of low electricity production by renewables, such as solar and wind generation, or by absorbing surplus electricity when renewables production is high. However, the ability of flexible assets to support the transition largely depends on how they are utilised, which in turn depends on the price signals conveyed by electricity markets.

In that regard, the current Review of Electricity Market Arrangements ("REMA") identified that the current market design has significant shortcomings. One particular concern is that as a result of disregarding bottlenecks on the GB transmission network in the national wholesale market, interconnectors frequently receive the "wrong" price signal – leading them to be scheduled to flow out of the country when it would be preferable for them to flow in, and vice versa at other times. Resolving this frequent mis-scheduling adds additional costs to consumers.

GB currently has 9.8 GW of interconnector capacity – so this problem is already obvious – and has partly driven the demand, from some stakeholders, for GB to replace the national wholesale market with a zonal market. As prices would better reflect transmission bottlenecks within GB under a zonal system, it is generally agreed that this would provide better signals for interconnectors to flow in the direction that is most beneficial to the GB system, and in turn lower costs for consumers.

While much of the REMA debate has been on how to correct interconnector scheduling, that is not the only cause for concern. We have thought for some time that batteries in some locations – particularly those in Scotland and the south of England – may also exhibit the same mis-scheduling problem. That is, batteries are being signalled by the national wholesale market to discharge electricity when, given transmission bottlenecks, it would actually be preferable to charge up, and vice versa at other times and locations.

Using data from April to September 2024, we find strong evidence that this is the case. For batteries located in the north of GB, 59% of all actions categorised ("flagged") by the system operator as needed to unwind a transmission constraint are simply just to reverse the batteries' intended output, given the price signals they received in the earlier wholesale market. We term these actions "flip-flopping" as the battery's initial intention to discharge into the wholesale market is "flipped" by the system operator in the Balancing Mechanism ("BM") to resolve transmission bottlenecks. As the battery pays a typically much lower (or even negative) price to charge, compared to the price it receives when it discharges electricity in the wholesale market, flip-flopping likely causes additional costs to be incurred by GB consumers.

Bizarrely, therefore, increasing flexibility in some locations could actually increase, rather than decrease, the costs of congestion that consumers bear. Even worse, higher congestion costs add to case for more transmission investment – at further cost to the consumer. We therefore risk facing a perverse situation where flexible assets, that should help avoid transmission spend, end up triggering more grid investment.

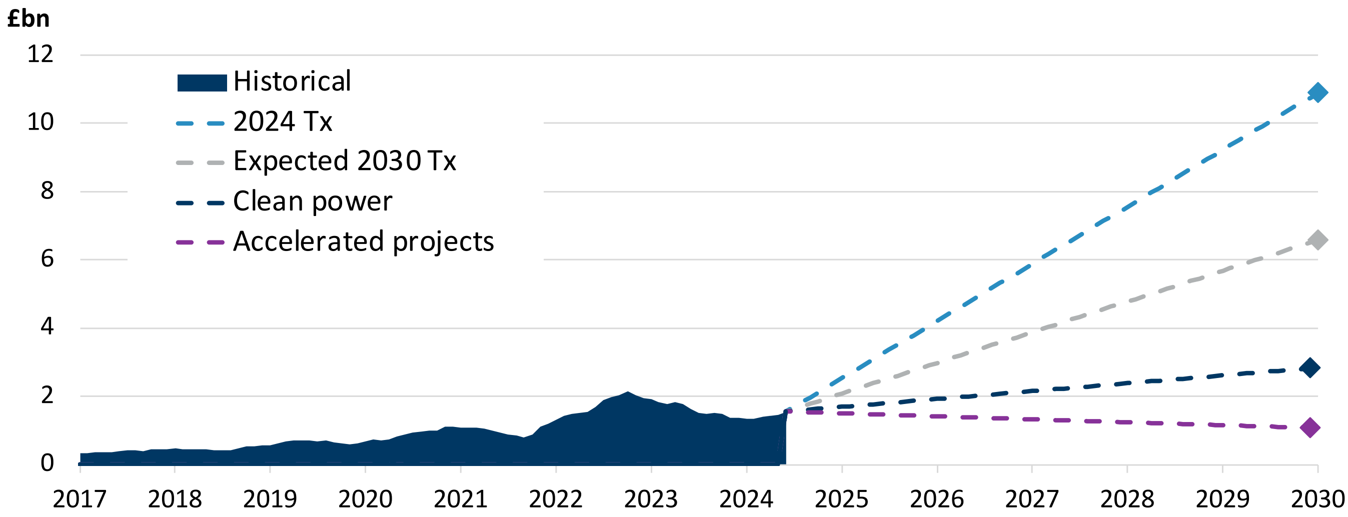
Addressing this issue while keeping the national wholesale market in place will be very difficult. If not resolved through a change in market design, we are concerned that policymakers could introduce increasingly stringent regulations that restrict battery operators' freedom to operate their assets. In turn, as we have already seen for some proposed interconnectors, this could endanger the business case for batteries as well as pumped hydro storage – a critical part of delivering a low-cost net zero power system. An alternative solution is to introduce zonal wholesale electricity prices which, by sending the right price signal to batteries in the first place, would ensure that flexible assets can bring maximum value to the GB electricity system at the lowest cost to consumers.

Introduction

Electricity traded in the wholesale market in GB receives a single price per trading interval, independent of where the electricity is produced or consumed. However, due to the physical limitations of the network, transmission constraints increasingly arise when generation scheduled in the wholesale market cannot be delivered to meet demand. In GB, much of our wind capacity is in the North. In hours of high wind speeds, all wind generation in the North is typically scheduled in the national wholesale market, but not all of that generation can physically be transported to the South, where most demand is located.

The mismatch between the market participants' intended generation – as determined in the wholesale market – and the transmission network's physical limits is resolved in the BM operated by the National Energy System Operator ("NESO"). The BM operates after gate closure time, one hour before the real-time delivery of electricity. The total BM volumes activated for reasons of transmission constraints have steadily increased over recent years and annual constraint costs have risen four-fold, from £0.3 billion in 2017 to over £1.3 billion in 2023 (see Figure 1). Despite ambitious plans to expand the transmission system, these constraint costs are expected to rise further, potentially to £7 billion by 2030 – which equates to roughly £250 per home when split over the estimated 29 million homes in GB.[1]

Figure 1 — Total GB transmission constraint costs – historical (12 month rolling average, 2017 to 2024) and projected pathways for 2030 (£bn).[2]



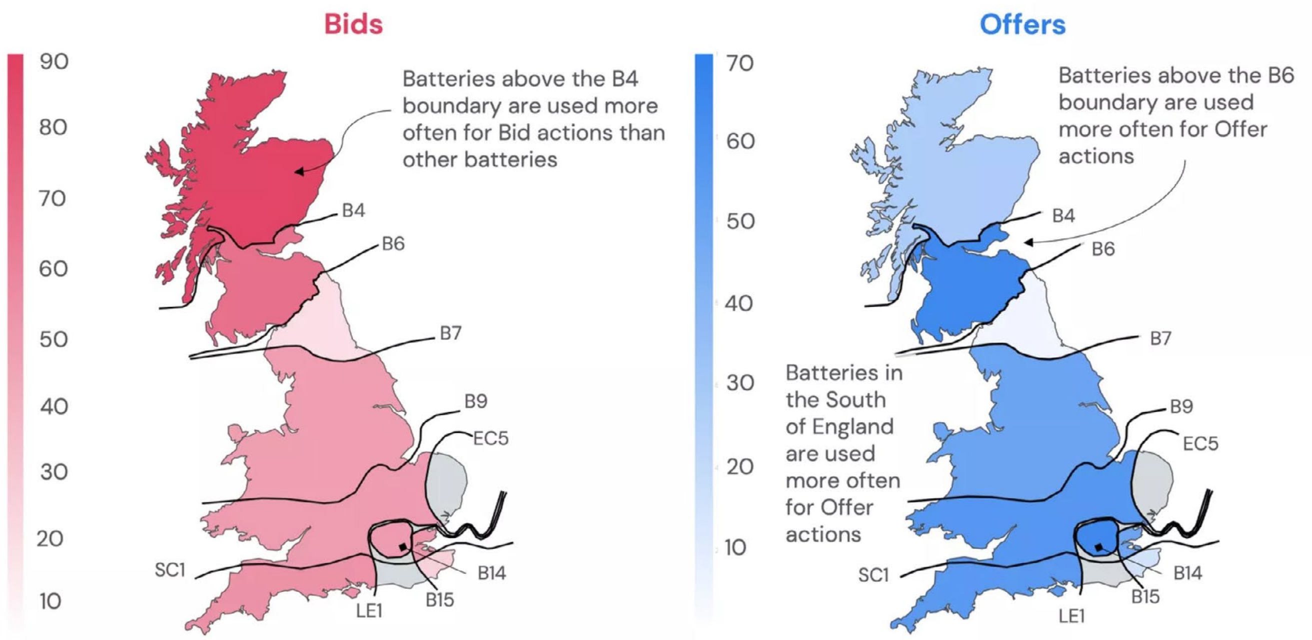
Sources: Monthly Balancing Services Summary, NESO; Clean Power 2030, NESO.

The standard approach to avoid overloading the transmission lines between the North and the South has been instructing Northern wind generation to be "constrained off" and Southern thermal generation to be "constrained on" in the BM.

However, with the growing capacities of flexible assets, such as batteries, interconnectors, pumped hydro storage and demand response, there are opportunities for alternative ways of resolving these transmission constraints. Some commentators have argued that the rapid increase of these flexible assets active in the BM could help reverse the increase in constraint costs while allowing GB to keep a national wholesale market in place.[3] Here our focus is on batteries which provide an ideal case study as, due to their extreme flexibility, they are active in multiple markets.[4] In the last year, battery storage has been increasingly supporting NESO both to balance supply and demand nationwide and to resolve local transmission constraints via the BM.

To help resolve rising transmission constraints, batteries in the North could charge in the BM ("accepted BM bid"), reducing the need to curtail wind generation. As such, the energy stored in the battery from buying electricity in the BM can be used in later hours to avoid the need to fire up fossil fuel generators. Similarly, batteries in the South can be instructed to discharge in the BM ("accepted BM offer") when a transmission constraint arises, replacing the need to start up thermal generators. Indeed, in recent months batteries above the B4 boundary are used more often for bid actions while batteries below the B4 boundary are used more often for offer actions (see Figure 2).

Figure 2 — Dispatched BM bids and offers (MWh dispatch/MW registered) for batteries located in different areas in GB



Source: Elexon, Modo Energy
Notes: Total dispatched volume in each region normalized by the total capacity registered to the Balancing Mechanism in the region from 25th March – 22nd July 2024.

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At first sight, this seems like a great win for the GB system. However, there is a catch – the net impact of flexibility on transmission constraints depends on their own position in the wholesale market. If flexible assets are initially scheduled to discharge, therefore potentially contributing to the constraints alongside the rest of the generation fleet, instructing them in the BM to turn down or charge merely cancels out their initial impact on the transmission constraint. We refer to such actions as "flip-flopping".[5] Though a similar dynamic could occur for any asset, because batteries are the most flexible asset on the system they will often be the first to respond and could be frequently unwinding their own wholesale position. Similar problems are already well recognised in the case of interconnectors which can schedule a flow in one direction in the wholesale market and then are instructed by NESO to reverse their position at a later stage.[6] Pumped hydro storage and demand active in the BM are likely to face similar issues.

To what extent are batteries helping to resolve transmission constraints through their BM actions or are they simply "flip-flopping"?[7] What are the risks for the operation of flexible assets under the current market design? How could locational wholesale pricing or other options help align the incentives of flexible assets with GB system needs?

The Interaction of Batteries Wholesale Schedule and BM Actions

Broadly speaking, BM actions can be triggered:

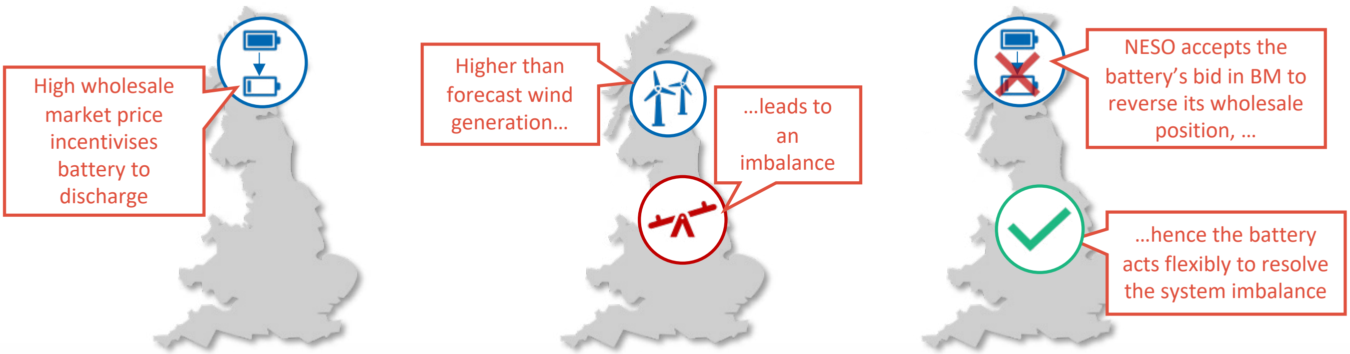
— To support **balancing** supply and demand in real time, which is required due to potential forecast errors and changing market conditions post gate closure (“non-flagged actions”).

— To resolve **transmission constraints**, amongst other technical issues, that arise when assets scheduled in the wholesale market cannot be physically dispatched due to the limitations of the GB transmission network (“flagged actions”).[8]

Example 1: Forecast Error — BM action of the battery benefits the GB power system (“non-flagged action”)

Figure 3 below provides an illustrative example of a battery being activated in the BM to resolve an energy imbalance. The battery is fully charged and initially scheduled in the wholesale market to discharge, as the price in the national wholesale market is relatively high. However, post gate closure time, wind generation is higher than forecasted, leading to a mismatch between supply and demand. NESO therefore instructs the battery in the BM to cancel its scheduled position (discharging) to resolve the imbalance. In this instance, the battery acts flexibly to resolve a system imbalance. The system imbalance could not be foreseen when the battery was scheduled in the wholesale market. The BM action of the battery benefits the GB power system as a whole and reduces costs to consumers.

Figure 3 — Illustrative example of a battery in North resolving energy imbalances in the BM



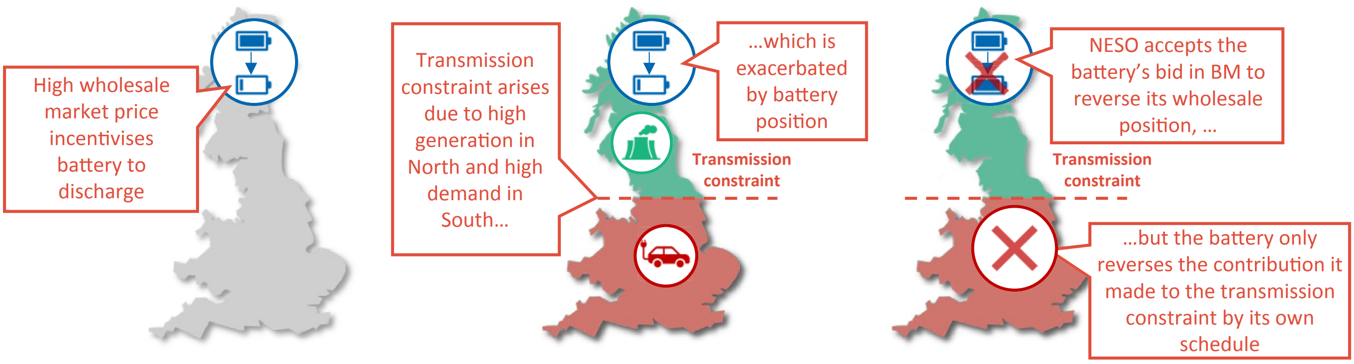
Example 2: Batteries "flip-flopping" in response to transmission constraints ("flagged action")

Figure 4 below provides an illustrative example of a battery acting in the BM to resolve a transmission constraint. Similar to the previous example, a battery in the North is fully charged and incentivised to discharge, as the wholesale market price is relatively high. However, due to excess generation in the North and high demand in the South, a transmission constraint arises between the North and the South of GB in the same hour the battery schedules to discharge. Post gate closure time, NESO instructs the battery in the BM to cancel its scheduling position (discharging) to reduce the transmission constraint.[9] In contrast to example 1 featuring an unanticipated forecast error, the transmission constraint was typically anticipated at the time the battery's wholesale schedule was determined.

The battery's initial schedule to discharge means that, in response to the prevailing wholesale price, its wholesale position contributed to the transmission constraint. In the BM, the same battery was chosen to turn down or charge which implies that the battery's BM action merely unwound its own position determined earlier in the wholesale market in response to the prevailing signal in that market, rather than resolving the underlying transmission constraint – ultimately, the battery was flip-flopping.[10]

In an alternative scenario, if there were Northern thermal generators scheduled in the wholesale market, the thermal generators might have been the most willing to be constrained off and be the ones to flip-flop.[11]

Figure 4 — Illustrative example of flip-flopping, i.e. a battery in the North reversing its contribution to transmission constraints



In the following section, we provide an initial empirical analysis of the relationship between a battery's wholesale position at gate closure ("physical notification") and its BM actions to understand the materiality of the issue.

Initial Empirical Analysis of Accepted Bids and Offers of Batteries in the BM

We have collected BM bid-offer acceptance level data on a minute-by-minute basis for the six-month period from April to September 2024 from Elexon for[12]:

— Four battery BM units, totalling 107MW, in North Scotland ("North")

— Six battery BM units, totalling 256MW, in London and the Southeast ("South")[13]

Comparing the accepted BM bids with accepted BM offers in the North and the BM actions in the South (see Table 1), two observations can be made.

1. For the Northern batteries, many more bids are accepted than offers. In contrast, for the Southern batteries, bids and offers each represent about half the total accepted BM actions.
2. For the Northern batteries, a very significant share of bids is flagged while offers are not. The share of flagged actions for Southern batteries is relatively low for bids and offers.

Table 1 — Total accepted BM actions and proportion of flagged BM actions (% of total): North vs South

Items	North		South	
	Total accepted	% flagged	Total accepted	% flagged
Bids	94,315	70.4%	83,103	6.1%
Offers	22,313	3.0%	80,863	0.1%
Total	**116,628**	**57.5%**	**163,966**	**3.2%**

These data show that batteries are active in the BM. Batteries' BM actions are in most cases non-flagged actions, resolving system imbalances, and typically can be expected to drive BM costs down for GB consumers.

However, an important share of the battery actions are flagged and those are concentrated in the North – more specifically accepted bids from Northern batteries accounting for 70.4% of 94,315 accepted bids. This is intuitive, because when transmission constraints appear in the GB market, the North of GB is typically an export-constrained region. As a result, the transmission constraints are unwound by accepting bids by Northern batteries in the BM, reducing discharging or increasing charging of a battery relative to its wholesale position.

Nearly no accepted BM offers of batteries in the South are flagged. This is surprising because when transmission constraints appear in the GB market, the South of GB is typically an import-constrained region. However, in the South, offers from batteries in the BM, reducing charging or increasing discharging of a battery relative to its wholesale position, do not seem to be a frequent action to unwind transmission constraints. It must be that resources other than batteries in the South are used to resolve transmission constraints.[14]

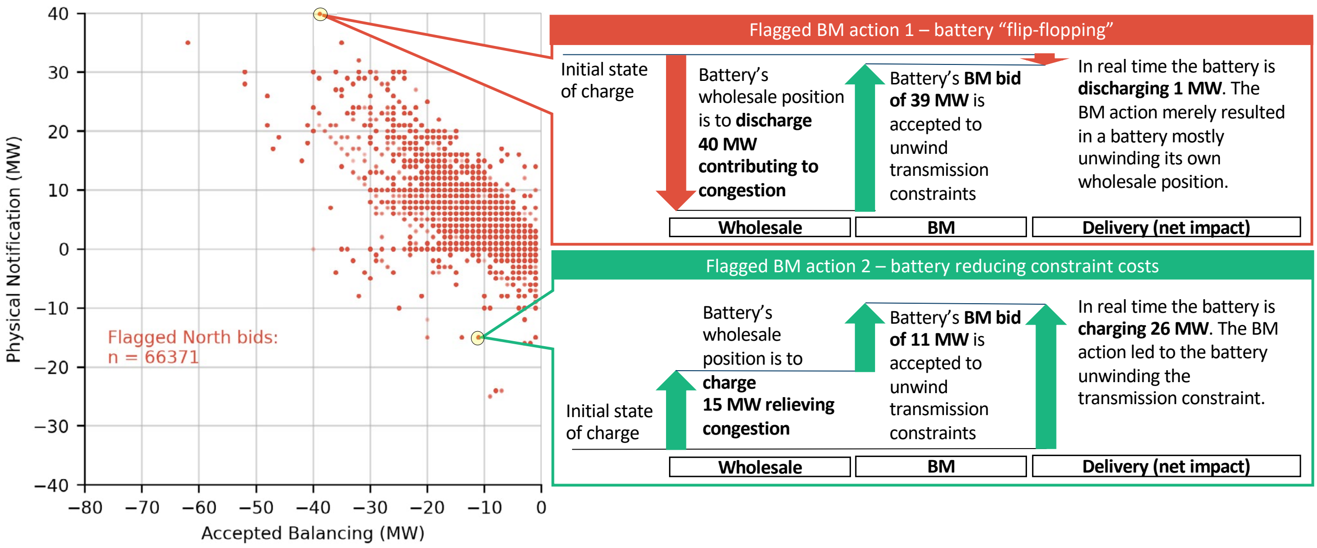
Northern Batteries Are Often Flip-Flopping To Unwind Transmission Constraints As the Most Flexible Response Available Within the Northern Generation Stack

Considering these findings, our focus is on the accepted flagged bids of Northern batteries[15] — calculating the net balancing action[16] and comparing it with the physical notification, which represents the battery's intended production/consumption in light of its transactions in the wholesale market.

In Figure 5 we highlight two observations. For Flagged BM action 1, the battery's wholesale position ("physical notification") was to discharge 40 MW, contributing to the export constraint in the North in the same trading interval. In the BM, the battery's bid to cancel almost entirely its discharging position was accepted (39 MW). Eventually, in real time, the battery discharged 1 MW. The BM action simply resulted in a battery flip-flopping, unwinding almost entirely its own wholesale position. Considering this instance in isolation, not only constraint volumes but also constraint costs would have been lower without the battery.[17]

In contrast, for Flagged BM action 2, the battery's wholesale position ("physical notification") was to charge 15 MW reducing the export constraint in North in the same trading interval. In the BM, the battery's bid to charge further was accepted (11 MW). Eventually, the battery charged 26 MW. The BM action led to the battery contributing to the unwinding of the transmission constraint. Considering this instance in isolation, the battery reduced both constraint volumes and costs.

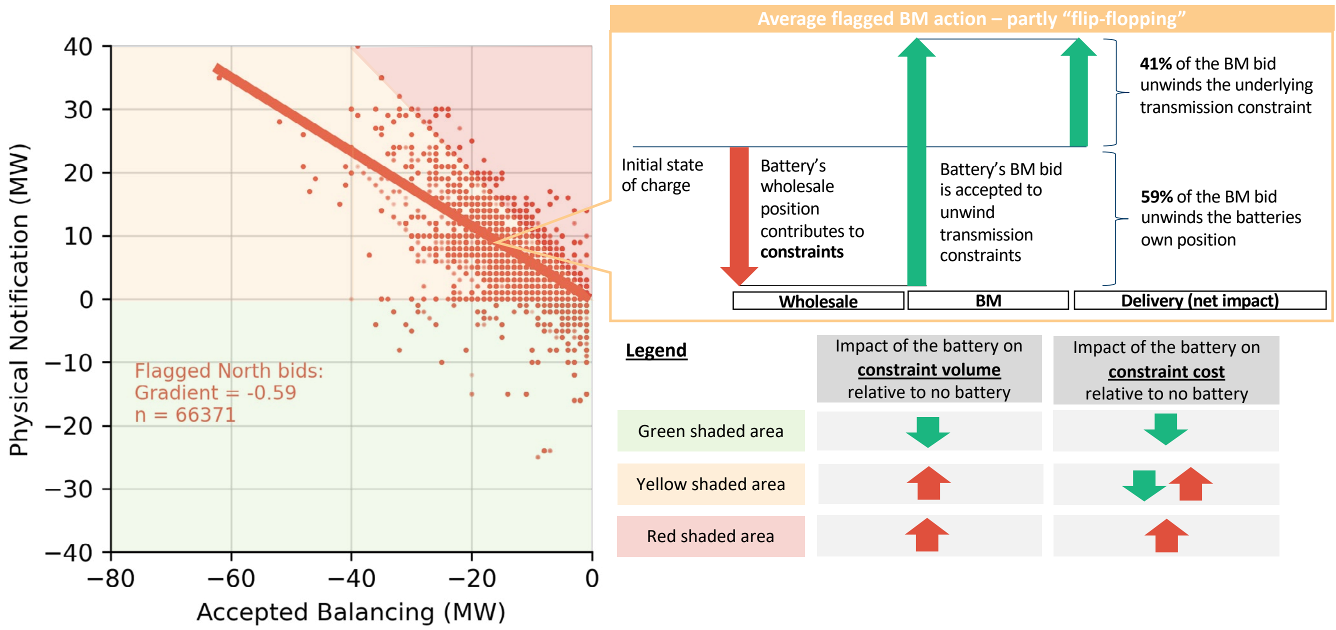
Figure 5 — Accepted bid volume versus physical notification for accepted BM bids of Northern batteries and a two highlighted BM actions.



Considering the entire dataset of accepted flagged BM bids of Northern batteries, we can divide all Northern accepted BM flagged bids into three groups (see Figure 6).

- The accepted BM bids that unwind a transmission constraint located in the **green shaded area** in Figure 6. Those are the BM bids that were accepted when the battery was scheduled to charge in the wholesale market. The acceptance of a BM bid implies that the battery increases its charging volume in real time relative to its wholesale position. In these instances, the battery is highly beneficial to the system as it reduced both constraint volumes and costs relative to a scenario without having the battery in place.
- The accepted BM bids that partly unwind a transmission constraint and partly the battery's own position are located in the **yellow shaded are**a in Figure 6 ("partly flip-flopping"). Those are the BM bids accepted when the battery was scheduled to discharge in the wholesale market. Accepting a BM bid in this case implies that the battery switches from a discharging position in wholesale to charging in real time. In these instances, the battery increased constraint volumes, while it is ambiguous whether the battery increased or reduced constraint costs relative to a scenario without having the battery in place.[18]
- The accepted BM bids that only unwind the battery's own position located in the **red shaded area** in Figure 6 ("flip-flopping"). Those are the BM bids that were accepted when the battery was scheduled to discharge in the wholesale market. Accepting a BM bid in this case implies that the battery discharges in real time but to a lesser extent than its wholesale position indicated. The boundary between the red and the yellow area represents the case where the battery's initial intention to discharge in the WM is entirely and exactly reversed in the BM. In these instances, the battery increased constraint volumes and increased constraint costs relative to a scenario without having the battery in place.

Figure 6 — Categorisation of the contributions of accepted flagged bids of Northern batteries to unwinding the underlying transmission constraint versus unwinding its own position.



On average, 59% of the volume of accepted flagged BM bids unwinds a battery's own position while 41% of the volume actually addresses the underlying issue.[19,20] This suggests that 59% of the accepted flagged BM actions of Northern batteries were flip-flopping in nature and would have led to an increase in constraint costs.

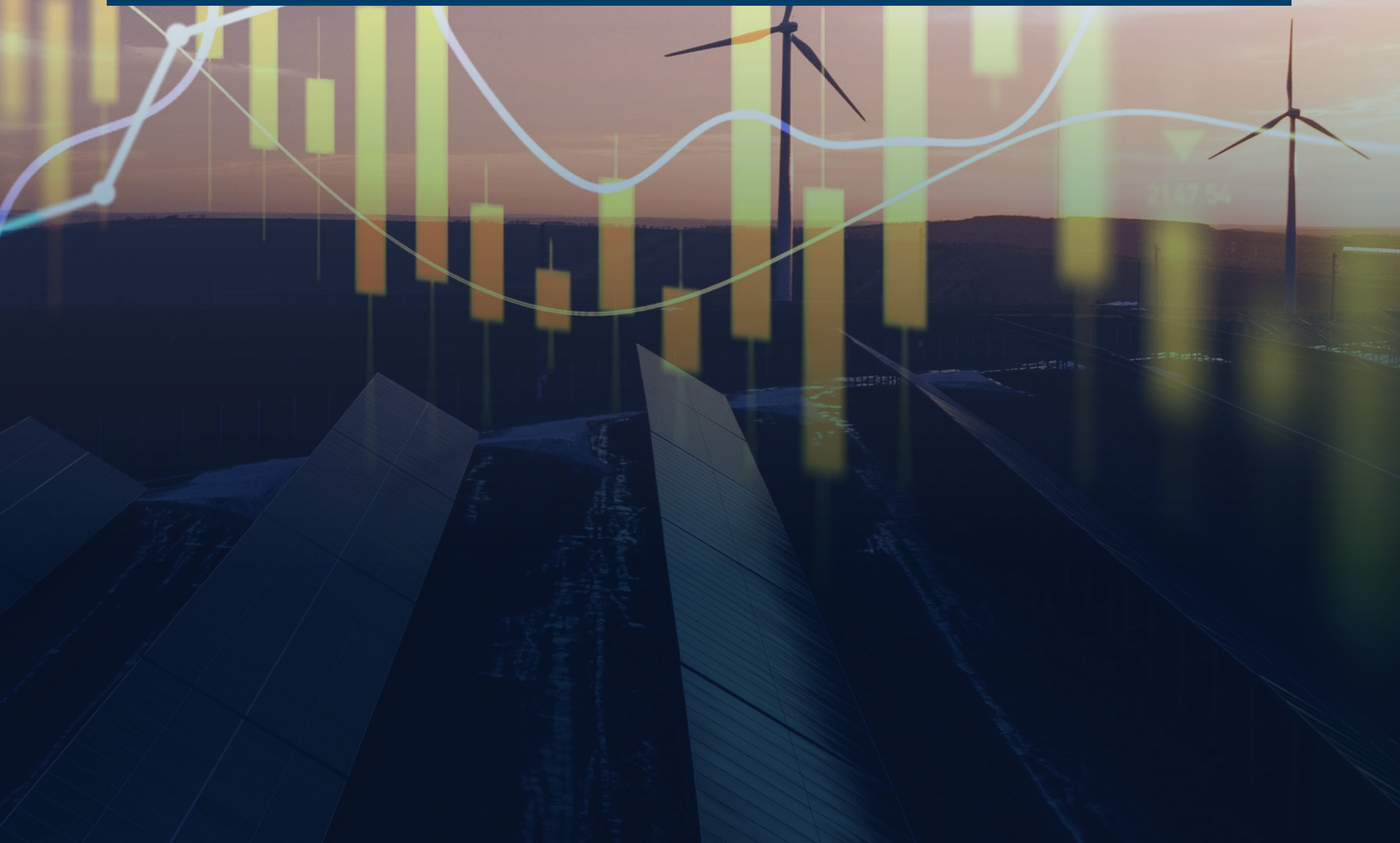
Not only can individual batteries offset their own wholesale positions in the BM, but they can also offset wholesale positions of their neighbouring batteries. We also performed an analysis aggregating wholesale and flagged accepted BM bids from all batteries in the North. The results are statistically significant with a slightly increased magnitude: 64% of aggregated flagged bid volume in North offsets physical notifications of the Northern battery fleet as a whole.

Recommendations

Our initial empirical analysis of battery storage in the wholesale market and BM in the summer of 2024 shows that batteries in the South have been providing a valuable source of flexibility for the energy system. However, this has not always been the case for batteries in the North. Under the current national-price wholesale market design, on many occasions Northern batteries have been scheduled to discharge in the wholesale market, before being constrained off in the BM to resolve transmission constraints to which they have unintentionally contributed. We see the unwinding occur in batteries as they are often the first to respond on behalf of the full generation stack in the north of GB. Concretely, for our selected sample of Northern batteries, we find that on average 59% of the volume of accepted flagged BM bids involved batteries flip-flopping, unwinding their own position, while 41% of the volume actually addresses the underlying issue. In other words, 59% of these BM actions would have been unnecessary if the battery's wholesale schedule was in line with transmission constraints.

This can create costs for GB energy consumers, both because batteries are not being used in line with what the system needs and because NESO typically incurs costs to unwind the battery's position in the BM. Even worse it is these costs – the costs of congestion – that are then currently used to prompt the need for more transmission.[21] As a result, battery flip-flopping between the wholesale market and BM is being used to justify incremental transmission when it could be doing the reverse – with batteries helping avoid transmission build by charging and exporting in line with regional needs. Given batteries can used as a substitute for transmission, the fact they currently might end up adding to the case for more transmission simply because the wholesale market is designed badly is, it seems to us, illogical and misplaced.

Though we have focused on battery actions because they are highly flexible two-way assets that are increasingly active in the BM , the issue we highlighted is not specific to batteries. The root cause is a flawed market design. A similar dynamic could occur for any asset, but we see the unwinding occur in batteries because they are often the most flexible among the full generation stack in the north of GB. In that sense, batteries are a victim of their own flexibility under the current market design. We expect the same issue to surface in relation to other important flexible assets, notably pumped hydro storage,[22] interconnectors,[23] and demand response.



We see three paths forward.

Option A: Keep the national wholesale price in place and do nothing. With increasing renewable generation, and flexible assets, NESO will need to take more extensive actions in the BM to resolve transmission constraints – especially if the planned transmission outbuild faces delays. Flexible assets will increasingly have their wholesale market schedules overridden in the BM. This would result in a very expensive GB system and in reaction, Option A might evolve in Option B.

Option B: Keep the national wholesale price in place and introduce new market rules aimed at limiting flexible assets' actions in the wholesale market to avoid them being scheduled in a way that increases constraint volumes.[24] For instance, flexible asset owners could be prevented from bidding in wholesale markets when their bids might be expected to increase constraints. Alternatively, rules could be introduced to restrict how flexible assets participate in the BM, building on the existing Transmission Constraint Licence Condition ("TCLC"), under which some pumped hydro storage providers have already been penalised.[25] However, any such restrictions, whether in the wholesale market or the BM, will inevitably prevent some beneficial actions, because of imperfect foresight of system constraints and the difficulties of identifying any gaming behaviour.

Overall, we would expect that ad hoc rules that affect how flexible assets can participate in the wholesale market differently from other assets on the electricity system would lead to significant problems. They could risk losing the substantial benefits that flexible assets bring, both in helping to unwind transmission constraints and in supporting the security and stability of the GB energy system as a whole. In doing so, they could also undermine the investment case for building the new flexible assets that a net zero energy system requires.[26]

Option C: Introduce a zonal wholesale market design with bidding zone boundaries reflecting frequent transmission bottlenecks. Battery operators' incentives would then be better aligned with the system and there would be no need for the interventions described under Option B. Batteries in the North would be incentivised to charge in the wholesale market when transmission constraints, captured by zonal boundaries, lead to low prices. They would therefore be working to resolve transmission constraints, rather than contributing towards them. In short, a zonal market design would avoid, rather than increase, regulatory risk and enable batteries to bring the most benefits to GB consumers – by better aligning the market signals that they receive to operate their assets with the needs of the GB electricity system as a whole.

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Endnotes

[1] See MFS, 'How many houses are in the UK and where could you look for opportunity?', March 2024.

[2] All 2030 results from the New Dispatch scenario. Pathways: 2024 Tx = 2024 transmission network assuming no further deployment; Expected 2030 Tx = network currently expected for 2030 (not including AENC/ATNC/SCDI); Clean power = network required for clean power, including three critical projects being delivered in 2030; Accelerated projects = network if all 7 further projects were accelerated to 2030

[3] See Regen, 'Seven solutions to the rising costs of transmission network constraint management', August 2022.

[4] Battery capacity in GB has grown steadily in recent years, with a total battery capacity installed of 4.3 GW/5.7GWh as of October 2024. See BESS Industry Growth – GB, Modo Energy.

[5] By "flip-flopping", we refer to all situations where an asset is reducing its charging or discharging relative to its wholesale market position, not just cases where its position is entirely reversed.

[6] See FTI Consulting, 'Assessment of locational wholesale electricity market design options in GB', October 2023.

[7] The current market design with a national wholesale market and locational actions in the BM creates gaming opportunities which would further aggravate the described problem. Such gaming strategies are well documented and often referred to as inc-dec gaming, see Stoft, 'Using Game Theory to Study Market Power in Simple Networks', 1998. For this piece, we have consciously chosen not to consider the gaming aspect of this problem. However, we anticipate that regulatory authorities are likely to become interested in this issue as the market develops further.

[8] The majority of flagged actions are triggered for thermal constraint reasons but they can also be triggered for other system needs, such as local voltage constraints or lack of inertia. For simplicity, here we consider that all flagged actions are triggered by thermal transmission constraints.

[9] At the same time a BM offer South of the constraint will be accepted to rebalance supply and demand.

[10] Equally, batteries in an import constrained region (typically the South of GB) can also contribute to transmission constraints by scheduling to charge in the wholesale market and then reduce their contribution by being instructed in the BM to reduce charging or reverse to discharging.

[11] We would expect that the most costly generator scheduled in the wholesale market that qualifies for participating in the BM would be the first one to be constrained off, i.e. the avoided costs when not generating are highest for this generator and its BM bid the highest – meaning that the generator would be willing to pay most to NESO to be constrained off.

[12] We consider 'first-stage flagged' actions. Data from Elexon BMRS.

[13] North Scotland BM units are all north of the SSE N-S constraint. London and Southeast BM units are all south of the SEIMPPR23 constraint. NESO.

[14] Note that flagging bids/offers done by the NESO operators in the control room can be ambiguous as there are synergies between actions resolving energy imbalances and transmission constraints. An alternative explanation can be the difficulties with the flagging of accepted BM offers by Southern batteries.

[15] Here we focus on the number of BM actions. The average size of accepted Northern flagged bids is 10.4 MW versus 7.8 MW for non-flagged bids. In this analysis we only focus on BM actions of batteries and their physical implications. We do not quantify revenue or consumer impacts.

[16] Calculated by deducting for each battery on a minute scale its physical notification (i.e. its indicated (dis)charge level at gate closure) from its bid-offer acceptance level (i.e. its (dis)charge level in real-time). We only consider BM bids/offers that have been accepted in the BM (i.e. balancing action implies a reduction in discharging or an increase in charging).

[17] Constraint costs can only be lower due to this action if the battery would sell back the energy it was planning to discharge for a lower price than it had sold the same energy in the wholesale market. We deem such situation to be unlikely.

[18] It is ambiguous whether the BM costs would have been lower without the battery. A proportion of the battery's BM action unwinds its own position, which would have been unnecessary without the battery. However, the other proportion of the BM action resolves an underlying transmission constraint which would have had to be resolved by a more expensive BM action in case the battery was not there.

[19] We find a negative gradient of 0.59 when plotting a best-fit line through all relevant datapoints. Looking at all data points in aggregate, the results show a statistically significant negative correlation between accepted bid volumes and physical notification volumes. Flagged correlation = 0.64, non-flagged correlation = 0.44. Both correlations have P-value < 0.001.

[20] This negative correlation is to be expected since when a battery is scheduled to charge in the wholesale market, only the difference between the maximum charging capacity of the battery and its charging position in the wholesale market can be offered as a bid in the BM. In contrast, when the battery is scheduled to discharge in the wholesale market the maximum charging capacity of the battery can be offered as a bid in the BM. For example, a battery that has a (dis)charging capacity of 10 MW can have a discharging position in the wholesale market of anywhere from 0 to 10 MW, it can always offer a bid volume of 10 MW. While if that same battery has a charging position of 3 MW in the wholesale market, it can only offer a bid volume up to 7 MW in the BM.

[21] "The Network Options Assessment (NOA) makes economic recommendations by comparing the cost of managing system constraints against the cost of reinforcing the network". See NGESO, 'Network Options Assessment 2021/22 Refresh', July 2022.

[22] For example, potentially the Coire Glas hydro plant located in the Scottish Highlands.

[23] Recently Ofgem approved five new interconnectors between GB and Europe.

[24] Some commentators have already proposed restrictions on the freedom of interconnectors to operate in the wholesale market. See Frontier Economics, 'Analysis of reform options for status quo electricity balancing arrangements', April 2024. We assess in more depth issues with proposed reforms to the BM, in FTI Consulting, 'Assessment of likely impacts of proposed reforms to the balancing mechanism within a national price regime' September 2024.

[25] See Ofgem, Notice of penalty - SSE Generation Limited, July 2023.

[26] For example, in the recent Window 3 assessment an important reason that some of the proposed interconnectors were not approved has been due to analysis finding that those interconnectors would likely worsen constraint volumes – see EDO, 'Cap and Floor Window 3 and OHA pilot scheme Needs Case Assesment', March 2024. However, such analysis could lead to different results when not taking the current national wholesale market design as a given.