BESS in GB: BM vs non-BM

August 2024

In the intraday market, battery assets employ various trading strategies depending on the type, size, data requirements and payments available to the asset. Balancing Mechanism Units (BMUs) are categorised into Primary and Secondary units, both of which are subject to stringent data and metering requirements due to their role in system balancing. Conversely, the position of non-BMU's tends to be less transparent, providing assets with greater flexibility to alter their generation or consumption through to real-time.

This year, an additional asset type has recently emerged that sees batteries, registered as BMUs, turn their FPN flag off and ultimately behave as non-BMUs. In this deep-dive, we explore the factors driving this emerging strategy including the differing requirements of BMUs and non-BMUs, and how this influenced trading strategies in the first half of 2024.

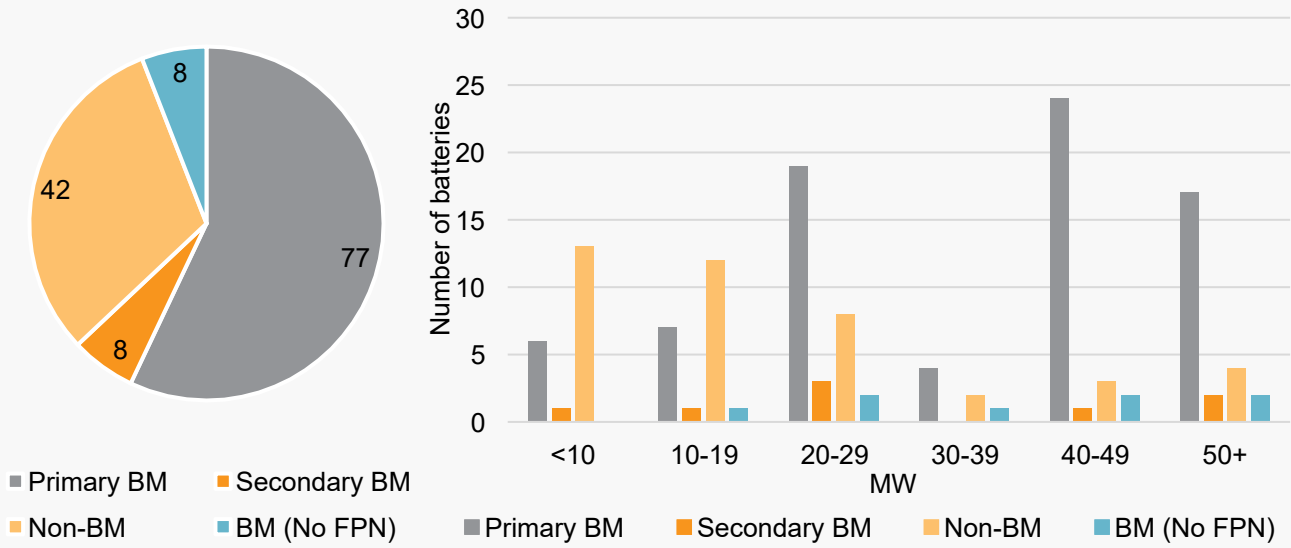

Figure 1: The number of batteries a) assigned to each asset group and b) across different capacity ranges (MW) for each asset group

What are the requirements of a BMU?

BMUs play a crucial role in maintaining the stability and efficiency of the power system through their participation in the Balancing Mechanism (BM). Consequently, these assets are subject to more rigorous and frequent data and metering submission requirements compared to non-BMUs. This includes the submission of Physical Notifications (PNs), which detail their expected generation or consumption, and Final Physical Notifications (FPNs) at gate-closure (1-hour prior to the settlement period, made public). Although this requirement restricts BMUs from participating in wholesale markets during the hour before delivery – where increased intraday market liquidity exists – it enables the Electricity System Operator (ESO) to more accurately forecast supply and demand and manage the grid in real-time. Reliable PNs also allow the ESO to operate the grid more efficiently by minimising the need for costly and emergency balancing actions that may arise from sudden mismatches between supply and demand.

In addition to PNs and FPNs, BMUs submit metering and dynamic data to the ESO, which are also made public. This includes their Maximum/Stable Export and Import Limits (MEL, SEL, MIL and MIL), ramp rates and Minimum Non-Zero/Zero Times (MNZT and MZT). This information allows ESO to optimise the dispatch of these assets in the Balancing Mechanism, with full visualisation on their operating parameters and restrictions. Further, the ESO is proposing to modify the Grid Code, GC0166, to introduce new state-of-charge parameters for limited duration assets (including BESS) to optimise dispatch and planning. It is expected that these new parameters will be submitted in the same way as other dynamic data and a decision is due in Q4 2024. Metering data is also required by ELEXON for the billing and settlement process, which charges market participants for any discrepancies between forecasted and actual generation or consumption.

To become a BMU, an asset must register with both ELEXON and the ESO, a process that can take over six months to complete. It is mandatory for assets to be active in the BM, and therefore registered as a BMU, if it is directly connected to the Transmission System or has a generation/demand capacity at or above 50MW in England/Wales, 30MW in South Scotland, or 10MW in North Scotland (Figure 2). Assets that fall below this threshold can choose whether to be active in the BM.

There are several types of BMU**, each representing different aspects of the system, and identified by different prefixes in their BMU ID. Primary BMUs include units that are directly connected to the Transmission System or embedded in the Distribution System, Interconnector BMUs and Supplier BMUs (see Appendix for further explanation). Secondary BMUs are registered by a Virtual Lead Party (VLP)* to provide balancing services to the ESO. One function of Secondary BMUs is to allow VLPs to aggregate several sites across multiple suppliers in order to provide these balancing services. Secondary BMUs may therefore be a single site, or a collection of sites within the same Grid Supply Point (GSP) Group* .

Figure 2: Asset capacity thresholds by region, above which it is mandatory to be a BMU

* See Appendix 1 for definitions

**See Appendix 2 for full breakdown of BMU types

Primary BMUs

Primary BMU battery assets predominantly contract volume in the BM, wholesale market and Dx services, notably Dx high services*. The prevalence of these assets in the Dx high services is due to their eligibility for Applicable Balancing Services Volume Data (ABSVD)*. When Primary BMUs deliver certain balancing services, such as Dx services, they may deviate from their expected wholesale position (FPN), resulting in an imbalance which is subsequently paid for at the system price. ABSVD removes these imbalance charges*.

ABSVD means that Primary BMUs do not receive any payment for energy discharged when contracted in the Dx low services* (when frequency drops below defined limits). However, this also means that they are not required to pay for any energy they take off the system when contracted into the Dx high services (when the frequency rises above defined limits). For the correct application of ABSVD in the settlement process, the ESO must provide data of each asset's adjustments per half-hour period to ELEXON, which administer this process.

Asset type	BM Active	ABSVD for Dx services	NIV Chasing*	PN submission	Predominant Dx service
Primary BMUs	●	●		●	High

Although primarily discussed in relation to Dx frequency response services in this article, ABSVD can apply to multiple balancing services for Primary BMUs, including:

Short Term Operating Reserve (STOR)	Balancing Reserve	Negative Quick Reserve (NQR)	Positive Quick Reserve (PQR)
Frequency Response Service	Commercial Intertrips	System to Generator Operational Intertripping	Maximum Generation Service

A complete guide to ABSVD methodology can be found on the ESO's website, here.

* See Appendix 1 for definitions

Secondary BMUs

Similarly to Primary BESS BMUs, Secondary BESS BMUs predominantly contract in the BM, wholesale market and Dx services. However, Secondary BMUs are not eligible for ABSVD* and are therefore more prevalent in Dx low services*. Historically, ABSVD has been applied to Mandatory Frequency Response (MFR)*, which was only available for Primary BMUs. This process was later extended to the new Dx services, granting Primary BMUs access to ABSVD, but excluding Secondary BMUs. Despite this, ABSVD does apply to Secondary BMUs for other balancing services, such as STOR, Fast Reserve, MW Dispatch, Local Constraint Market (LCM) and Demand Flexibility Service (DFS). Further, it is worth noting that the ESO intends to extend the ABSVD process to include Secondary BMUs, however the complexity of the process has led to a delay in this change occurring.

The absence of ABSVD for Dx services means that Secondary BMUs are subject to imbalance charges* when they deviate from their wholesale position to deliver balancing services. As a result, these assets receive payments for energy discharged in response frequency drops (Dx low services) but must pay the ESO for energy they take off the system (i.e. charge with) when frequency rises (Dx high services*).

Asset type	BM Active	ABSVD for Dx services	NIV Chasing	PN submission	Predominant Dx service
Secondary BMUs	●			●	Low

What are the requirements of a non-BMU?

Non-BMUs refer to any other asset not in the BM, which exist on the distribution network. They cannot participate in the BM and therefore have considerably less stringent metering and data submission requirements compared with BMUs. Instead, these assets provide a service to the system by providing liquidity post-gate closure to allow for the market to balance via trading through to real-time. Non-BMUs are only required to submit PNs to the ESO when active in the Dx services and their merchant market activities remain non-public. This allows non-BMUs to adjust their generation or consumption in real-time when not contracted into Dx services, creating revenue opportunities such as Net Imbalance Volume (NIV) chasing*.

To become a non-BMU, but participate in ESO-facilitated markets, an asset must register with the ESO only. Due to the different communication systems required – non-BMUs use the Ancillary Service Dispatch Platform (ASDP) to send PNs, unlike the Electronic Dispatch and Logging (EDT and EDL) links used by BMUs – this registration process can take as little as 30 days to complete, compared to six or more months for a BMU. Although non-BMUs are not required to register with ELEXON, they are still subject to imbalance charges when they deviate from their PNs, which are submitted only when contracted into the Dx services. The ESO provide this metering data to ELEXON, which administers these charges via the Lead Party associated with the non-BMU.

Non-BMUs

Non-BMUs primarily allocate volume to merchant markets and NIV (Net Imbalance Volume) chasing*, with some also participating in ESO-facilitated markets like Dx or STOR. NIV chasing is a strategy used to capitalise on forecasted discrepancies between supply and demand. When generation exceeds demand, the system is long, NIV is negative, and the system price is generally set by cheaper Bids. Conversely, when demand exceeds generation, the system is short, NIV is positive, and the system price is generally set by more expensive Offers. The NIV fluctuates throughout the day and within settlement periods as the ESO accepts Bids and Offers in the BM to balance the system. Flexible assets can 'chase' NIV by adjusting their output to discharge energy when the system is short and charge when the system is long. increased intraday liquidity occurs close to and after gate-closure, when assets can more reliably predict the system imbalance. This means that when a non-BMU is not contracted into Dx services, and thus is not required to submit a PN, it has greater flexibility to adjust its physical output through to real-time. This enables battery assets to estimate NIV, predict the system price, and adjust their output to maximise revenues.

Further influencing the trading strategy of non-BMUs is the eligibility for ABSVD*. Although non-BMUs are eligible for ABSVD in relation to some balancing services (STOR, Fast Reserve, MW Dispatch, LCM and DFS), they are not eligible in regard to Dx services. Therefore, when non-BMUs take energy off the system during Dx high services*, they must pay to do so. However, when contracted into the Dx low services*, these assets will be paid to discharge energy. Non-BMUs are therefore more prevalent in the Dx low services, compared to their high counterparts.

Asset type	BM Active	ABSVD for Dx services	NIV Chasing	PN submission	Predominant Dx service
Non-BMUs			●	Only when contracted into Dx services, although not publicly visible.	Low

BMU (no FPN)

Recently, the market has seen that nine out of 93 BMU batteries have adopted a particularly niche strategy whereby, after registering as a BMU, they turn their FPN Flag off, thus acting like non-BMUs (Table 1). Notably, six of these batteries have never participated in the BM, indicating that they adopted this strategy from their operational start dates.

The FPN Flag determines whether a unit must submit PNs to the ESO. Further, the Grid Code mandates that any BMU registered with the ESO. If the FPN Flag is set as 'True', the unit is required to submit PNs to the ESO every hour from 13:30, D-1, and an FPN at gate closure (1-hour prior to the settlement period).

If, however, a BMU decides that it wants to operate as a non-BMU, and maximise revenues through NIV chasing, it would need to restart the registration process as if it were a completely new non-BM asset and incur all the delays that come along with this. To circumvent this, assets have begun to turn their FPN flag off, a method suggested by the ESO. Some assets have even begun operation with this strategy, potentially allowing themselves the flexibility to enter the BM in the future, should expected value begin to increase.

* See Appendix 1 for definitions

BMU (no FPN)

As BMUs with their FPN Flag off are operating like non-BMUs, the expectation is that they should not be eligible for ABSVD*. However, it remains unclear within the industry whether this has been consistently enforced, with anecdotal evidence suggesting that these assets have been receiving ABSVD to date. This is something which the ESO are looking into, and they intend to clarify the parameters of ABSVD eligibility in the future.

Asset type	BM Active	ABSVD for Dx services	NIV Chasing*	PN submission	Predominant Dx service
BMUs (no FPN)				Only when contracted into Dx services, although not publicly visible.	Low

Asset	Optimiser	Owner	Duration (mins)	Power (MW)	Operational start date	BM Active dates
Torquay	Conrad Energy	Conrad Energy	60	20	December 2023	N/A
Brentwood	SMS	SMS	60	50	November 2023	N/A
Newton Wood	SMS	SMS	60	49.9	October 2023	October 2023 to January 2024
Winchester	Conrad Energy	Conrad Energy	60	19	July 2023	N/A
Brook Farm	SMS	SMS	60	50	April 2023	April 2023 to January 2024
Gipsy Lane	RGreen Invest	Habitat	60	20	February 2023	N/A
Mannington	EDF Energy	Swindon Borough Council	120	35	March 2022	March 2022 to May 2023
Greenfield Road	Conrad Energy	Conrad Energy	75	40	2019	N/A
Broxburn Energy Storage	The Renewables Infrastructure Group	British Gas Trading	60	20	March 2018	N/A

Table 1: BMU (no FPN) assets currently in operation

* See Appendix 1 for definitions

Comparing strategies across asset types

The presence of ABSVD* forms a key driver in the contracting strategy of battery assets. For Primary BESS BMUs, the availability of ABSVD incentivises them to contract larger volumes in Dx high services* to benefit from free charging. In the first six months of 2024 (H1 2024), on average, 58% of these assets' monthly volume was contracted in Dx high services, with 39% of this attributed to DC-H. DC is the short duration, post-fault service designed to arrest frequency in large-loss, low inertia scenarios. This service, therefore, has the largest volume requirements of any of the Dx services and typically has the greatest monthly contracted volumes across asset types. Conversely, Secondary BMUs, Non-BMUs and BMUS (no FPN) do not receive ABSVD, resulting in a predominant contracting strategy focused on Dx low services*, rather than Dx high services. In H1 2024, Dx low services comprised 60%, 63%, and 65% of the monthly contracted volumes for Secondary BMUs, non-BMUs and BMUs (no FPN), respectively.

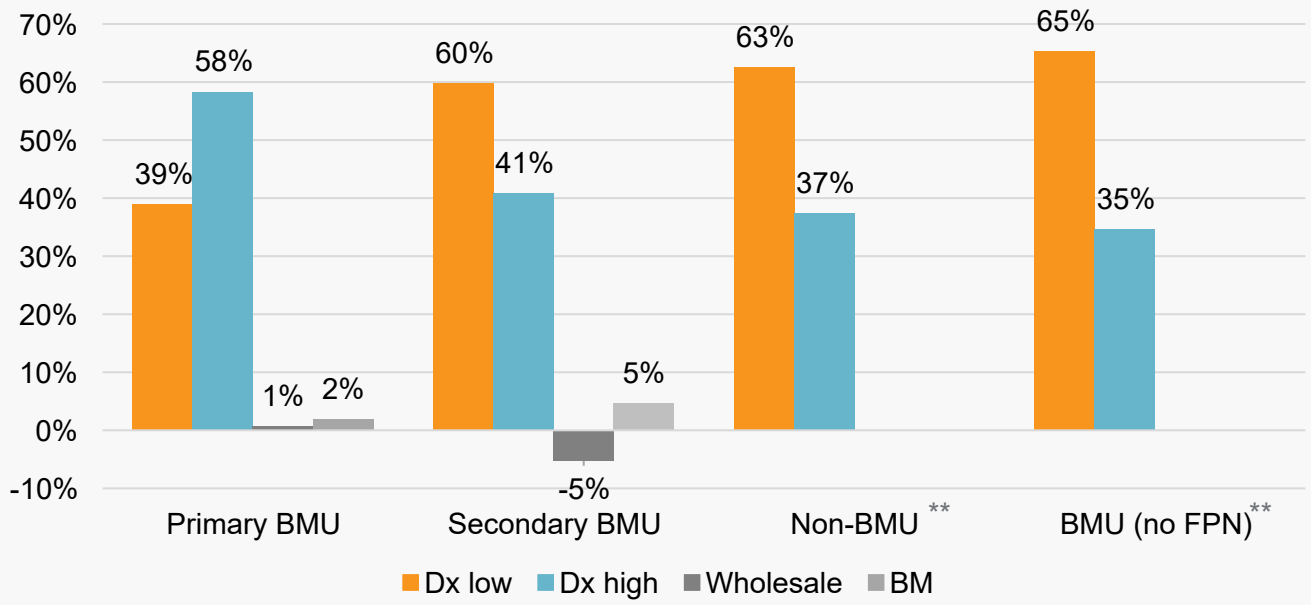

Figure 3: Distribution of BESS H1 2024 contracted volumes across the Dx services, wholesale market and BM (%)**

The introduction of Enduring Auction Capability (EAC)* in November 2023 allowed assets to be co-optimised across Dx services, prompting a strategic shift from Secondary BMUs, non-BMUs and BMUs (no FPN). Prior to EAC, these assets primarily contracted in DC-H and DC-L, representing 57% to 92% of their total monthly volumes in H1 2023. However, in H1 2024, we observed a shift in strategy amongst these assets, redistributing their volumes to be primarily prevalent in the DR-L and DC-H services. Both non-BMUs and BMUs (no FPN) shifted approximately 20% of their monthly volumes into the DR-L service, whilst Secondary BMUs allocated an additional 40%. DR is the most frequently used Dx service, providing a constant power response to frequency deviations up to ±0.2Hz. Therefore, by contracting high volumes into the DR-L service, Secondary BESS BMUs can frequently discharge in DR-L and be paid (due to the absence of ABSVD) and subsequently charge for short durations via the DC-H service (at a cost).

* See Appendix 1 for definitions

**Merchant market volumes are not estimated here for non-BMU and BMU (no FPN) assets

** See Appendix 3 for further chart breakdown

Conversely, H1 2024 generally saw lower volumes contracted into the Dx high services* compared to H1 2023, decreasing between 5% and 21% for Secondary BMUs, non-BMUs and BMUs (no FPN), whilst increasing 3% for Primary BMUs. As well as co-optimisation, the introduction of EAC* allowed assets to big negatively into the Dx services, driving Dx high prices down from between £2.09/MW/h to £3.72/MW/h in H1 2023 to between £1.95/MW/h to -£4.25/MW/h in H1 2024. These lower prices may have disincentivised BESS assets from contracting volume in the Dx high services. Despite this, it is difficult to draw definitive conclusions from the shift in contracted volumes observed, due to the small number of assets assigned to some asset groups. Notably Secondary BMUs and BMUs (no FPN) both comprise of eight assets, and some variation is expected due to differing strategies.

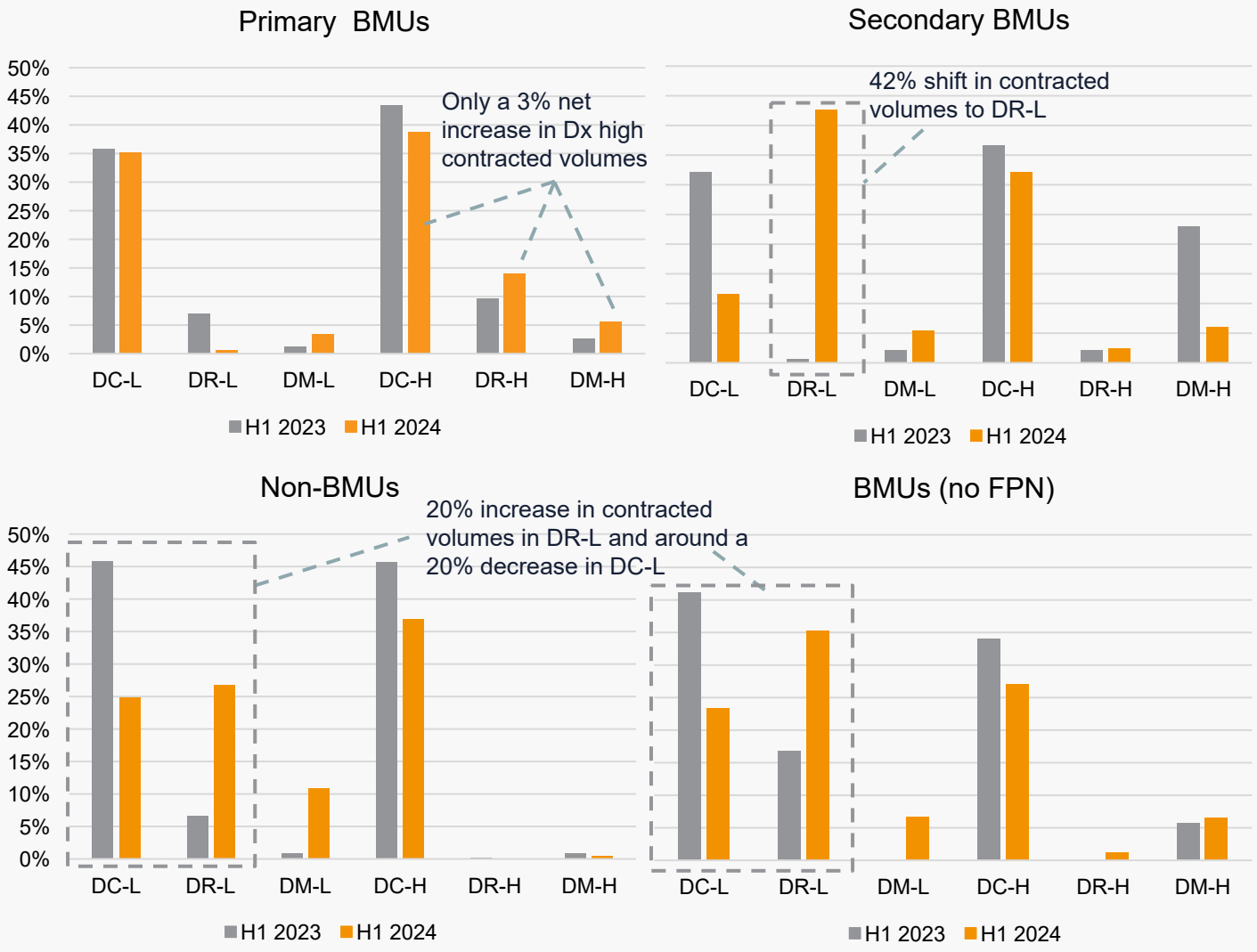

Figure 4: The distribution of BESS contracted volumes in H1 2023 and H1 2024 across the Dx services and the different asset types

The duration of BESS assets also affects contracting strategies. For short duration BESS assets (<1-hour), you would expect to see greater volumes contracted into the DC service, where the delivery duration is 15 minutes and the time between utilisation is usually longer, allowing the BESS time to re-charge. Conversely, long duration assets (>1-hour) will allocate greater volumes to DR and DM, where the delivery duration is 60 minutes and 30 minutes, respectively and they are utilised frequently throughout each period. Due to higher demand in DR and DM services, assets must ensure they maintain a state of charge to fulfil their contracts. In H1 2024, Secondary BESS BMUs contracted the largest monthly volumes into the DR-L service at 43%, while also procuring an additional 5% of power from the wholesale market, likely due to the large volumes being discharged into DR-L.

* See Appendix 1 for definitions

Deep Dive: Mannington Battery

Mannington is a 35MW, 2-hour duration, Primary BMU (no FPN) BESS asset which is owned by Swindon Borough Council and optimised by EDF Energy. After first becoming operational in March 2022, the asset turned its FPN Flag off in May 2023. In its 15 months as an active BMU, Mannington was primarily active in the DR, DC, and DM-L services, whilst only having between 0.1% and 2.8% of its total monthly contracted volume accepted in the BM.

From May to October 2023, Mannington was solely participating in DR-L, bidding in 24MWh on average during this time and leaving 10MWh available for NIV chasing*. Upon the introduction of EAC* in November 2023, which allowed units to co-optimise their assets across Dx services, Mannington began participating in DC-H, alongside DR-L. Since then, the asset has had 18MW accepted into these services on average, leaving 17MW of capacity available for NIV chasing and trading in the merchant markets.

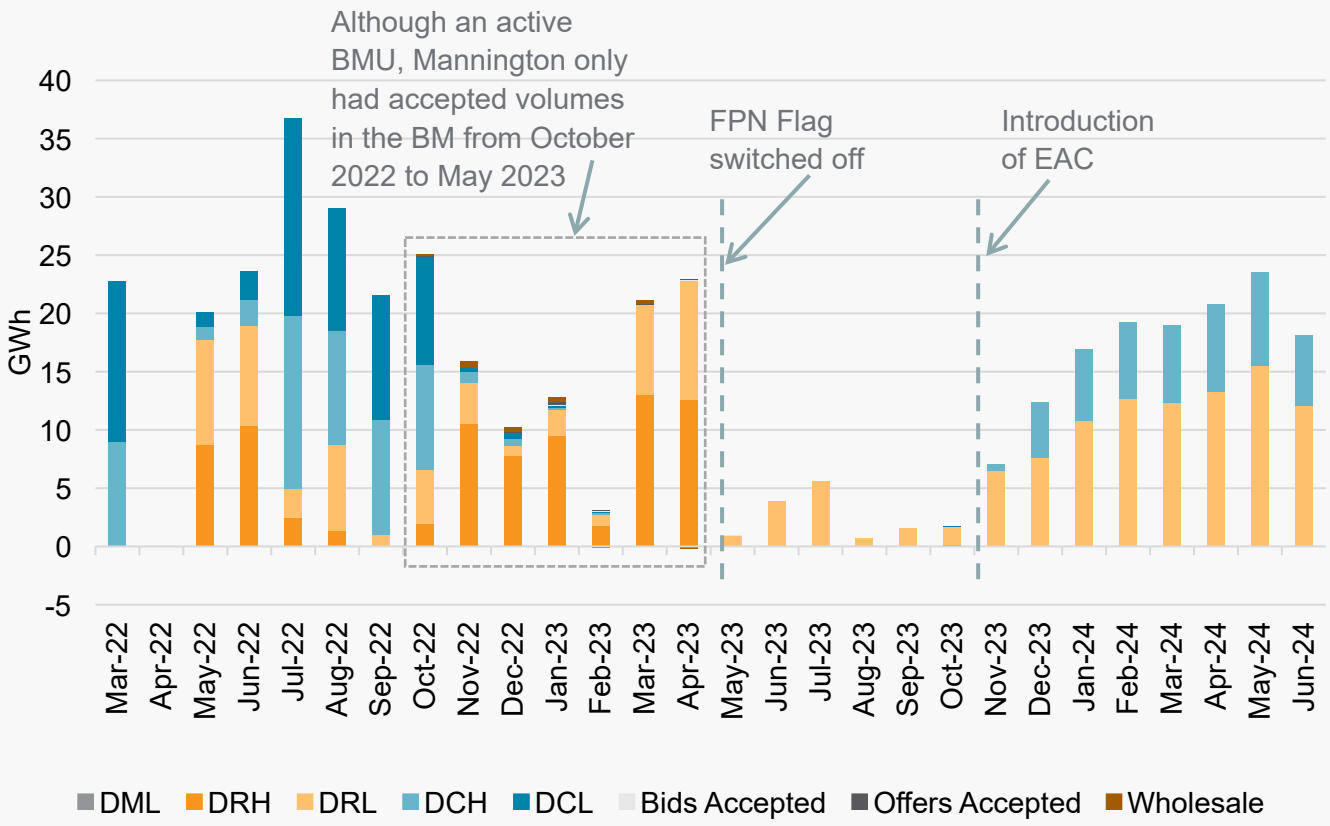

Figure 5: Mannington's total monthly volume allocated to the Dx services, BM and wholesale market from March 2022 to June 2024

* See Appendix 1 for definitions

Future Outlook

Historically, market focus has been on BM assets due to the vast amount of data available. However, with the increased participation of non-BMUs – primarily BESS – in newer ESO frequency and reserve markets, the visibility of these assets, including their trading strategies is growing.

The ESO aims to extend this visibility further by implementing changes to the frequency response service. To achieve this, it has launched a consultation outlining the proposed changes, which include:

- **24/7 operational baseline and metering data for non-BMUs**. This change would enhance the transparency and forecasting abilities of the ESO, allowing it to balance the grid more effectively and efficiently whilst reducing balancing costs
- **Removing the Maximum Ramp Rate (MRR).** Currently set at 5% the MRR restricts batteries from increasing power in the opposite direction of their frequency response contract. Removing this limit could enable batteries to stack frequency response services with trading, potentially increasing BESS revenues.
- **Adjusting service terms for the availability and State of Energy (SoE) policy.** SoE guidance requires batteries to reserve enough power in the opposite direction of their contract to recover 20% of the energy needed to perform the service in any given settlement period. Clarifying these policy terms aims to incentivise the desired behaviour from battery assets and could impact the volumes batteries contract into the more demanding Dx services of DR and DM.
- **24/7 disarming/arming instructions.** This would allow the ESO to send instructions to batteries to stop/restart (disarm/re-arm) the provision of Dx services before the contract begins. Currently the ESO can only send these instructions during contracted period which has a subsequent 2-minute delay.

The consultation for these changes is due to close on July 29th 2024, with implementation as soon as October 2024.

The ESO also intends to extend the ABSVD* process to include Secondary and non-BMUs. However, the complexity of the process is largely contributing to a delay in this change occurring. The main complication is that ABSVD is applied through the settlement process, administered by ELEXON, rather than directly by the ESO. When this change occurs, we may see a strategic shift in Secondary and non-BMUs to increase volumes in the Dx high services* to charge at little to no cost. This may drive up prices in the Dx low services* if they become less saturated.

* See Appendix 1 for definitions

Summary

The evolving landscape of BESS within the intraday market underscores the strategic adaptations of both BMUs and non-BMUs. Primary BMUs leverage ABSVD* to optimise their participation in Dx high services*, while Secondary BMUs and non-BMUs, lacking ABSVD eligibility, focus on Dx low services* and innovative strategies such as NIV chasing*.

Recent observations highlight a trend where some BMUs deactivate their FPN flags to operate similarly to non-BMUs, seeking flexibility and maximising revenue opportunities. This shift is influenced by post-gate closure liquidity via NIV chasing, complexities of ABSVD and the stringent requirements of BM participation.

The ESO is actively working to increase the visibility and efficiency of non-BMU operations through proposed changes in frequency response services, including 24/7 operational data requirements and the removal of maximum ramp rates. These changes aim to enhance grid stability and reduce balancing costs, while also potentially altering market dynamics by incentivising specific behaviours from BESS assets.

As the market continues to adapt, the anticipated inclusion of Secondary and non-BMUs in the ABSVD process may drive a significant strategic shift, with these assets potentially increasing their presence in Dx high services. The ongoing consultation and forthcoming regulatory adjustments signal a period of transition, promising to refine the operational landscape and optimise the integration of BESS assets into the power system.

* See Appendix 1 for definitions

Appendix 1: Definitions

Applicable Balancing Services Volume Data (ABSVD): ABSVD is a mechanism for ensuring that parties are not exposed to Imbalance Charges when assets within their BM Units deliver certain Balancing Services to the ESO which results in a deviation from their PN.

Dx high: The DC-H, DR-H and DM-H frequency response services. These services are utilised to reduce the system frequency when it is too high. Assets will charge in order to increase overall demand and reduce the system frequency.

Dx low: The DC-L, DR-L and DM-L frequency response services. These services are utilised to increase the system frequency when it is too low. Assets will discharge in order to increase overall generation and in turn increase the system frequency.

Enduring Auction Capability (EAC): The EAC is a market platform allowing for co-optimised procurement of multiple Frequency Response and Reserve products, launched in November 2023. Initially including the Dx services, all new products going forward will be added by default, starting with the Balancing Reserve.

Grid Supply Point (GSP): A GSP is a Systems Connection Point at which the Transmission System is connected to a Distribution System.

Imbalance Charges: Imbalance charges are used to settle energy imbalance volumes. At the end of a Settlement Period, BSC Systems compare a Party's contracted (traded) volume with the metered volume of energy used in the Settlement Period. If a Party is in imbalance of its contracted volume, then it will be subject to imbalance charges.

Mandatory Frequency Response (MFR): MFR is an automatic change in active power output in response to a frequency change. The service helps us to keep frequency within statutory and operational limits.

Net Imbalance Volume (NIV): The Net Imbalance Volume is a measure of the total energy imbalance in the system. It is calculated by adding up all the actions taken to balance both the system and the energy levels during the Settlement Period.

Virtual Lead Party (VLP): VLP is an independent aggregator that controls (potentially on behalf of a third party) power generation and/or electricity demand from a range of assets for the purposes of selling Balancing Services to National Grid ESO.

Appendix 2: Different BMU types

BM Unit	Prefix	Description
Directly Connected	T_	BMUs directly connected to the Transmission System
Embedded	E_	BMUs embedded into a Distribution System
Interconnector	I_	BMUs related to an Interconnector
Supplier	2_	BMUs that cover Supply, and contain all of a particular Supplier's MPANs in either a Base or Additional Supplier BMU for a given Grid Supply Point (GSP) Group
Supplier	C_	Additional Supplier BMUs registered solely for the purpose of allocating CfD assets to them
Secondary	V_	Secondary BMUs may be registered by a Virtual Lead Party to provide Balancing Services to the ESO
Misc	M_	Other types of BMUs that don't fit the above categories. This prefix does not apply to newly registered BMUs.

Directly Connected Primary BMUs

These comprise of equipment directly connected to the Transmission System. They are usually Generating Units, relating to Power Stations or other Generation Sites (e.g. wind farms) but can also be large demand sites. The equipment within each Primary BM Unit is independently controlled and is metered separately.

Embedded Primary BMUs

These comprise of equipment that is connected to a Distribution Network. They are usually Generating Units, relating to Power Stations or other Generation Sites (e.g. wind farms). They can include the imports relating to these sites, but large embedded demand sites without any generation cannot be registered as a Central Volume Allocation (CVA) Primary BMU Unit. The equipment within each Primary BMU is independent of other Units and is metered separately.

Embedded Primary BM Units need CVA Line Loss Factors (LLFs) for use in their Aggregation Rules. The relevant Licensed Distribution System Operator (LDSO) is responsible for submitting them within the LLF timescales in. The LDSO should submit CVA LLFs (as opposed to Supplier Volume Allocation, SVA, LLFs) for the site.

Interconnector Primary BMUs

Interconnector Primary BMUs allow Parties to trade over a particular interconnector and always come in pairs – one for electricity entering the system (production) and one for electricity being

taken off the system (consumption). Each interconnector has many pairs of these Primary BMUs, one pair for each Party who has registered to it. Interconnector Primary BM Units work differently to other Primary BM Units because the electricity is not metered for each Party's Primary BM Units, but at the Interconnector Boundary.

Supplier Primary BMUs

These measure the amount of electricity supplied by Suppliers. Due to the high number of Supplier Meters that exist, individually identifying them all is unfeasible. Instead, all the Meters for a particular Supplier ID in a specific GSP Group are grouped into one Supplier Primary BMU. When a Party signs up as a Supplier, they must register 14 'Base' Supply Primary BMUs, one for each GSP Group, even if they do not plan to use them all. All their supply and SVA registered embedded generation in a particular GSP Group will by default be allocated to the relevant Base Primary BMU.

Secondary BMUs

These record the amount of Balancing Energy provided by VLPs (Virtual Lead Parties) or AMVLPs (Asset Managing VLPs). Secondary BMUs were introduced to allow SVA registered customers and generators to participate in the BM through an independent aggregator (VLP or AMVLP).

Appendix 3: Distribution of BESS contracted volumes

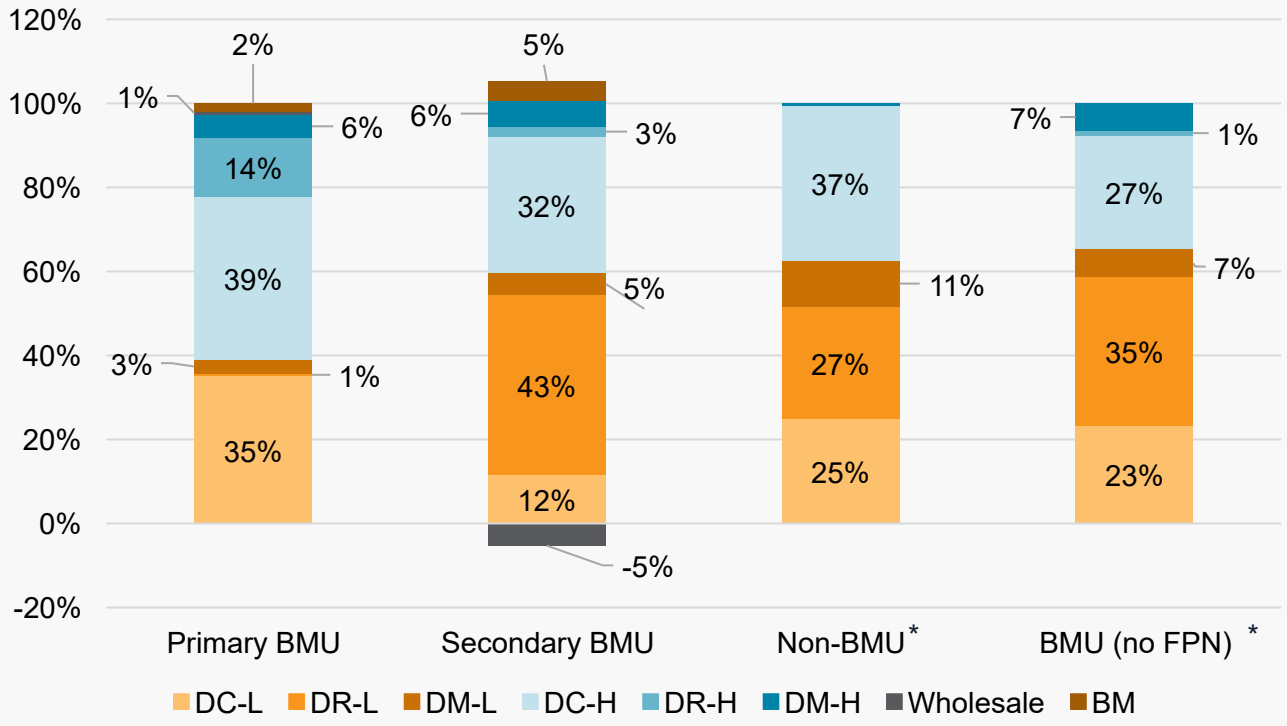

Figure 6: Distribution of BESS H1 2024 contracted volumes across the Dx services, wholesale market and BM (%)

*Merchant market volumes are not publicly visible for non-BMU and BMU (no FPN) assets