BESS Grid Services in the UK

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Introduction

Battery energy storage systems (BESS) can generate revenues by participating in various UK energy and grid service markets. These markets vary in maturity, with some well-established, others being phased out, and new ones emerging. We advise clients to closely monitor the roadmap development outlined by the National Electricity System Operator (NESO)[1]https://www.nationalgrideso.com/document/278301/download%5D. We have detailed the requirements and core principles of critical markets currently accessible to BESS in the UK as of October 2025, including:

- Capacity Market.
- Balancing Mechanism.
- Reactive Power Services.
- Response Services.
- Reserve Services.
- Restoration Services.

For tailored support in navigating these evolving opportunities, we invite you to get in touch with our team. Whether you're in the early stages of project development or seeking to optimise an operational asset, we offer bespoke guidance to help you unlock the full potential of your BESS. Our experts are on hand to ensure your project is strategically positioned to access and benefit from all available grid services, in alignment with the latest NESO roadmap and market developments. Please contact Harry Thomson at h.thomson@blanboz.com or Andres Blanco at a.blanco@blanboz.com to discuss how we can support your project.

About the Authors

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Project consultant with over 2 years of experience in the renewable energy industry, specialising in Battery Energy Storage Systems (BESS). Having graduated in 2023 and taking an interest in energy storage after writing my honours project “An Investigation Into Future Electrical Grids and The Increasing Role of Energy Storage”, I have been working as a consultant in a BESS Engineer and Assistant Project Manager capacity for developers and lenders. During this time, I have collaborated closely with client teams to successfully secure the signing of over 4.1 GWh of BESS supply agreements, driving project delivery through technical and commercial guidance. My experience includes early stage of project development, having prepared technical drawings and reports for DCO submissions of hybrid developments.

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With over 15 years of experience in the renewable energy industry, I am a well-rounded chartered engineer in the UK. For the past ten years, I have specialised in the battery energy storage system (BESS) sector, a self-proclaimed BESS Master. As a technical lead, I have overseen the successful execution of projects worth 12 GWh of BESS and 7.5 GWp of solar PV globally. Experienced with the majority of cell manufacturers and BESS integrators in the market. Technical expert with solid knowledge from early design and development to project implementation, construction, and commissioning of BESS projects. Highly capable in commercial integration and procurement, providing advisory services in technical reviews, compliance with different energy markets and grid services across the UK and EMEA region.

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[1] https://www.neso.energy/document/358126/download

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1 Capacity Market

The Capacity Market (CM) is a crucial mechanism introduced by the UK government to mitigate the risk of power blackouts and ensure a reliable energy supply. It operates as an insurance policy, providing financial incentives to encourage investment in new capacity or retaining existing capacity. Understanding this market is key to making informed investment decisions in the UK energy sector.

1.1 How it Works:

- Assets are entered into capacity auctions to secure revenue.
- Two auctions annually: T-4 (main auction) and T-1 (top-up auction).
- Successful bidders receive a Capacity Agreement, outlining obligations and payments.

1.2 Key Provisions:

- Administration: The Electricity Market Reform (EMR) Settlement Limited (EMR Delivery Body) administers the payment mechanism.
- Participation: Capacity Providers must pre-register their projects and participate in the auction process. Successful bidders are awarded Capacity Agreements outlining their obligations and payment terms.
- Payment Structure: Based on the auction clearing price, monthly payments are made to Capacity Providers over 15 years.
- Obligations: Capacity Providers must only generate energy during System Stress Events, with a minimum of 4 hours' notice. When called upon, they must export energy to the grid at full power for at least 30 minutes.
- Non-Compliance: Failure to provide energy when required will result in penalties.

The Capacity Market is designed to ensure a reliable energy supply and mitigate the risk of power blackouts. CM participants are paid to be on standby during periods of high demand; thus, by providing financial incentives, the CM encourages investment in new capacity and retaining existing capacity, ultimately contributing to a more resilient energy system.

1.3 De-rating Factors

A “de-rating” factor is applied to all forms of electricity generation to account for not all capacity being available at all times. This is because generating plants can break down occasionally, and output from wind and solar sources varies daily. The amount of electricity generation required to meet the Government's Reliability Standard can be determined by applying a de-rating factor.

In essence, de-rating factors represent a reduction in the expected output of a generating unit, acknowledging that it may not always perform at its maximum capacity. This adjustment ensures a more accurate calculation of the total generation capacity needed to meet demand.

1.3.1 Storage De-rating Factors

De-rating factors for storage, specifically, have been observed in an overall downward trend, reflecting a significant increase in contracted storage capacity for future years. This trend is influenced by factors such as the Duration Limited threshold, which has increased for some auctions and decreased for others.

The de-rating factor methodology considers storage units' duration limitations, acknowledging that their output may be limited during periods of high demand. By applying de-rating factors,

a more realistic assessment of the contribution from each generating unit can be made, ultimately helping to ensure a reliable electricity supply.

Although the overall trend for the storage de-rating factor has been downwards, the de-rating factor has increased from the previous year in the latest Capacity Market Guidelines released by NESO, for both the T-1 and T-4 auctions. This means that contracts for new projects will have a larger percentage of capacity discounted from eligibility to participate in the capacity market. Therefore, there is reduced revenue potential from capacity market participation, which impacts the economics of developing and operating a BESS project.

Figure 1-1 shows the de-rating factor for T-1 Auction for 2023/2024, 2024/2025 and 2025/2026 delivery.

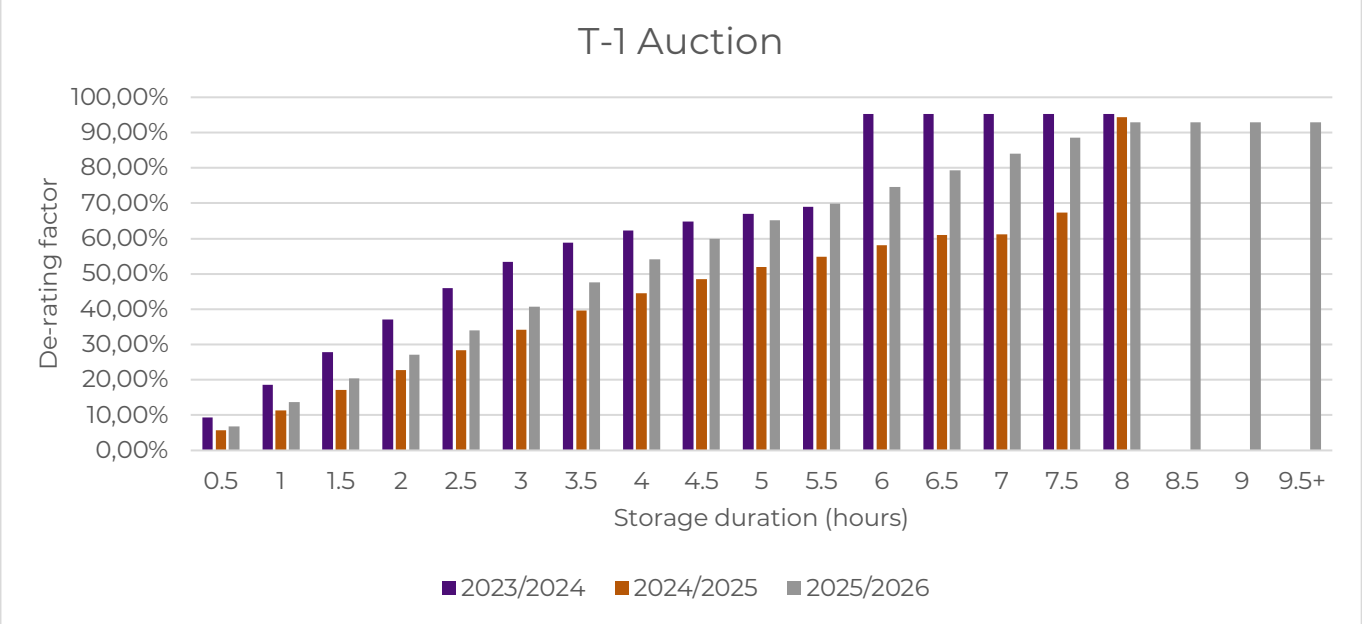


Figure 1-1: Trend of de-rating factors in the T-1 Auction[23]

Figure 1-2 shows the de-rating factor for T-4 Auction for 2026/2027, 2027/2028 and 2028/2029 delivery.

[2] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/ECR%202023%20Summary.pdf

[3] https://nationalenergyso-emr.my.salesforce.com/sfc/p/#8d000002dUGC/a/J70000004yr3/ciZ8WUEqk0uYaJdf9q963tIfm8sTeRTS28rsE3hWYew

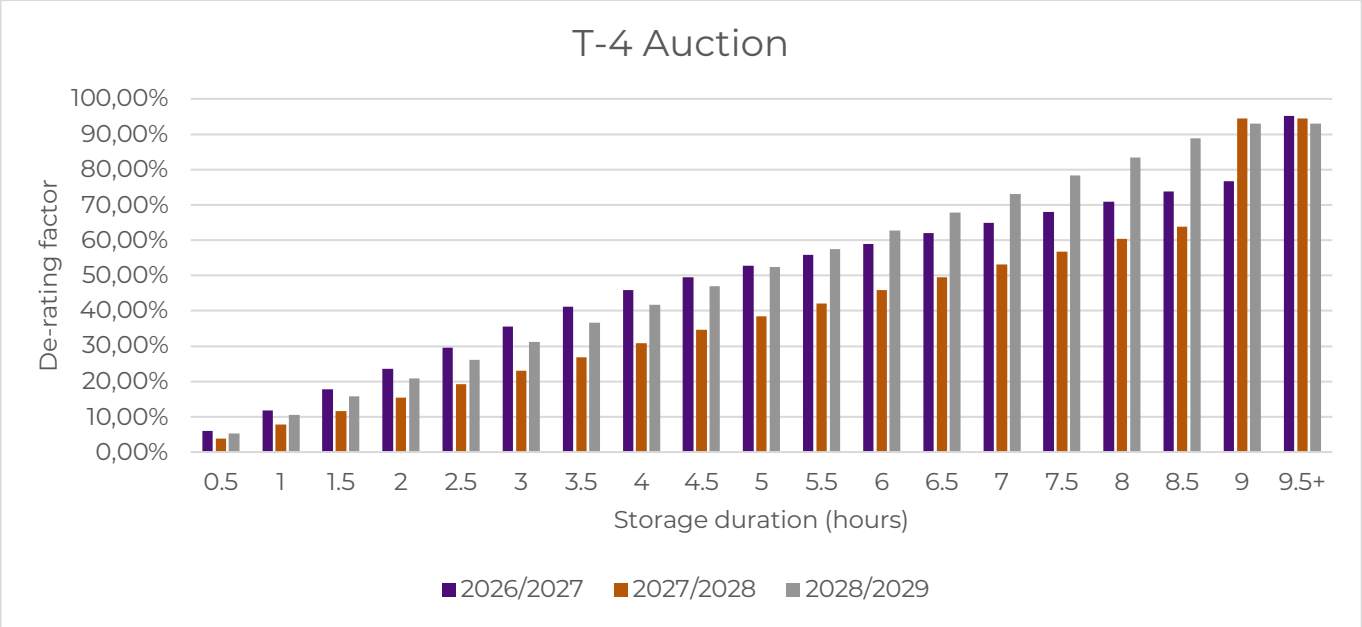


Figure 1-2: Trend of de-rating factors in the T-4 Auction[24]

1.4 Prequalification for Capacity Auctions

Before participating in a Capacity Auction, companies must prequalify as either Generation or Demand Side Response (DSR) resources. This process verifies their eligibility to participate and determines their capacity.

1.5 Why Prequalify?

Prequalification ensures that only eligible generation and DSR units participate in the auction. It also allows existing generation units to opt out of the auction if desired. A summary of the prequalification process is shown in **Figure *1-3***.

1.6 Prequalification Stages:

- Submission of information to the EMR Delivery Body.
- Verification of eligibility and capacity.
- Notification of intention to opt-out (if applicable).

1.7 Capacity Market Unit (CMU) Types:

- Existing Generating CMU.
- Existing Interconnector CMU.
- New Build Generating CMU.
- Refurbishing Generating CMU.
- Proven DSR CMU.
- Unproven DSR CMU.
- Refurbishing Interconnector CMU.

[4]https://nationalenergyso-emr.my.salesforce.com/sfc/p/#8d000002dUGC/a/J70000004yr4/q7dOyyzDCuivI5vY1nnlwgLX4Wd5HTUS5tDACrTH14A

- New Build Interconnector CMU.

The Prequalification Process flow is according to NESO:

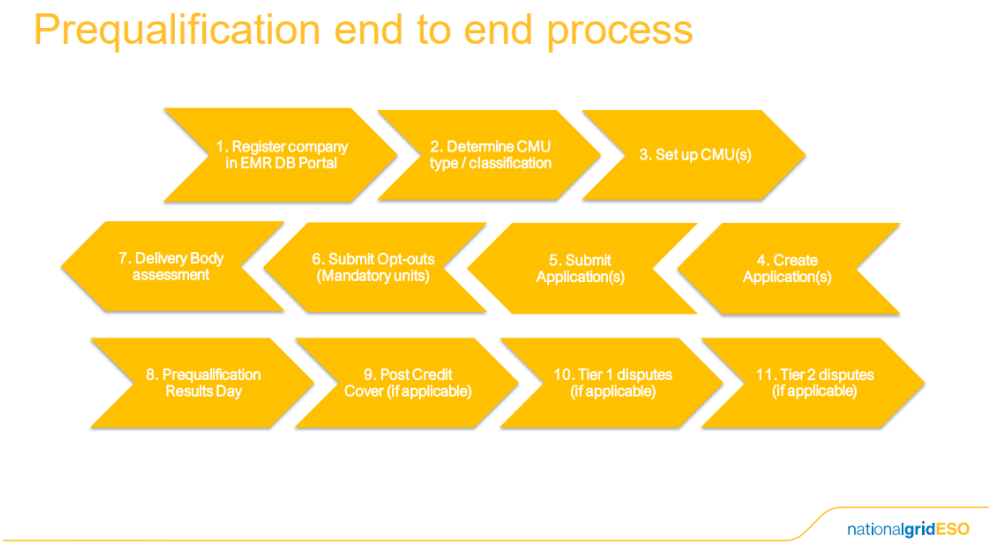


Figure 1-3: CM Prequalification Process[5]

1.8 Capacity Requirements:

Note that there is no upper capacity limit for Generation CMUs to participate in the auction. However, DSR CMUs must have a capacity between 1 MW and 50 MW to be eligible.

In summary, prequalification is crucial for companies seeking to participate in Capacity Auctions, ensuring they meet the necessary eligibility and capacity requirements.

1.9 Capacity Market Auction:

The Capacity Market Auction is an auction where bidders withdraw their capacity as the price drops:

- The auction starts at a set price cap and decreases in each round.
- Bidders place bids in fixed windows and must submit an Exit Bid to leave the auction.
- The auction clears when the remaining capacity is less than the capacity sought.

1.9.1 Auction Parameters

- The Secretary of State sets the auction parameters, including the quantity of capacity required at certain prices.
- NESO informs these parameters through analysis.

1.9.2 Current and Previous Auction Prices[6]

- T-4 2028/2029: £60/kW.
- T-4 2027/2028: £65/kW.
- T-4 2026/2027: £63/kW (15-year agreement for new systems).
- T-4 2025/2026: £30.59/kW

[5] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/General%20Prequalification%20Information%202023.pdf

[6] https://emrdeliverybody.nationalenergyso.com/IG/s/article/Auction-Results

- Previous years: T-4 2024/2025 = £8.40/kW; T-4 2023/2024 = £22.50/kW; T-4 2022/2023 = £18/kW; T-4 2022/2020 = £19.40/kW.

1.10 Metering Requirements for Capacity Providers

A Capacity Provider (generator, interconnector, or DSR) using a metering system registered with the Central Meter Registration Service must meet specific requirements. These include:

- Balancing and Settlement Code (BSC) Section L.
- Retail Energy Code Metering Operations Schedule.
- Relevant Code of Practice (CoP) based on circuit capacity.

1.11 Calibration, Testing, and Commissioning

These obligations are outlined in the Code of Practice. For a BSC-registered Capacity Provider using the Settlement Metering System as CMU Metering Equipment, the metering arrangement must comply with the applicable CoP at the time of registration for Settlement payments.

1.11.1 Capacity Market Testing

According to the CM Metering Asssment / Metering Certificate Guidance version 2.0 published by NESO in July 2022[7], the following must be considered for generators registered as CM providers.

1.11.1.1 Metering Assessment

A Metering Assessment is a questionnaire that evaluates the metering arrangements for a CMU. All CMUs awarded a Capacity Market Agreement must complete this assessment. The assessment determines if a Metering Test is required based on the site's metering arrangements.

1.11.1.2 Metering Test Certificate

A Metering Test Certificate confirms that a CMU has passed a successful Metering Test, as required by CM Rule 13.3.6. The certificate is issued by EMRS and includes details such as the Capacity Provider's name, test date, CMU name, and metering configuration.

1.11.1.3 Metering Assessment Requirements

All Metering Assessments must include:

- Answers to all relevant questions.
- Detailed line diagrams showing electrical configurations and metering sites.

1.11.1.4 Metering Assessment Deadlines

- Prequalification: CMUs can complete the Metering Assessment during the submission window or defer it until later.
- Deferral: The deadline depends on the CMU type and Auction type.

1.11.1.5 Metering Test Certificate Requirements

[7] https://www.emrdeliverybody.com/Capacity%20Markets%20Document%20Library/Metering%20Assessment%20-%20Metering%20Test%20Certificate%20Guidance%20-%20v2.0.pdf

- A Metering Test Certificate is required if the Metering Assessment determines a test is necessary.
- The certificate must be provided to the Delivery Body by the deadline for the CMU's Capacity Market Agreement.
- EMRS processes tests might take to produce a Metering Test Certificate approximately 16 weeks.
- Failure to provide the certificate may result in termination.

1.11.2 Satisfactory Performance Day Requirements

According to the updated Satisfactory Performance Day (SPD) and extended performance guidance V2.0 published by NESO in January 2019 on behalf of the EMR Delivery Body[8], Capacity Agreements from 2017 T-4, 2019 T-3, and 2022 T-1 require a CMU to achieve three SPDs during the Winter Period. At least one SPD must occur between 1 January and 30 April (inclusive) for the delivery year.

1.11.2.1 Demonstrating Satisfactory Performance

A CMU with a Capacity Obligation must demonstrate satisfactory performance by achieving a capacity level equal to or greater than its Capacity Obligation for at least one Settlement Period on three separate days during the Winter Period.

1.11.2.2 Capacity Agreements Awarded Before and After December 2017

Capacity Agreements awarded before December 2017 require three SPDs during the Winter Period. Those awarded after December 2017 require three SPDs, with at least one occurring between 1 January and 30 April.

1.11.2.3 Storage Generating Units

Storage Generating Units with Capacity Agreements must demonstrate extended performance for at least one day in the Winter every three Delivery Years. This involves continuously generating an average of their connection capacity multiplied by the technology class weighted average availability (TCWAA) for consecutive settlement periods equivalent to the storage duration (TCWAA for storage is 96.11% for the CM providers registered from the delivery year 2018/2019). This is critical to BESS CM as the energy degradation of the batteries would have to be considered if full project power and energy capacity were registered into CM.

1.11.2.4 SPD Process

- The Capacity Provider submits SPD dates via the EMR Delivery Body Portal.
- The Delivery Body sends a data request to EMRS.
- EMRS sends data to the Delivery Body, who review it within three working days.
- A system-generated notification is sent, stating the review status.

1.11.2.5 Data Used for Assessment

The data used to assess SPDs and extended performance is the same metered volume data submitted to EMRS by the Capacity Provider. This can be found in WP195 – Capacity Market and CFD Metered Data.

[8] https://www.emrdeliverybody.com/Prequalification/Demonstrating%20satisfactory%20and%20extended%20performance%20guidance%20v2.0%202019.pdf

1.12 Planning Consents

The Prospective Generating must submit the following to the Delivery Body by a specific deadline (22 working days before the first Bidding Window):

- Declaration confirming you have obtained all necessary planning consents and legal rights to use the land.
- Director's certificate (or certificate from two officers) confirming the declaration is accurate.
- Maximum allowable capacity granted under planning consent.

The Delivery Body will then notify you within 16 working days before the first Bidding Window whether you've prequalified based on receiving the required documentation.

1.13 Connection Capacity

If the Connection Capacity of a Generating Unit exceeds the maximum allowable capacity, the Delivery Body will set the Connection Capacity to a lower value. They will then recalculate the De-rated Capacity of the CMU (if necessary) and confirm the Prequalified De-rated Capacity position for the relevant Auction.

2 Balancing Mechanism

According to NESO guidance[9] and NESO BM portal[10], the Electricity National Control Centre (ENCC) uses the Balancing Mechanism (BM) as its primary tool to balance supply and demand on the UK's power grid in real-time. The ENCC uses the BM to match electricity generation (supply) with usage (demand), buying electricity when demand is high and supply is low, and procuring less when demand is low, and supply is high. This ensures the grid remains stable, reliable and provides the right amount of electricity to meet the UK’s needs.

2.1 Accessing the BM

There are several routes to access the BM.

2.1.1.1 Traditional Route

Sign a NESO Connection Agreement, which includes:

- Bilateral Embedded Generation Agreement (BEGA) in England and Wales.
- Bilateral Embedded Licence Exemptible Large Power Station Agreement (BELLA) in Scotland.
- Bilateral Connection Agreement (BCA) for new transmission system connections.

2.1.1.2 Supplier Route

This route requires registration as a supplier with ELEXON, which issues 14 base BMUs for passive participation. To actively participate, additional BMUs must be registered, with aggregation allowed within Grid Supply Point Groups. Parties must accede to the Connections Use of System Code (CUSC) and BSC codes through NESO and ELEXON and meet technical and Grid Code requirements.

[9] https://www.nationalgrideso.com/document/170896/download
[10] https://www.nationalgrideso.com/industry-information/balancing-services/balancing-mechanism-wider-access

2.2 Wider Access to the BM

Aims to make the BM market more accessible to non-traditional providers and aggregators by:

- Improving data submission at an aggregated level.
- Introducing the Virtual Lead Party (VLP) concept, allowing registration of BMUs as small as 1MW.

2.2.1.1 Virtual Lead Party Route

VLP is the newest route to market, developed for TERRE, enabling aggregators and small-scale providers to participate in the BM. It requires registration as a VLP through NESO's online system, followed by registration of Secondary BMUs with both NESO and ELEXON and acceding to the CUSC with NESO and the BSC with ELEXON.

The routes to the BM are summarised in ***Figure 2-1***.

Route	Contract	Relevant NGESO team
Traditional	Connection Agreement. Registered as a Primary Balancing Mechanism Unit (BMU).	Connections Team transmissionconnections@nationalgrideso.com
Supplier	Registered Supplier and Additional Supplier BMUs created.	Commercial Operation (Account Manager) – commercial.operation@nationalgrideso.com
Virtual Lead Party	Registered and completed through our new electronic portal. Parties sign a VLP agreement and units register as secondary BMU's.	Commercial Operation commercial.operation@nationalgrideso.com

Figure 2-1: Routes to the Balancing Mechanism[8]

2.3 System Requirements for Balancing Mechanism Units (BMUs)

2.3.1 Primary BMUs

- Account for all energy flowing on or off the Total System (Transmission and Distribution Systems combined).
- Smallest grouping of generation and/or demand equipment that can be independently metered for Settlement.
- All generation and demand equipment must be part of a Primary BMU.

2.3.2 Secondary BMUs

- Can be registered by VLPs for Supplier Volume Allocation.
- Half-hourly metered generation and/or demand equipment within a single Grid Supply Point.

2.4 Registration Process

- Start at least 30 working days before the proposed Effective From Date for standard Primary BMUs.
- Start at least 60 working days before the Effective From Date for non-standard Primary BMUs.
- Forms can be submitted in any order as long as timescales are met.
- Alternatively, use the Self-Service Gateway (Elexon Kinnect Customer Solution) to complete the process.

2.5 Permissible Configurations

- Electricity Storage Modules (BESS) with total Exports ≤ 50MW (England and Wales), ≤ 30MW (South Scotland), or ≤ 10MW (North Scotland) can be single Primary BMUs.

- Other configurations meeting Standard Primary BM Unit criteria are also permissible.
- Configurations not on the list or not meeting criteria require a Non-Standard Primary BM Unit application.

2.6 Intercommunication

Ensure communication with the ENCC through:

- Electronic Dispatch Logging (EDL)11.
- Electronic Data Transfer (EDT) or WA API12.
- Control or System Telephony.
- Operational Metering data provision.

2.7 Operational Metering

2.7.1 Registration

- Active Balancing Mechanism Units (BMUs) must register their Metering Systems (MS) for Central Volume Allocation with a unique system ID (MSID).
- Each BMU requires its own MSID.

2.7.2 Compliance

Metering Systems must meet the requirements outlined in:

- BSC Section L.
- Retail Energy Code Metering Operations Schedule.
- Relevant Code of Practice (CoP).

2.7.3 Data Submission

Asset operators must provide operational metering data on delivered volumes, with varying requirements depending on generating technology

2.7.4 New Operational Metering Solution

- NESO offers a cloud-based solution for operational metering, providing a cost-effective, scalable, and future-proof option.
- This solution may reduce costs compared to traditional Metering Systems.
- Clients are recommended to evaluate this option, potentially with an Optimiser.

2.7.5 Accessing Technical Details

- Parties can access a high-level document on the new Operational Metering Submission API on the Wider Access webpage.
- Further technical details will be provided through a secure platform as parties progress with solution development and testing.

2.8 Additional Requirements for National Grid Transmission System Users

Connection and Use of System Code

- All users must comply with CUSC criteria.

[11] https://www.nationalgrideso.com/document/300231/download
[12] https://www.nationalgrideso.com/document/208206/download

Electricity Generation Availability and Margin Analysis (eGAMA)

- All Balancing Mechanism Units (BMUs) must submit capacity availability to eGAMA.
- Applies to:
    - Directly connected generators (NGET, SPT, SHET).
    - Other generators (via their respective license).

Communication Links

- Consider installation and testing timescales for required communication links.
- Two options for dynamic data exchange:
    - Traditional fixed-line technology (up to 6 months to install).
    - Web services and internet-based connectivity (WA API).

Data Upload

- After registration, a separate data upload process may be required (minimum 2-month lead time).
- If new communication links are required, add an additional 6 months to the lead time.

2.9 Procurement and Payment

BM services are procured through an auction process, generally prioritising bids received by cost and ability to deliver. Payment to providers is made for availability and for the actual delivery of services.

2.9.1.1 Auction

The BM operates using trading periods of 30 minutes. The online auction is continuously open with providers submitting bids and offers to adjust their output during the assigned trading period. Final adjustments are made 60-90 minutes before the trading period, with closure of the auction occurring 60 minutes before delivery.

- Bids: Price calculated to either consume more electricity or generate less electricity.
- Offer: Price calculated to consume less electricity or generate more electricity.

2.9.1.2 Prioritisation of Bids

At auction closure, the ENCC evaluates submissions to select the most suitable providers for balancing the grid:

- Cost: The lowest-priced bids and offers are typically selected.
- Technical capability: Providers must be technically capable to deliver their submitted bid or offer, complying with response times and required delivery output.
- Other factors: Whilst the cost and technical capability of a provider's bid or offer are the most critical elements considered, other factors including locational constraints can affect ENCC's evaluation.

Once accepted, the ENCC issues Bid Offer Acceptances (BOAs) to chosen providers, instructing them to adjust their output during the relevant trading period.

2.9.1.3 Payment

Payments for BM services are made for both availability and utilisation to successful providers:

- Availability: Payments for being available (£/MW/hour) to adjust output, even if not dispatched.
- Utilisation: Payments for actual energy delivered or reduced (£/MWh), based on the BOA terms.

Providers are penalised with an Event of Default if they fail to deliver the contracted availability or a dispatch instruction, forfeitting the availability payment for the entire trading period.

3 Reactive Power Services

NESO[13] requires reactive power to maintain a stable and efficient electricity grid. The Reactive Power Services help balance the flow of electricity and maintain the grid's voltage levels.

Reactive power refers to the energy movement in an AC system caused by electric and magnetic fields. Devices with magnetic fields absorb reactive power, while those with electric fields generate it. This affects voltage levels, which vary across the system, forming a unique “voltage profile” based on active and reactive power supply and demand. Unlike frequency, which remains consistent network-wide, NESO manages local voltage levels to meet changing system needs.

Under the CUSC, users must follow the requirements for:

- Obligatory Reactive Power Service (ORPS) – Mandatory[14].
- Enhanced Reactive Power Service (ERPS) - Optional[15].

These requirements apply at the BMU level, which manages the balance of electricity supply and demand.

Typically, energy storage systems control their voltage output. However, NESO can remotely instruct a BESS to switch to controlling its reactive power output using the EDL system to meet a specific target.

3.1 Obligatory Reactive Power Service

According to NESO’s ORPS is a mandatory service that requires generators, including transmission-connected generators above 10 MW, to absorb or produce reactive power within their declared capability levels and to manage system voltages.

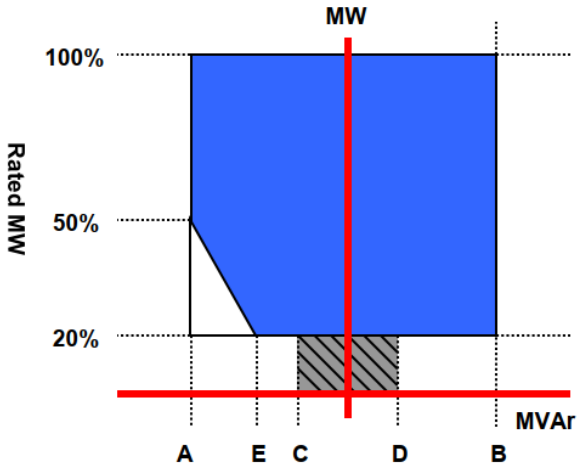
BESS are classified as Power Park Modules under the Grid Code[16], and those that have entered into a Bilateral Connection Agreement with NESO must meet the reactive power requirements given in the clause of ECC.6.3.2.4, shown in **Figure 3-1**. Furthermore, as Energy Storage Modules, the reactive capability requirements apply when importing and exporting active power. This capability must be met at the Grid Entry Point. Modern BESS would have no problem achieving reactive power levels at all active power levels, so the declared reactive capability for the ORPS service would indicatively be set at the project's rated apparent power (MVA).

[13] https://www.nationalgrideso.com/industry-information/balancing-services/reactive-power-services

[14] https://www.nationalgrideso.com/industry-information/balancing-services/reactive-power-services/obligatory-reactive-power-service

[15] https://www.nationalgrideso.com/industry-information/balancing-services/reactive-power-services/enhanced-reactive-power-service-erps

[16] https://dcm.nationalgrideso.com/



Point	Equivalent to…(in MVAr)
Point A	0.95 leading Power Factor at Rated MW output
Point B	0.95 lagging Power Factor at Rated MW output
Point C	-5% of Rated MW output
Point D	+5% of Rated MW output
Point E	-12% of Rated MW output
<20% Rated MW	No obligation to provide Reactive capability

Figure 3-1: Power Park Module Reactive Power Performance (Example)[17]

3.1.1 Technical Requirements

BESS are classified as Power Park Modules (BESS classifies as "non-synchronous") and must meet ORPS requirements, including:

- Capable of supplying their rated power output at any point between the limits of 0.85 power factor lagging and 0.95 power factor leading at the BMU terminals.
- Have the short circuit ratio of the BMU less than 0.5.
- Keep the reactive power output under steady state conditions fully available within the voltage range ±5% at 400kV, 275kV, 132kV and lower voltages.
- Have a continuously acting automatic excitation control system to provide constant terminal voltage control of the BMU without instability over the entire operating range of the BMU.
- Providing export and import of reactive power (equivalent to 0.95 power factor).
- All transmission-connected generators over 47 MW must provide ORPS. New providers must sign an MSA, while existing providers are advised during their connection compliance process.

3.1.2 Procurement and Payment

ORPS is paid via Default Payment Arrangements in £/MVArh, updated monthly based on market indicators as set out in Schedule 3 of the CUSC[18]. Payment starts after signing the Mandatory Services Agreement (MSA) and testing reactive capability.

ORPS providers are paid for utilisation in £/MWh delivered per 30-minute Settlement Period. Payments start after the Mandatory Service Agreement (MSA) is signed and reactive capability tests are submitted

3.1.3 Dispatch and Impact on BESS

NESO dispatches ORPS via the EDL interface, instructing BMUs to provide reactive power within two minutes. BESS must reserve a minimum state of charge for ORPS unless the energy capacity is oversized enough to compensate. The PCS MVA must also be equally sized to allow compensation. Generators are instructed to reach a target MVAr level within 2 minutes.

[17] https://www.nationalgrideso.com/document/87326/download
[18] https://www.neso.energy/data-portal/obligatory-reactive-power-service-orps-utilisation

3.2 Enhanced Reactive Power Service

ERPS is a service that allows generators to provide extra reactive power to support the grid's voltage levels. It's for generators that can supply more reactive power than required by the Grid Code and ORPS.

3.2.1 Who can provide ERPS?

Any site with equipment that absorbs or injects reactive power can provide ERPS. This includes:

- Synchronised plants that already provide ORPS and want to offer extra voltage support.
- Other sites with the ability to generate or absorb reactive power, including demand-side providers.

3.2.2 Technical Requirements

To provide ERPS, generators must:

- Exceed the minimum technical requirements of ORPS.
- Supply their rated power output at a power factor between 0.85 lagging and 0.95 leading.
- Have a short circuit ratio of less than 0.5.
- Keep reactive power output available within a ±5% voltage range.
- Have an automatic excitation control system for constant terminal voltage control.
- Be able to provide a MVAr level within two minutes.

3.2.3 Procurement and Payment

ERPS is procured through tenders held every six months. Generators can choose their term, from 12 months to 36 months or more. The payment structure includes:

- Available Capability Price (£/Mvar/hr).
- Synchronised Capability Price (£/Mvar/hr).
- Utilisation Price (£/Mvar/hr).

Successful tenders lead to a market agreement, while unsuccessful tenders result in default arrangements for ORPS requirements or no payments. Instructrions are normally sent via an EDL system.

3.3 Stability Market

Historically, NESO has procured reactive power in the UK via ORPS mostly from large thermal generators; however, as these traditional generators retire as part of the Net Zero targets, the NESO has been investing in innovative ways to procure reactive power, inertia, and short-circuit levels. NESO launched a pilot programme for procurement of reactive power, inertia and short-circuit level back in 2019 through the “Stability Pathfinder” tenders to enhance volume and management of stability on the grid (Reactive power, inertia and short-circuit). Few BESS generators secured Stability Pathfinder’s contracts between 2019 – 2022 tenders. However, ORPS is a mandatory service which should be distinguished from Stability Pathfinder services.

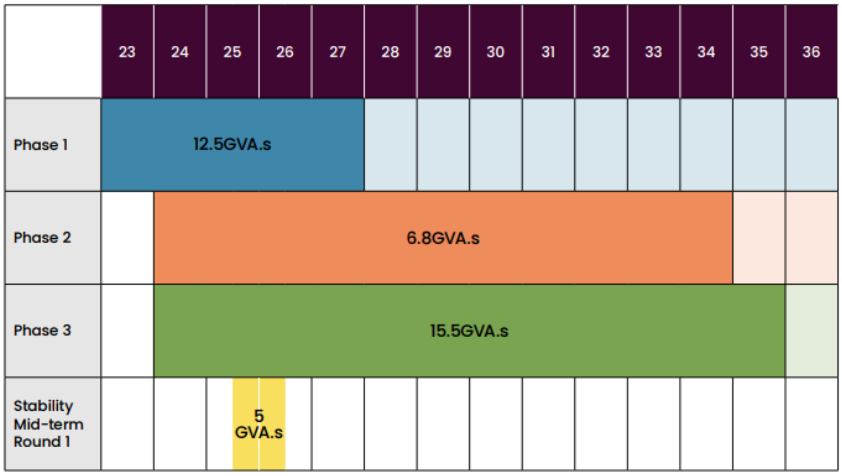


Figure 3-2: Total volume of contracted inertia (GVA.S) through stability pathfinder 1, 2, 3 and Round One of the mid term Y-1 market.[19]

NESO is now looking beyond Stability Pathfinder by procuring stability (Inertia and Short-Circuit level) through fully commercialised markets. According to the NESO Market Roadmap[20], there are three different markets that form the Stability Market:

- A D-1 market, contracting for Stability at a day-ahead level. This will help maintain day-to-day stability levels (short-term).
- A Y-1 market, contracting for stability one year out (mid-term).
- A Y-4 market, contracting for stability four years out. There is no current requirement for this, but it gives NESO the ability to bring new providers to market if the need arises (long-term).

3.3.1 D-1 Market

The D-1 market is intended to facilitate further competition close to real-time and top up capacity procured via the mid-term market. The D-1 market is still under development with further information to be released by NESO at a later date, following industry consultation.

3.3.2 Y-1 Market

To take part in the mid term Y-1 Stability Market[21], bidders must complete a comprehensive tendering process:

- Step 1 Expression of Interest and Consultation Window: Participants must formally express their interest to be invited to the Invitation to Tender (ITT) Stage. From previous rounds, the deadline for this stage is December-January.
- Step 2 Launch ITT: At this step NESO will publish the ITT documentation. Market participants who express their interest in participating during the Expression of Intent (EOI) window will be invited to the ITT stage.
- Step 3 ITT Window: This is the period of time allocated for market participants to develop their technical and commercial submissions. Those participating must return their tender submissions to the NESO by the stipulated deadline to be considered for contract award.

[19] https://www.neso.energy/document/358126/download
[20] https://www.nationalgrideso.com/document/278301/download
[21] https://www.neso.energy/industry-information/balancing-services/stability-market/mid-term-y-1-stability-market

- Step 4 Contract Award: Market participants whose tenders are successful will be notified by NESO and can begin work to meet their contractual requirements.[22]

In Round 1 (2025/2026) of the Y-1 Market twenty tenders were entered. Six passed all assessment criteria, with five selected totalling 5 GVA.s inertia, as shown in **Figure 3-2**. All successful bidders were Great Britain Grid Forming – Synchronous providers.[23] For Round 2 (2026/2027), NESO are seeking to increase the procurement to 15 GVA.s.

3.3.3 Y-4 Market

The Long-term (Y-4) 2029 tender[24] is being run as a simultaneous procurement process (a bundled tender process) seeking stability, reactive power and restoration services from 2029 onwards. Previously, this type of tender would have been referred to as a 'pathfinder'. Going forward, in line with NESO's BP2 business plan, these types of tenders will be run through the dedicated markets under their Network Services programme. The tendering process for the Y-4 2029 tender is:

- Step 1 Identify Requirements: Completed.
- Step 2 Expression of Interest and Consultation Stage: NESO will publish its EOI pack, inviting market participants to express their interest in participating in the 2029 tender. The EOI pack will include tender documents such as the technical specification, contract terms and connection requirements to allow market participants to understand the requirements of this tender and express an interest. During this stage NESO will invite the market to provide feedback on these documents prior to the launch of the tender.
- Step 3 ITT: Market participants who successfully pass the EOI stage will be invited to the long-term 2029 ITT stage. At this stage NESO will publish its ITT pack to the registered bidders through its tender platform.
- Step 4 ITT Stage: This is the period of time allocated for market participants to develop their technical and commercial tender submissions. Bidders invited to tender must return their complete tender submission to NESO by the tender submission deadline.
- Step 5 NESO Tender Assessments: Upon receipt of tender submission NESO will assess both technical and commercial submissions alongside any counterfactual solutions submitted by Network Owners.
- Step 6 Contract Award: Successful tenders shall be notified and awarded contracts.[25]

4 Response Services

NESO provides Response Services[26] to balance frequency changes in the transmission grid. These services help restore normal frequency thresholds by ramping up or down generators in response to events.

4.1.1.1 Types of Response Services

- Firm Frequency Response (FFR): Being phased out.
- Dynamic Containment (DC):
    - Dynamic Containment Low Frequency (DCL).

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[22] https://www.neso.energy/industry-information/balancing-services/stability-market/mid-term-y-1-stability-market#Mid-term-Y-1-Round-1-2025-26

[23] https://www.neso.energy/document/358126/download

[24] https://www.neso.energy/industry-information/balancing-services/stability-market/long-term-y-4-stability-market

[25] https://www.neso.energy/industry-information/balancing-services/stability-market/long-term-2029-tender

[26] https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services

    - Dynamic Containment High Frequency (DCH): Introduced in November 2021.
- Dynamic Moderation (DM).
- Dynamic Regulation (DR).
- Mandatory Frequency Response (MFR): Being phased out.

4.1.1.2 Payment and Stacking

- NESO pays £/MW/h for Response Services, regardless of energy throughput.
- Stacking Response Services (e.g., DCL + DR) is currently not permitted.

4.1.1.3 Accessing the Market

- Non-Balancing Mechanism Unit (BMU) assets must pre-qualify for Real-Time Monitoring (RTM) to participate.

4.2 Firm Frequency Response

FFR is almost fully replaced by DC, DM and DR. For this document, we have provided a brief description of FFR. FFR provides a stable route to market for service providers, protecting against price uncertainty. It offers both dynamic and non-dynamic responses to frequency changes after a stress event.

4.2.1 Key Characteristics:

- Dynamic response: Continuous service managing second-by-second frequency changes.
- Non-dynamic response: Discrete service triggered at defined frequency deviations.

4.2.2 Technical Requirements:

- Dispatch at full power (import/export) for up to 30 minutes.
- Maintain constant power within required tolerances.
- Respond outside the deadband (50 +/-0.015 Hz).
- Provide proportional response at discreet frequency levels.
- Follow grid frequency within 2 seconds of frequency change.

4.2.3 Response Speeds:

- Primary: Within 10 seconds, sustained for 20 seconds.
- Secondary: Within 30 seconds, sustained for 30 minutes.
- High Frequency: Within 10 seconds, sustained indefinitely.

4.2.4 Providing FFR:

- Open to Balancing Mechanism (BM) and non-BM providers meeting technical requirements.
- Includes generators, storage providers, and aggregated demand side response.
- Providers can offer other balancing services outside FFR windows.
- Units must be ready and in frequency-sensitive mode at the start of each FFR window.

4.2.5 Technical Requirements for FFR Providers:

- Suitable operational metering.
- Pass FFR pre-qualification assessment.
- Deliver minimum 1MW response energy.
- Operate at tendered demand/generation levels when instructed.
- Capable of frequency-sensitive mode or automatic relay operation.
- Communicate via automatic logging device.
- Single point of contact and control for multi-site FFR units.

4.3 Dynamic Services

The Dynamic Services are composed of DC, DM and DR. The aim of these services is to maintain a system frequency of 50 Hz ± 1%.

To participate in DC, DM and DR, assets must meet specific technical requirements outlined in **Figure 4-1** and the delivery requirement curves of each service is displayed in **Figure 4-2**. Additionally, each response unit must have a minimum response capacity of 1 MW and a maximum response capacity of 100 MW. Both BM and non-BM registered assets can participate.

The Dynamic Services are procured in a "day-ahead" auction hosted on the ELEXON platform at 14:00. Deliveries are made across four-hour Electricity Forward Agreement (EFA) Blocks.

Payments are made for availability only and are settled against the market clearing price (£/MW/h) for each EFA block.[27]

Service specification	Description	DC	DM	DR
Initiation time	The maximum time between a change in frequency and change in the delivery of response	0.5s	0.5s	2s
Max time to full delivery	The maximum time between frequency devition occurring and delivery of the saturation quantity	1s	1s	10s
Delivery duration	Time that an energy limited provider must be capable of sustained delivery	15 minutes	30 minutes	60 minutes

Figure 4-1: Technical Requirements for Dynamic Services[28]

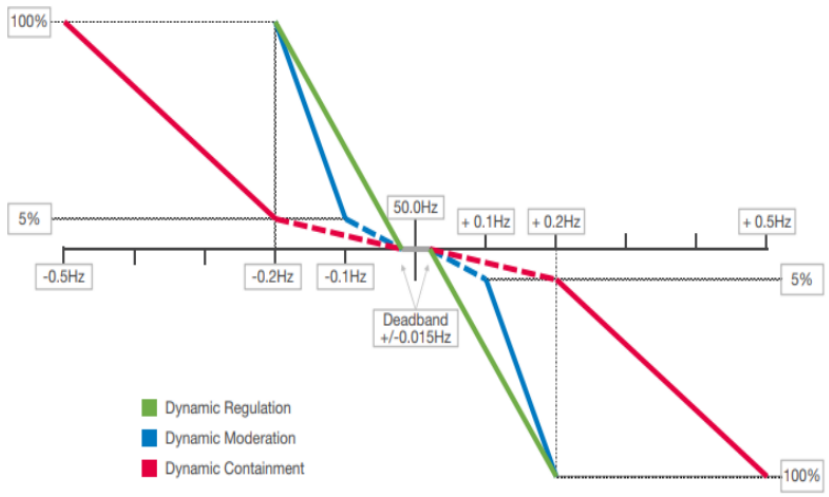

Figure 4-2: Delivery Requirement Curves for Dynamic Services[29]

4.3.1 Dynamic Containment

DC provides rapid frequency response after a fault when the frequency exceeds specific limits (lower for DCL, upper for DCH). A small response is also required within these limits.

[27] https://www.neso.energy/document/276606/download
[28] https://www.neso.energy/industry-information/balancing-services/frequency-response-services/dynamic-services-dcdmdr
[29] https://www.neso.energy/document/276606/download

4.3.1.1 Key Characteristics:

- Fast-acting service to contain frequency within +/-0.5Hz.
- Particularly suited to act in the event of sudden demand or generation loss.
- Delivers quickly and proportionally to the frequency deviation.
- Two separate services:
    - DCL: Responds to frequency drops below the statutory range.
    - DCH: Responds to frequency increases above the statutory range.
- Separate contracts with NESO for DCL and DCH.

4.3.1.2 Technical Requirements:

- Set out in the **Figure 4-3** (subject to change by NESO).
- Apply to both DCL and DCH.

Service specification	Details
Deadband delivery	0% (+/- 0.015Hz)
Small linear delivery	Between 0.015Hz and 0.2Hz (maximum of 5% at 0.2Hz)
Knee point activation	+/- 0.2Hz is 5%
Full delivery	+/- 0.5Hz is 100%
Linear delivery knee point	0.2Hz
Full activation	0.5Hz
Full delivery	1s (but no faster than 0.5s)

Figure 4-3: Dynamic Containment Delivery Requirements[30]

4.3.2 Dynamic Moderation and Dynamic Regulation

NESO has recently introduced further frequency response services, DM and DR[31,32], to support the decarbonisation of the electricity system. These services will work together with DC to mitigate risks and maintain grid stability. DM offers fast-acting pre-fault delivery for volatile periods, and DR is the NESO approach for a slower pre-fault service.

4.3.3 How to Participate

DM and DR are separate services with individual contracts, which cannot be combined with each other or with DC. To participate:

- Assets are registered on the Single Markets Platform (SMP).
- Access the SMP via the NESO portal[33].
- Register as a user, share company details, and register assets.
- Create units to participate in services and seek pre-qualification.

4.3.4 Single Markets Platform

The SMP is a new system replacing the Form A, B, and C process. It allows market participants to:

[30] https://www.neso.energy/document/177091/download
[31] https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services/new-dynamic-services-dcdmdr
[32] https://www.nationalgrideso.com/document/276606/download
[33] https://portal.nationalgrideso.com/smp/s/login/

- Register and pre-qualify for day-ahead frequency response markets (DC, DM, and DR).
- Take ownership of their data.
- Access the SMP via the NESO portal.

4.4 Mandatory Frequency Response

MFR was designed to operate in pre-fault and post-fault scenarios, however as inertia on the system decreases it is becoming less effective as a post-fault service. MFR is procured in real-time on a pay-as-bid basis used to cover any increases in requirement following the day-ahead auctions of the dynamic services.

As set out by the NESO 2025 Markets Roadmap[23], MFR is expected to be replaced by an improved real-time service in the future, with a focus to improve cost savings and efficiency. Due to the increased usage of the dynamic services, 2024 volumes of MFR are over 33% lower than 2023 volumes. The reliance and usage of MFR is expected to continue to reduce in coming years with further use of the day ahead dynamic services and with the release of an improved, within day service. NESO are currently engaging with industry to implement a new service, as they can only use the MFR service until 2029.

4.5 Static Firm Frequency Response

Similarly to DC, Static Firm Frequency Response (SFFR) is a post-fault, low-direction service that acts to restore the frequency to 49.8 Hz following a fault. Unlike the dynamic services, SFFR only actives when frequency moves beyond a set limit (49.7 Hz). Payment is made for availability (£/MW/hr) via the SMP for six four-hour EFA blocks per day.

4.5.1 Technical Requirements

- Minimum entry threshold is 1 MW by either a single or aggregated assets.
- Response time must be achieved within 30 seconds of the frequency dropping 49.7 Hz.
- The response must be sustained for 30 minutes.

To prove assets are compliant with the technical requirements above, pre-qualification testing is carried out, and a test certificate must be prepared by an Independent Technical Expert.

4.6 Operational Metering Requirements

Accurate metering is ensured by following these guidelines:

- The same metering requirements used to register the Balancing Mechanism Unit (BMU), as outlined in the BM section, are to be utilised
- Two types of data are to be submitted by Registered Service Providers:
    - Operational Data: Submission is to be made via Balancing Mechanism (BM) systems, such as EDT or EDL
    - Performance Data: Submission is to be made via the Data Concentrator
- Technical support is available for clients, and in-depth technical details for projects can be provided.
- These requirements are in addition to existing BM systems (such as EDL/EDT) and the Wider Access API, used for Physical Notifications and other dynamic data submissions required by the Grid Code for BM units.
- Non-BM units will need to conduct additional testing for Operational Metering, Performance Monitoring through the Data Concentrator, Ancillary Service Dispatch Platform testing.

4.7 Response Services Improvements

NESO are currently in the process of assessing possible improvements for the response services[34]. These include considering both locational procurement of the Dynamic Services, as well as an ad-hoc real-time procurement mechanism to supplement the day-ahead auction. The Real-time Dynamic Response[35] released 01 October 2025 outlines the proposed changes for the real-time procurement mechanism, which would see additional pre-qualification requirements for the Dynamic Services, however it also includes the option for assets to be paid a utilisation fee (£/MW/hr).

Other improvements include reformation of the legacy MFR and Static Firm Frequency Response services.

5 Reserve Services

Reserve Services, which currently correct energy imbalances in the GB power system, will be retired as new services are introduced. The NESO's Reserve Reform program[36] aims to modernise procurement and simplify services.

Reserve is a slower solution to correct energy imbalances in the GB power system, bringing frequency back within operational limits. It is used alongside frequency response, which provides a near real-time reaction to grid disturbances.

The Reserve Reform program will introduce two new services: Quick and Slow Reserve.

5.1.1 Quick Reserve

- A pre-fault service that responds to small energy imbalances.
- Two types; Negative Quick Reserve and Positive Quick Reserve.
- Replaces Fast Reserve and SpinGen.
- Critical for enabling greater penetration of renewable generation on the grid.
- Launched in November 2024, with Phase 2 launched in September 2025 to allow non-BM units to participate.
- Procured through day-ahead auctions on the Enduring Auction Capability platform.
- Technical requirements: full delivery within one minute, maximum dispatch duration of 15 minutes, maximum recover period of three minutes and one Hz operational metering.
- Minimum entry threshold of one MW.
- Payments made for both availability (£/MW/hr) and utilisation (£/MWh).

5.1.2 Slow Reserve

- Previously announced to go live in October 2025, but anticipated to be delayed until early 2026[37].
- Introduced to replace Short-Term Operating Reserve (STOR).
- A post-fault service that combats problems arising from large faults on the network.
- Two types; Negative Slow Reserve and Positive Slow Reserve.
- Open to non-BM units and BM units to participate.
- Procured through the same co-optimized auction as Quick Reserve.

[34] https://www.neso.energy/industry-information/balancing-services/reserve-services/future-reserve-services
[35] https://www.neso.energy/document/369491/download
[36] https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/balancing-reserve
[37] https://www.neso.energy/industry-information/balancing-services/reserve-services/slow-reserve

- Technical requirements: full delivery within 15 minutes, maximum dispatch duration of up to two hours, minimum recovery period of 30 minutes and 1 Hz operational metering.
- Payments made for both availability (£/MW/hr) and utilisation (£/MWh).

5.1.3 Participation

Batteries will likely participate in Quick Reserve due to their near-instantaneous response capabilities. Slow Reserve is open to a wider range of participants, including gas-peaking plants, CCGTs, pumped hydro, and Demand-Side Response. Batteries can participate in Slow Reserve but must meet the slower ramp requirements. Additional power sources, known as “reserve services,” are utilized by the NESO at certain times of the day to manage unexpected spikes in electricity demand on the UK's transmission system that exceed forecasted levels. These reserve services, consisting of increased generation or demand reduction, are made available to ensure grid stability, with varying timescales required for different sources to be prepared and deliver the necessary power.

5.2 Balancing Reserve

Energy imbalances in the GB power system, which occur when generation and demand are not matched, are currently corrected using the Regulating Reserve product. This product relies on optional bids and offers to create a Regulating Reserve in real time. However, this method can be expensive during periods of scarcity, as the cost of bids and offers has risen significantly.

To address this, a new Balancing Reserve (BR) service is being introduced. This service will allow for the procurement of Regulating Reserve on a firm basis a day ahead, reducing balancing costs and improving system security. By procuring BR, reserve volume is locked in ahead of the day-ahead energy market, and energy is not available to be sold into continental markets over the interconnectors.

5.2.1 Key Benefits

- Procures Regulating Reserve on a firm basis a day ahead, reducing uncertainty and costs.
- Reduces balancing costs by providing a more efficient solution.
- Improves system security by guaranteeing reserve capacity for the Control Room.
- Enhances the overall stability of the GB power system.

5.2.2 Eligibility

- BM units with a minimum contract capacity of 1 MW or above are eligible to participate in the Balancing Reserve market.
- Units must be able to offer headroom (capacity to increase output) and/or footroom (capacity to decrease output).
- Providers must be registered in the SMP.

5.2.3 Participation

- To participate in the Balancing Reserve market, providers must submit their availability prices for four-hour service windows they wish to offer volume into before the day-ahead auction.
- Providers will receive payments for availability and utilisation.
- Payments will be made in accordance with the BR Service Terms; for both availability (£/MW/hr) and utilisation (£/MWh).

5.2.4 Technical Requirements

- BM units must be able to provide a minimum contract capacity of 1 MW or above.

- Units must be able to offer headroom and/or footroom, expressed through submission of BM data parameters such as Maximum Export Limit (MEL), Physical Notification (PN), Stable Import Limit, Stable Export Limit, and Maximum Import Limit.
- Time to full delivery within 10 minutes, including Notice to Offer and Notice to Bid.

5.3 Short Term Operating Reserve

5.3.1 What is Short-Term Operating Reserve?

STOR is a service that helps NESO manage unexpected increases in electricity demand or unexpected power plant outages. It provides additional power to the transmission network when needed. STOR will be replaced by Slow Reserve. The daily procurement requirement of STOR from 01 April 2025 (season 19) onwards is 1700 MW.

5.3.2 Key points to participate in STOR

- Both Balancing Mechanism (BM) and non-BM participants can provide STOR.
- STOR is required during specific times of the day, known as Availability Windows, which vary by season.
- Providers must offer at least 3 MW of generation or demand reduction, which can come from multiple sites.
- Providers must respond to instructions within 20 minutes, sustain the response for at least 2 hours, and have a recovery period of no more than 1200 minutes.

5.3.3 Participation

- Prequalification: sign a STOR Framework Agreement.
- Tenders: submit technical parameters and price via a competitive tender process (three rounds per year).
- Tenders can be for one or multiple seasons (up to two years).

5.3.4 STOR Seasons

- The STOR year runs from April to April, divided into six seasons.
- Each season has two Availability Windows per day (except Season 2).
- Providers must be available to operate at the contracted MW level during these windows.

5.3.5 Additional information

- STOR providers can offer additional services outside of the contracted Availability Windows.
- Providers must deliver at least three times per week.
- STOR dispatch equipment consists of a PC connected to a central server and the provider's metering equipment.
- Payment is made for both availability (£/MW/hr) and utilisation (£/MWh).

5.4 Slow Reserve

A new Slow Reserve[38] service is being introduced to manage frequency imbalances in the energy system. This is necessary because the system conditions are changing, and faster-acting services are required to meet specific criteria.

The Slow Reserve service will be used to:

- Restore frequency to within statutory limits within 60 seconds.

[38] https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/slow-reserve

- Recover frequency to within operational limits within 15 minutes.
- Respond to transient supply-demand imbalances that bring pre-fault frequency close to operational limits.

The existing Reserve products, including STOR, Fast Reserve, and Optional Downward Flexibility Management, will be replaced by a new suite of products. Slow Reserve, which includes Negative Slow Reserve and Positive Slow Reserve, is the first of these new products.

Slow Reserve is designed to operate after a fault has occurred and aims to provide NESO with access to firm, bi-directional energy. This will help to displace large losses on the system and recover frequency to within ± 0.2Hz within 15 minutes.

5.5 Fast Reserve

5.5.1 What is Fast Reserve?

Fast Reserve[39] is a service that provides rapid and reliable delivery of active power to the grid. This is achieved by increasing output from power generators or reducing consumption from demand sources. This service is planned to be replaced by Quick Reserve.

5.5.2 Technical Requirements

To participate, providers must meet the following criteria:

- Deliver active power within 2 minutes of receiving the dispatch instruction.
- Achieve a delivery rate of over 25 MW per minute.
- Sustain the reserve energy for at least 15 minutes.
- Deliver a minimum of 25MW.

5.5.3 Participation

- Potential providers must pass a pre-qualification assessment and sign a framework agreement.
- Providers will then be given access to an electronic tender platform to submit their tenders.
- Providers set their own prices for availability, nomination, and utilisation during the tender process.
- These prices are used to determine which providers are accepted.
- The Fast Reserve service is dispatched electronically. For BM units this is through the Balancing Mechanism, and for non-BM units, this is through the Platform for Ancillary Services.

5.5.4 Payment Structure

- Availability fee: paid for making the service available to NESO (£/hr).
- Nomination/positional fee: paid for being called upon to provide the service within a nomination window (£/hour).
- Utilisation fee: paid based on the actual energy delivered in a nomination window (£/MWh).

5.6 Quick Reserve

A Quick Reserve[40] is required to manage frequency when there's an imbalance between energy supply and demand. This service helps restore the frequency to within statutory limits within 60

[39] https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/fast-reserve
[40] https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/quick-reserve

seconds and operational limits within 15 minutes. It also responds to transient supply-demand imbalances. Phase 2 of Quick Reserve was launched inSeptember 2025, allowing non-BM units to take participate.

5.6.1 Service Objective

The Quick Reserve service, comprising Negative Quick Reserve and Positive Quick Reserve, aims to react to pre-fault disturbances and restore the energy imbalance quickly.

5.6.2 Service Updates

Quick Reserve will replace the legacy Fast Reserve service, minimizing the duration of events outside operational limits.

5.6.3 Technical Design Key Features

- A minimum 1MW capacity for generation reduction/increase or demand reduction/increase from any technology.
- Submission of dynamic parameters, location, and prices.
- Full utilisation of contracted capacity within 1 minute.
- Minimum Activation Periods not greater than 5 minutes and Maximum Recovery Period not longer than 3 minutes.

5.6.4 Contract Awards and Payments

- Contracts will be awarded based on bids.
- Providers will receive availability and utilization payments.
- Metering data with 1Hz granularity is required.
- The performance will be monitored using 1-second performance metering data.

5.6.5 Procurement Design

Service Windows and Procurement:

- Flexible service windows set in advance or 30-minute blocks.
- Daily firm procurement, with optional within-day procurement.

5.6.6 Auction Platform and Timing

- National auction platform.
- Results by D-1 09:00 am (Phase 1: D-1 14:30).

5.6.7 Bidding Rules

- The same MW cannot be sold twice.
- Stacking is only allowed between Positive and Negative (Phase 1).

5.6.8 Payment Structure

- Firm: Availability + Utilisation, Optional: Utilisation only.
- Payment Mechanism: Availability: Pay-as-Clear, Utilisation: Pay-as-Bid.

5.7 Operational Metering for STOR and Fast Reserve

5.7.1 How it works?

- BM (Balancing Mechanism) providers receive instructions and requirements through the EDL system.
- The Grid Code specifies the exact requirements.

5.7.2 What's monitored?

To ensure availability, the following BM Unit parameters are monitored during relevant periods:

- MEL: the maximum amount of power that can be exported.
- PN: notification of physical power output.
- Offer Price: the price at which the provider offers to generate or reduce power.
- Bid Price: the price at which the provider bids to generate or reduce power.
- Stable Export Limit: the stable amount of power that can be exported.
- Dynamic Parameters: rates at which power output can be increased or decreased (e.g. Run Up/Run Down rates).

6 Restoration services

The Restoration Service[41], formerly known as Black Start, is a process used to restore power in the event of a total or partial shutdown of the national electricity transmission system (NETS), an unlikely event. Contingency arrangements are in place to ensure timely and orderly restoration of electricity supplies.

6.1 Procurement of Restoration Services

- Restoration services are procured from Power Generating Modules or High Voltage Direct Current (HVDC) systems capable of restarting without external supplies.
- Top-up services are also procured to supplement technical requirements.
- Restoration tenders, launched in 2022, invite Distributed Energy Resources service providers for a bottom-up approach to restoration.

6.2 Service Requirements

During a shutdown, providers must:

- Restart.
- Energise sections of the NETS and distribution network.
- Restore sufficient demand to create a stable 'power island'.
- Deliver start-up supplies to other assets/sites as required.
- Synchronise with other power islands.

6.3 Availability and Dispatch

- Providers are expected to achieve high availability levels.
- Availability payments (£/settlement period) are made for being available to provide restoration services.
- Settlement periods accrue annually.
- Providers are dispatched by the Electricity System Operator's control room, with testing occurring at least every three years, as per the Grid Code.

6.4 Payments

- Payments are applicable depending on the type, age, and status of the Power Generating Modules (PGM) or HVDC System.
- Contribution sums are available for new or refurbishing plants.
- Payments may be profiled (staged) or upfront, supported by valid invoices.

[41] https://www.nationalgrideso.com/industry-information/balancing-services/system-security-services/restoration-services#New-providers

6.5 Existing Providers

- Payments will be applicable depending on the type, age, status, etc. of the Power Generating Module or HVDC System Contract Terms.
- NESO reserves the right to request further evidence to verify that the work has been completed.

6.6 Capable Power Generating Modules or HVDC Systems:

- PGMs/HVDCs can provide Restoration Services.
- Must meet specific technical requirements and have the capacity to re-start from shutdown without an external supply.
- Can restore the grid in conjunction with other services.

6.7 Tendering Process for Restoration Services

Overview of the Electricity System Operator (ESO) procuring process for restoration services:

- Submission: Tenderers submit their bids, which are then checked for completeness and compliance.
- Evaluation: Bids are evaluated in two stages:
    - Technical evaluation: assesses the feasibility of the proposed solution.
    - Commercial evaluation: reviews the costs (CAPEX and OPEX) and scores bids based on the most competitive price.
- Scoring: Technical and commercial scores are combined, with the lowest-cost provider receiving the highest points.
- Shortlisting: The ESO determines the number of contracts to award based on the final scores and restoration requirements.
- Approval: The ESO Executive Team and Board review and approve the selected tenders.
- Notification: Tender participants are informed of their outcome, and successful tenderers proceed to contract signing.
- Audit: The restoration process undergoes an external audit to ensure due diligence.

7 Optimisers

Optimisers, also known as route-to-market providers or aggregators, help battery asset owners increase revenue by:

- Controlling battery operations.
- Designing trading strategies.
- Accessing electricity markets and grid services (ancillary services).
- Reducing revenue risks and increasing investment interest.

7.1 Why are Optimisers important?

As the electricity market moves towards real-time procurement, Optimisers play a crucial role in ensuring the financial and technical success of battery projects.

7.2 Known Optimisers in the UK

Below is a non-exhaustive list of current Optimisers in the UK:

- Anesco.
- Arenko.
- Bp.
- Centrica.
- Conrad Energy.

- E.On.
- EDF.
- Engie.
- Field Energy.
- Flexitricity.
- Grid Beyond.
- Habitat Energy.
- Shell Energy.
- SSE.
- Kraken (Part of the Octopus Energy group).
- Statkraft.

7.3 Trading Arrangements

The agreements between BESS owners and optimisers revolve mainly around three main models[42, 43]: Floor Price, Merchant, and the most recently introduced, Tolling model.

7.3.1 Floor Price Model

Floor price agreements are contracts between BESS owners and their optimisers to ensure a minimum income from BESS operations over a specified period. These agreements offer revenue stability by guaranteeing a baseline income, and in exchange, optimisers receive a share of profits when the BESS asset surpasses the agreed-upon floor price. By utilising floor prices, BESS owners can attract potential investors with the promise of consistent revenue streams, thereby increasing the likelihood of investment in BESS projects. These contracts typically range from yearly to five-year terms, with rare instances of extended 10-year blocks, aiming to secure revenue performance and mitigate investment risks.

7.3.2 Tolling Model

The tolling model in the battery storage industry involves a contract where the BESS owner is paid a set fee for offering energy storage services. This system works like a toll road, where users pay to use the road. Within battery storage, this fixed fee ensures a certain level of revenue reliability for investors, helping to reduce the unpredictability risk linked with fluctuating energy markets.

7.3.3 Merchant Model

The merchant model is at the opposite end of the scale, where revenue depends entirely on market conditions. In this setup, the BESS owner assumes greater risk but can achieve higher returns during periods of high demand or favourable market conditions. The merchant model typically aligns with a more dynamic and competitive environment, necessitating investors to track market trends and adjust their strategies as needed closely. Embracing a merchant approach to batteries requires understanding the fundamental value drivers. The energy system is experiencing significant changes, and numerous factors—such as renewable energy deployment and gas prices—will influence future price volatility. Understanding these

[42] https://www.solarpowerportal.co.uk/gridbeyond-investors-are-progressively-embracing-the-potential-of-battery-storage/
[43] https://gridbeyond.com/lp/tolls-floors-and-merchant-models-white-paper/

interactions is crucial for developing an investment thesis for batteries and gaining a competitive edge.

7.4 Recommendation:

- Engage with Optimisers early to understand risk profiles, cash flow, revenue profile within finance model and technical assumptions and design implications.
- Early engagement with Optimisers can result in more realistic forecasting revenues throughout understanding grid service participation.

Appendix A

Table 7-1: Abbreviation List

Abbreviation	Definition
BCA	Bilateral Connection Agreement
BEGA	Bilateral Embedded Generation Agreement
BELLA	Bilateral Embedded Licence Exemptible Large Power Station
BESS	Battery Energy Storage System
BM	Balancing Mechanism
BMU	Balancing Mechanism Unit
BOA	Bid Offer Acceptances
BR	Balancing Reserve
BSC	Balancing and Settlement Code
CM	Capacity Market
CMU	Capacity Market Unit
CoP	Code of Practice
CUSC	Connection and Use of System Code
DC	Dynamic Containment
DCH	Dynamic Containment High Frequency
DCL	Dynamic Containment Low Frequency
DM	Dynamic Moderation
DR	Dynamic Regulation
DSR	Demand Side Response
EDL	Electronic Data Logging
EDT	Electronic Data Transfer
EFA	Electricity Forward Agreement
eGAMA	Electricity Generation Availability and Margin Analysis
EMR	Electricity Market Reform
ENCC	Electricity National Control Centre
EOI	Expression of Intent
ERPS	Enhanced Reactive Power Service
ESO	Electricity System Operator
FFR	Firm Frequency Response
HVDC	High Voltage Direct Current
ITT	Invite to Tender
MEL	Maximum Export Limit
MFR	Mandatory Frequency Response
MS	Metering Systems
MSA	Mandatory Service Agreement
NESO	National Electricity System Operator
NETS	National Electricity Transmission System
NGET	National Grid Electricity Transmission
ORPS	Obligatory Reactive Power Service
PGM	Power Generating Module
PN	Physical Notification

Abbreviation	Definition
SFFR	Static Firm Frequency Response
SHET	Scottish Hydro Electric Transmission
SMP	Single Market Platform
SPD	Satisfactory Performance Day
SPT	Scottish Power Transmission
STOR	Short-Term Operating Reserve
TCWAA	Technology Class Weighted Average Availability
UK	United Kingdom
VLP	Virtual Lead Party

Table 7-2: Prefix List

Symbol	Definition
G	Giga
M	Mega

Table 7-3: Unit List

Unit	Definition
VA	Volt-ampere
var	Volt-ampere reactive
VA.s	Volt-ampere-second
W	Watt
Wh	Watt-hour

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