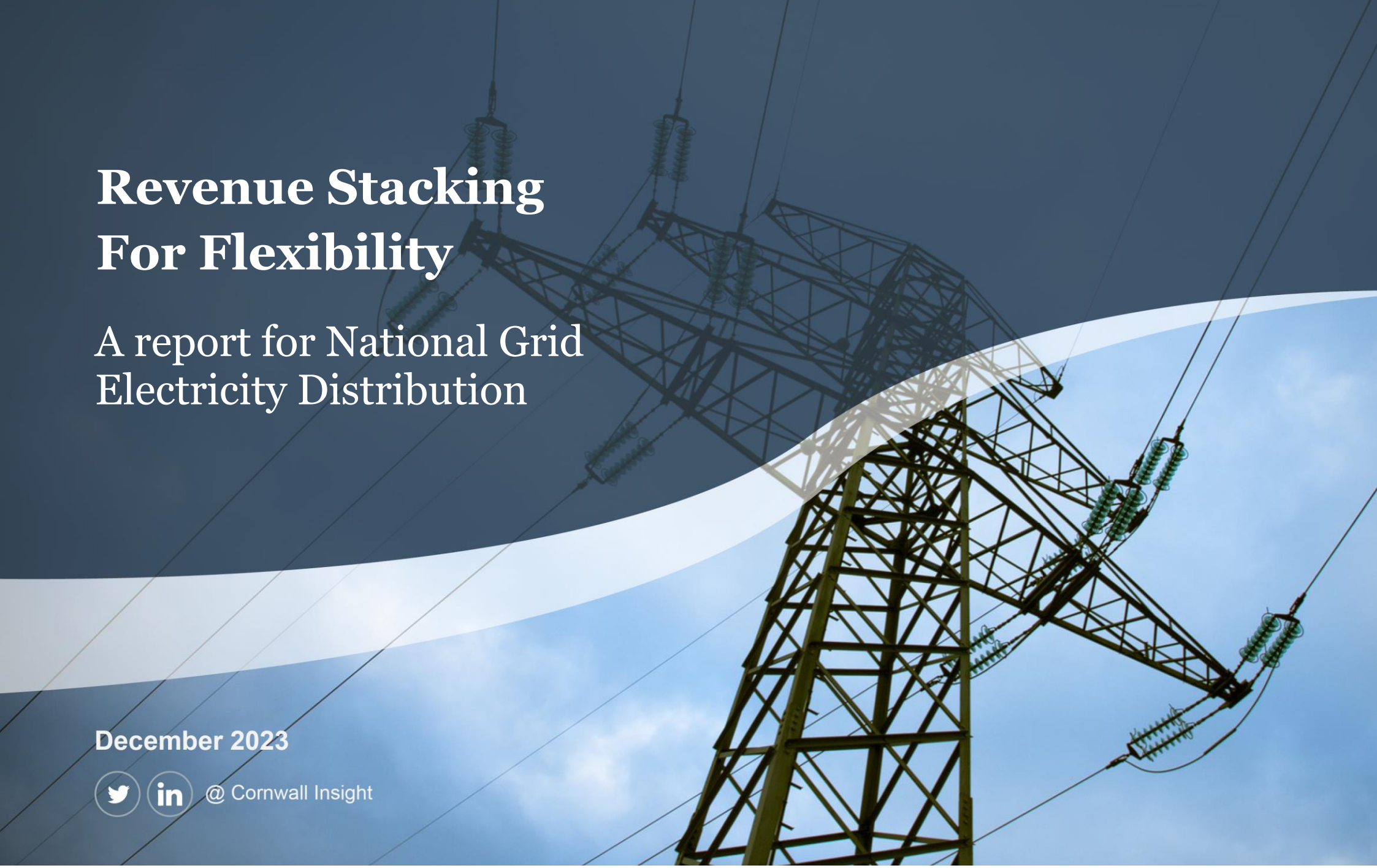
Revenue Stacking For Flexibility

A report for National Grid Electricity Distribution



December 2023

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About Cornwall Insight

Getting to grips with the intricacies embedded in energy and water markets can be a daunting task. There is a wealth of information online to help you keep up-to-date with the latest developments, but finding what you are looking for and understanding the impact for your business can be tough. That's where Cornwall Insight comes in, providing independent and objective expertise. You can ensure your business stays ahead of the game by taking advantage of our:

- **Publications** – Covering the full breadth of the GB energy industry our reports and publications will help you keep pace with the fast moving, complex and multi-faceted markets by collating all the "must-know" developments and breaking-down complex topics.
- **Market research and insight –** Providing you with comprehensive appraisals of the energy landscape helping you track, understand and respond to industry developments; effectively budget for fluctuating costs and charges; and understand the best route to market for your power.
- **Training, events and forums** – From new starters to industry veterans, our training courses will ensure your team has the right knowledge and skills to support your business growth ambitions.
- **Consultancy** – Energy market knowledge and expertise utilised to provide you with a deep insight to help you prove your business strategies are viable

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2. Executive Summary

This report has been prepared by Cornwall Insight. It explores the extent to which flexible service providers (FSPs) can stack revenue streams, with a particular focus on the way in which services being procured by Distribution Network Operators (DNOs) integrate with other, more established revenue streams. It provides an update on two earlier papers produced for Western Power Distribution (WPD) and the Energy Networks Association (ENA)'s Open Networks programme in 2020. The update has been commissioned by National Grid Electricity Distribution (NGED, formerly WPD).

2.1. Methodology

This report has been compiled using our understanding of the revenue streams available to FSPs, supplemented by primary research of the details and service terms of the full range of balancing services and flexible revenue streams available to distributed energy resources (DER). We have verified these findings through collaboration and engagement with industry stakeholders, including FSPs and NGED. The research has been conducted during summer and autumn 2023, and should be read in this context.

While, in general terms, the industry refers to the ability of assets to stack revenues or the "stacking" of different revenue streams, there are nuances to how and when assets can earn revenues from each of these services co-optimally. Therefore, we have assessed the "stacking" of revenues under three different definitions:

- **'Co-delivery'**– being able to deliver multiple services and earning revenue from the same MW in the same time period in the same direction. There are also variations on this, such as being able to earn utilisation revenues in opposite directions in the same settlement period across some services and services that place onus on availability but adjust volumes so that providers are not penalised (the Capacity Market, or CM)
- **'Splitting'** – earning revenue and being able to deliver multiple services from the same asset in the same time period, but not from the same MW. The asset can provide different MWs at the same time, providing the ability of the asset to deliver in all contracted service(s) is not impeded
- '**Jumping'** – earning revenue from the same asset and the same MW, but during adjacent or different time periods

We note that in most instances there is no single definition on the explicit interaction between services and how these would be concurrently provided by FSPs. In order to distinguish between the different levels of clarity in stacking, we have classified between services as follows:

- **Explicitly stackable** – rules or guidance explicitly state the alignment and ability to co-optimise services
- **Implicitly stackable** – based on our understanding of market rules, regulations and processes, there is nothing preventing this, and there are no service terms such as exclusivity that would prevent co-optimisation
- **Implicitly unstackable/ technical issues arise** – as above, but inter-operational challenges mean FSPs are unlikely to be able to or want to co-deliver the services
- **Explicitly unstackable** – rules or guidance explicitly state that revenues cannot be co-optimised across services e.g. the service requires exclusivity from the provision of all other services for the duration of the agreed contract

- The co-deliverable table includes **Utilisation available in opposite direction** where the asset can be asked to move in opposite directions while earning revenues in another revenue stream

In reality many services are implicitly able to be co-optimised together but require FSPs or aggregators to make commercial decisions about the services they wish to pursue to maximise profitability. They also place the onus on FSPs to identify any operational challenges in co-delivery, splitting or stacking of different services. Generally, balancing services and revenue streams in GB have been developed such that FSPs cannot earn revenue from more than one source for the same MW of response provided. This lack of double-counting means most services are not fully co-deliverable, and are more likely to be splitable or jumpable. However, due to the wide range of system requirements required to effectively operate and recover the system, and therefore the range of services procured, there are exceptions to this rule. Two notable exceptions include:

- The CM and Relevant Balancing Services (RBS). The RBS are services where their delivery during a CM-relevant system stress event is discounted from provider's obligation under the CM, therefore ensuring the provider is not penalised for providing the service
- The provision of Active power and Reactive power to purchasers, for *example* providing Active power response to the Distribution System Operator (DSO) while providing Reactive support to the Electricity System Operator (ESO). However, due to the loss of phase in delivering Reactive power, this will also have an impact on an asset's ability to deliver Active power

Finally, this report makes only a light touch comment on the commercial terms, respective benefit for co-optimising certain revenue streams, and the technical requirements for each service. It is primarily an evaluation of stacking and interoperability between revenue types, rather than a detailed assessment and recommendation of commercial co-optimisation.

2.2. Progress against the previous report

Many of the recommendations from the *previous report* remain relevant today, although the context may have changed slightly within the broader remit of a changing system and modified balancing services to meet changing system need. They can be summarised as:

- Flexible asset providers remain able to move between revenue streams in different time periods much more readily than they are able to stack multiple revenue streams in the same time period. NG ESO's new Enduring Auction Capability (EAC) is supporting the optimal assignment of assets MW into reserve and response services (optimally splitting from a least cost perspective of the ESO), which will support in improving access and optionality for FSPs in ESO revenues only
- Contract terms or regulatory arrangements continue to cause an unnecessary barrier to revenue stacking in instances. The Capacity Market rules include a series of services which an asset may provide without risk of penalty under the CM, but this does not include a number of available balancing services which have been recently introduced by the ESO or services procured by DNOs
- There remain opportunities for greater coordination across services being procured by the ESO and DNOs and the timescales for procurement and dispatch – the easiest quick win being to ensure services are jumpable by assets, e.g. through aligning procurement over EFA block or providing optionality by settlement period. Participants have also highlighted that the ESO and DNOs could work together to standardise contracts further. Progress has been made in development of a standard agreement, which has now reached version 2.1 that we understand the DNOs and ESO will use for their Autumn 2023 tenders

- However, DNOs and the ESO have made progress on co-ordination and a hierarchy of services through the primacy workstream
    - For clarity, primacy refers to the services that take precedence when assets in a region are contracted to different services that direct them to provide response in opposite directions, thus diminishing or cancelling out the effects of one-another's response
    - Due to the relatively limited number of technically suitable assets in a suitable location to provide DNO services, DNO services tend to have primacy over a range of ESO services where there is a conflict. This has now been formalised for voltage management, thermal constraint and system inertia instructions in the BM and the ESO's Transmission Constraint Management service procurement for all DNO products except Restore
    - While this is not directly stacking-related, it does show progress in the consideration of whole system network thinking and service procurement
- Generally, newer services and procurement rounds are learning lessons from previous generations and generally improving in terms of access and ability to jump. DSO services are a good example; however, this is not universal and we continue to see deployment of services where stacking is either prohibited or unclear, MW Dispatch and Demand Flexibility Service (DFS) for example

2.3. Other key findings

Access to the relevant supporting information is important for FSPs in determining their trading strategies. Fundamentally, at present:

- The ease of access to information on stacking is low
- Interactions can be unclear and open to interpretation
- There may be misunderstanding in how services can be stacked

The above is especially true in instances where different procurers are purchasing products from the same FSP, and there may be different interpretations between parties in instances. Some information is available, however, this is only for the ESO's most widely procured and stacked services and it is unclear how up to date that information is or when it will next be updated. For example, the *Unlocking Stacking of BOAs with Frequency Response Services* document.

In the procurement of balancing services there is presently a disconnect between DSO and ESO procurement of key balancing services. This is due to a range of factors, both from an operability perspective (alignment of delivery windows, interface with Capacity Market and industry settlements, etc.) and that of FSP prioritisation (maturity of market, terms and requirements, etc.).

One of the key challenges is that some DSO services that are dependent on short-term non-scheduled activations are not easily compatible with Balancing Mechanism (BM) registered assets. Such assets must notify National Grid ESO of their physical position in each half hour settlement period, and must do so by one hour ahead of the start of the period. As provision of the DSO services does not feed through into settlements, responding to the DSO service would require deviation away from the PN and ultimately may put the asset in breach of its Grid Code requirements. At the very least this would mean the asset would be exposed to imbalance prices as the DSO services are not subject to adjustment for their dispatch, through Applicable Balancing Services Volume Data (ABSVD) or similar.

There are conflicts in the delivery of some services between DSOs and the ESO at the network level. There is emerging thinking under the Open Networks programme on primacy between different services procured by different players via the Open Networks Primacy Subgroup. Examples include Active Power

DSO services, which have explicit primacy over Transmission Constraint Management services, and BM-led Voltage management thermal constraints and system inertia instructions. Work needs to continue in this space e.g. DNVGL's *Independent cost-benefit analysis on ESO-DSO primacy rules for STOR vs ANM flexibility service conflicts*.

Other barriers to stacking exist. For example, committed STOR is a challenge to stack with other services. It requires a ≤0MW starting point prior to instruction meaning it cannot be split with other services. Stacking capability of committed STOR varies within the day contract (i.e., more stacking opportunities outside of availability windows than inside them). Other examples are highlighted in the report.

2.3.1. Non-firm connections

Non-firm or interruptible connections appear to be broadly contractually allowable across the majority of flexibility revenue streams, with the exception of the:

- The Local Constraints Market (LCM) where it is explicitly stated a providing asset cannot be subject to Active Network Management (ANM)
- CM. The EMR Delivery Body (EMRDB, National Grid) stated that existing Capacity Market Units (CMUs) require firm connections, although we were unable to find any clear statement in the *Capacity Market Regulations* that mandates this

Regardless, there are operational challenges that must be navigated in delivery. These are lowest with provision of DSO services, where the vast majority of procurement is for generation turn up or demand turn down. If the DNO is calling upon assets to respond, it is extremely unlikely to be concurrent with a period of surplus generation in which the DNO needs to disconnect the asset. ESO service delivery is more challenging, as there is no guarantee local conditions will be reflective of the broader system. However, asset owners can take a view of when they face the greatest risk of curtailment based on local conditions, experience, and information provided by the DNO and plan entry into services accordingly. Estimated levels of curtailment, and curtailment limits as set out in the *Access Significant Code Review final decision*, should support this.

2.4. Recommendations

This report's key recommendations are summarised below:

Challenge	Examples	Recommendation	Who	Priority
Broader uncertainty on co-deliverability and whether this is intentional. Priority/ concern on this varies between procuring parties.	An FSP can provide flexibility under the defined relevant balancing services and co-deliver the Capacity Market. However, the ESO *Balancing Services guide* states: "A single Active or Reactive power service cannot be provided to multiple buyers over an Availability Window, as this would result in the potential for double counting of MW or MVars. Also, once instructed by one Operator, the provider may become unavailable for the other. This would add uncertainty and require over-procurement to compensate. This adds cost at the national scale and may make some local schemes with limited volume unworkable."	Make a decision on whether value should be achievable for delivery of multiples services with the same MW. Explore a cost-benefit analysis of explicitly enabling this where both services can be delivered simultaneously with no impact on delivery.	Ofgem/ ESO and DSOs	High
Visibility of the ability to stack services is opaque and unclear. In instances it depends on interpretation of legal text or operational conflicts/ misalignment between services. This can lead to misunderstanding of how services can be stacked and lower liquidity in the market place.	No explicit splitting issues for STOR, but T&Cs state STOR requires assets to operate from a baseline of zero or less, which conflicts with splitting MW between services. MW Dispatch doesn't explicitly say you can or can't co-provide services. T&Cs imply you can't but operationally (as with BM) an FSP could input bids taking them out of the market.	Establish cross- service guidance. Establish a regular opportunity for Q&A (FAQ or annual forum). Information regularly reviewed, updated and put in one readily accessible location online.	ESO and DSOs, potentially through the ENA or Open Networks programme	High
Service window timeframes vary between services. Assets jumping between services may lose revenue waiting for new period to begin.	DNO procurement windows across the services dependent on local need and DNO, EFA blocks for response services, settlement period procurement windows for BM, LCM and MW Dispatch (broken down	Align service window timeframes where possible. Shortening them supports jumping (e.g. a BESS requiring time to charge).	ESO/ DSO	High

Challenge	Examples	Recommendation	Who	Priority
	into 48 settlement periods per day), evergreen requirements for CM and the ERS.			
Long procurement timelines mean the value for flexibility may be unknown at the point of contract award. FSPs will price this into their bids, however the issue is that it may lead to assets taking penalties if counterfactual value significantly increases in run up to delivery. Therefore, firmness of delivery may be lower than DNO expects.	Seasonal contract procurement and award e.g. DNO flexibility services	In instances where possible (and we recognise not all services will be able to) move as close to real time procurement as possible. An alternative solution may be to align penalties for non-delivery to current market conditions, although this may be contractually difficult.	DSOs	Medium
Service terms and requirements are varied, T&Cs can put significant liability on FSPs, stymying participation.	*NGED*, *UKPN* and sample *ESO service terms*.	Co-develop a contractual framework with common elements/ areas and schedules for ESO/ DSO specific requirements.	ESO and DSO legal teams	Medium – progress in train
Service requirements can hinder FSP's ability to split, jump or stack services. This is typically most relevant of starting positions of BM-registered assets that comprise a BMU, and some ESO-related services.	The BM and Grid Code require assets to adhere to Final Physical Notifications (FPNs) submitted at gate closure. Short term DSO activation asking the asset to deviate away from FPN can put the aggregator or FSP in violation of the Grid Code. BM STOR requires assets to have a Physical Notification (PN) less than or equal to zero.	While there are potentially good reasons for different starting requirements, they prevent service splitting. E.g. actions in DSO services for BM participants may contravene Grid Code. Zero output starting requirements (if enforced, e.g. through FPNs) prohibit service splitting. Further, starting points that cannot be adjusted for provision of other services may also prohibit service splitting. Review service requirements to understand if they are necessary for service provision.	ESO	Medium
Baselines from which service delivery and performance are assessed differ between ESO and DSO services. They also vary between DSO. **Performance monitoring takes different approaches between different procurers. This feeds into settlement and payment for these services, meaning FSPs are paid**	Baselines can vary widely: • BM baselines are FPNs submitted at gate closure • Dynamic FR services use PNs • FFR uses real time monitoring to assess response • NGED DSO services for generation	Align baseline approaches across DNOs. Base exceptions on requirements for the DNO and clear communication on the differences with FSPs. Align baselining and performance monitoring across other services where appropriate. There are very good reasons for different baselines in some services (e.g.	ESOs and DSO	Medium/ Low

Challenge	Examples	Recommendation	Who	Priority
differently for delivering the same volume. **Further, if an FSP changes output, it is unclear how this impacts the baseline and performance monitoring of other services if stacking. E.g. providing some capacity to DSO and some to ESO, utilisation in one service will affect performance and settlement in the other service.**	assets use an assumed zero baseline • DFS service is from ~2 weeks historic data	FFR dynamic data monitoring). Decisions on the best baseline depend on other fundamental stacking questions. For example, zero baselines with unadjusted volumes can support multiple service delivery (i.e. being paid across multiple services for the same MW), but this may not be desired. Closer attention may need to be given to adjusted baselines to account for multiple service delivery, and how performance monitoring is impacted by multiple service delivery.		
RBS excludes many services including DSO services.	ERPS, DSO services, and the new Slow and Quick Reserve are not listed yet.	Review and incorporate services or explicitly state in a central repository why the services have been excluded.	ESO/ EMRDB	Low
Eligibility of assets with non-firm connections is not clearly outlined in a number of services, the assumption is that they can enter but will face non-delivery penalties if curtailed. **Where eligibility is clear, requirements are often strict and exclude non-firm connections even if the requirement is likely during times of low likelihood of curtailment.**	Outlined well in some services, e.g. LCM. Implicit or unclear in a wide range of other services. Capacity Market makes no explicit reference to firm or non-firm connections. Implicitly able to participate with non-firm connections rules as written, although EMRDB bilaterally advised us that existing CMUs required firm connections. MW Dispatch is a method of curtailing non-BM assets, but it is unclear if this will be the only method of curtailment or if the DSO can still ANM the assets.	Provide clear guidance on non-firm connection eligibility for every service. Enhanced information sharing on curtailment likelihood, supporting procuring entities in allowing service provision when curtailment likelihood is low.	ESO/DSO	High
Data used to demonstrate delivery is sourced from several points – meters, settlements (adjusted or not). This causes conflicts that can result in over or under-compensation.	DSO services awarding SIP to assets that generate when called upon.	The solution here will depend on the decision made on whether assets should be able to be paid for delivery across multiple services simultaneously. If so, no action need be taken, otherwise alignment or adjustment is required, perhaps through	ESO/ DSO	Medium

Challenge	Examples	Recommendation	Who	Priority
		DNOs submitting volumes delivered in response to DSO services for ABSVD.		
No obligation to continue to consider these impacts or needs for future services or procurement platforms. **This is linked to recommendation 1 in that a strategic multi-party approach to flexibility procurement would be beneficial.**	N/A	Develop a set of principles in order to maximise liquidity/ stacking in the market via self-governance. This can be across service terms, data sources, procurement platforms, etc. E.g. transparency, optimising etc. Apply them to all new services being developed.	ESO and DSO via ENA	High/ Medium
The design of flexibility services for very small scale flexibility limit stacking options, due to the speed of deployment and system need. This approach may be the best solution for the ESO in the short-term but is unlikely to be the optimal whole of market approach as it may result in higher costs than necessary in other services.	ESO DFS requires exclusivity with express intent of providing the ESO with access to "new" flexibility.	Review with DSOs the ruleset to ensure the DFS can facilitate access to new small scale assets as intended but does not preclude such assets from participation in the DFS. This could be through a clause around DSO services being exempt from the requirement, or other monitoring.	ESO	Medium

2.4.1. Information access

Entities procuring services could make interactions clearer. We suggest a sensible first step would be to outline how their own products and services interact before interacting across the ESO/DSO boundary to determine the inter-operability of services that are likely to be procured and/ or utilised over similar time periods. Outlining the relevant balancing services for Capacity Market delivery in the same location can also support this.

Finally, all DSOs could transition to using the same terms and conditions, contractual baselining and structure, and service definitions and requirements. This would support entities with multi-site loads/ generation (supermarkets, EV charge points, logistical centres, etc.) engaging with and understanding the requirements of the services.

There are a wide range of positive and rapidly evolving services and platforms each with their own requirements and terms. However, as the number and complexity of different services has evolved over time, piecemeal information located on various websites could be consolidated to support ease of access, and summary information provided to support understanding of interactions. An easy first step could be to ensure information is hosted in a single repository, supporting FSPs in accessing information and therefore making commercial decisions.

2.4.2. Future trends and developments

The ESO's Enduring Auction Capability (EAC) went live from October 2023 and is gradually rolling out to its reserve and response products. The auction clearing algorithm is able to select between alternative provider bids and alternate ESO requirements to better optimise the overall market clearing. This co-optimisation approach should allow for units capable of providing more than one of the eligible services to place multiple bids in the auction for different services. This means that the service provider doesn't have to choose in advance which of the services to bid into the auction for. Therefore, from go-live, the EAC has allowed for participants to offer delivery for more than one frequency response service simultaneously from the same unit.

Alongside the co-optimised approach inherent in the new market design, the EAC also enables providers to bid to deliver more than one service simultaneously from the same unit in the same service window, dubbed splitting (service stacking). Splitting is allowed between Dynamic Response products (DCL, DCH, DRL, DRH, DML and DMH), Quick Reserve products (PQR and NQR), or between Slow Reserve products (PSR and NSR). Initially service splitting will not be allowed between response and reserve products, and Quick Reserve and Slow Reserve products will not be allowed to be mixed.

This approach could further focus the attention of aggregators and FSPs on delivery of ESO service requirements, to the detriment of others except where specific opportunity or customer desire to engage in wider services presents itself. For example, FSPs could focus on bidding into the highly liquid EAC market but opportunistically transition specific customers or aggregated units to the DSO services or Local Constraint Markets. The ability of providers to jump between these services and the services procured under the EAC then become paramount to remove barriers and support participation in wider services.

2.5. Comment on different types of flexibility

This report discusses stacking as if it were equally applicable to DSR and generation, and between small scale and larger scale distributed assets. This is an oversimplification. Where relevant due to stacking considerations we've highlighted the difference, otherwise treated the same in the interests of simplicity.

2.6. Stacking summaries

The following sections summarise the interaction of different services based on Cornwall Insight's research and understanding of the stacking of revenue streams across markets, based on:

- Co-delivery of
- Splitting of
- Jumping of

The views regarding stacking are Cornwall Insight's best view as of summer/ autumn 2023 based on its understanding of service terms, potential operability challenges, industry rules, and occasionally our understanding of industry practice where other information is less available. Where new services are included in the tables, information has been taken from latest service designs or direction taken from similar recently developed services. While the tables are a well informed view regarding stacking, there may be instances where industry views or experience may deviate from our own, or may vary due to specific asset or party circumstances. We welcome feedback and comment on the findings within this report.

2.7. Co-delivery of services

This table summarises the ability of different services to be co-delivered together. Note the ability to co-deliver services is typically very limited, as providers are not typically to permitted to earn revenues from multiple sources for the same MW in the same settlement period in the same direction.

Figure 1: Ability to co-deliver different services

Revenue stream/ Service	Wholesale	Balancing Mechanism	NIV Chasing	Capacity Market	Short Term Operating Reserve	Firm Frequency Response	Enhanced Reactive Power Service	DSO services	Local Constraint Market	MW Dispatch Service	Demand Flexibility Service	Slow Reserve	Quick Reserve	Balancing Reserve	Electricity Restoration Services	Dynamic Containment	Dynamic Moderation
Balancing Mechanism																	
NIV Chasing																	
Capacity Market																	
Short Term Operating Reserve																	
Firm Frequency Response																	
Enhanced Reactive Power Service																	
DSO services																	
Local Constraint Market																	
MW Dispatch Service																	
Demand Flexibility Service																	
Slow Reserve																	
Quick Reserve																	
Balancing Reserve																	
Electricity Restoration Services																	
Dynamic Containment																	
Dynamic Moderation																	
Dynamic Regulation																	

Note that the Enhanced Reactive Power Service is included as N/A in the service summaries in the Appendices, as the service is for the provision of reactive power measured in MVA, rather than the active power provided in all other services. The ESO explicitly highlights that reactive and active power services can delivered at the same time, although delivery of reactive power is likely to impact the active power that an asset can provide for the grid.

Key		Short explanation
	Explicitly unstackable	Service terms, rules, guidance, or clear market/ technological reasons render services unstackable.
	Technical challenges inhibit	While not explicit in service terms or guidance, something (e.g. operational or contractual conflicts) implicitly means FSPs either can't or would unlikely attempt to stack the services.
	Utilisation available in opposite direction	Where service terms or guidance allows an asset to provide the same service in the same settlement period but in opposite directions. This may be where service terms and industry practices allow a 'reverse' action to be taken (while still be paid for both without penalty), or an action in one direction does not impede the delivery of another service in another direction in the same service window.
	Codeliverable	Service terms, rules, guidance, or clear market/ technological reasons means the services are stackable (for the same MW of power in the same direction).
	Restoration availability possible	Availability payments may be made for system restoration services at the same time as providing other regular services. In the unique scenario where electricity system restoration services are required and used, assets would likely no longer be required to perform any other service and the restoration service requirements would take precedent.

2.8. Splitting of services

This table summarises the ability of different services to be delivered by the same asset but different MW in the same settlement period. There are typically more options for splitting flexibility services, however, many are implicitly rather than explicitly allowed and numerous operational challenges can arise (e.g. from baselining and performance monitoring implications).

Figure 2: Ability to split different services

Revenue stream/ Service	Wholesale	Balancing Mechanism	NIV Chasing	Capacity Market	Short Term Operating Reserve	Firm Frequency Response	Enhanced Reactive Power Service	DSO services	Local Constraint Market	MW Dispatch Service	Demand Flexibility Service	Slow Reserve	Quick Reserve	Balancing Reserve	Electricity Restoration Services	Dynamic Containment	Dynamic Moderation
Balancing Mechanism																	
NIV Chasing																	
Capacity Market	N/A	N/A	N/A														
Short Term Operating Reserve				N/A													
Firm Frequency Response				N/A													
Enhanced Reactive Power Service				N/A													
DSO services				N/A													
Local Constraint Market				N/A													
MW Dispatch Service	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Demand Flexibility Service				N/A						N/A							
Slow Reserve				N/A						N/A							
Quick Reserve				N/A						N/A							
Balancing Reserve				N/A						N/A							
Electricity Restoration Services	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Dynamic Containment				N/A						N/A					N/A		
Dynamic Moderation				N/A						N/A					N/A		
Dynamic Regulation				N/A						N/A					N/A		

Note, the Capacity Market and ERS services cannot be split as they are provided over extended periods and don't require delivery of a specific MW on a regular basis (yet, at least). MW Dispatch is an all-or-nothing service where the ESO can disconnect an asset from the grid and so is not stackable.

Key	
	Explicitly unstackable
	Implicitly unstackable
	Implicitly stackable
	Explicitly stackable
	Replacement

2.9. Jumping of services

This figure outlines whether services can be delivered by jumping from one service to another in adjacent or nearby settlement periods. This typically has the greatest availability and flexibility. Limitations typically arise when a service has long or enduring delivery windows, are written into connection agreements, or registration and/ or the ability to participate in one market excludes an asset from another market (e.g. cannot be a registered Balancing Mechanism Unit (BMU) and participate in the Local Constraint Market).

Figure 3: Ability to jump different services

Revenue stream/ Service	Wholesale	Balancing Mechanism	NIV Chasing	Capacity Market	Short Term Operating Reserve	Firm Frequency Response	Enhanced Reactive Power Service	DSO services	Local Constraint Market	MW Dispatch Service	Demand Flexibility Service	Slow Reserve	Quick Reserve	Balancing Reserve	Electricity Restoration Services	Dynamic Containment	Dynamic Moderation
Balancing Mechanism																	
NIV Chasing																	
Capacity Market	N/A	N/A	N/A														
Short Term Operating Reserve				N/A													
Firm Frequency Response				N/A													
Enhanced Reactive Power Service				N/A													
DSO services				N/A													
Local Constraint Market				N/A													
MW Dispatch Service				N/A													
Demand Flexibility Service				N/A													
Slow Reserve				N/A													
Quick Reserve				N/A													
Balancing Reserve				N/A													
Electricity Restoration Services				N/A													
Dynamic Containment				N/A													
Dynamic Moderation				N/A													
Dynamic Regulation				N/A													

Please see the individual service descriptions and summaries for more information on why there are challenges with jumping between some services.

Note, the Capacity Market is procured in annual tranches and is co-deliverable with a wide range of services. It cannot be “jumped” in the traditional sense.

Please note that some DSO services are dispatched post-gate closure, and in these instances are unstackable with the BM.

Key	
	Explicitly unstackable
	Implicitly unstackable
	Implicitly stackable
	Explicitly stackable
	Replacement

3. Service prioritisation from a provider's perspective

This section summarises some of the key points that support FSPs in prioritising service delivery, and helps to put the paper in context for the reader.

3.1. FSP prioritisation

While FSPs have a wide range of strategies for maximising their customer portfolios and optimising revenue streams, there are some common themes. Firstly, FSPs will only bid assets into services in which they are technically capable of delivering the service. The following factors are then used to support decision making on the flexibility services to participate in:

- Value, comprised of:
    - Bid value, which includes availability fee plus utilisation fee multiplied by expected utilisation
    - Expected bid success rate
    - Transparency of the above to support decision making
- Established market place with regular requirement
- Access
- Penalties for non-delivery
- Interoperability/ stacking with other services supported by procurement timescales, delivery windows, etc.

3.2. Value

The following figure summarises the values observed in each revenue stream over the past year. Please note that 2022 was a period of very high prices due to global energy market dynamics however, for some revenue streams, such as NIV and wholesale pricing, an average value is a gross under-representation of the values that flexible assets can achieve. For example, since 2020, annual average day-ahead prices have ranged between £37/MWh and £216/MWh, while average daily hourly prices have ranged from –£10/MWh to £597/MWh.

Figure 4: Average values of services over the past year

Service/ revenue stream	Average service price
Wholesale	£137.9/MWh
Balancing Mechanism	Bid = £28.1/MWh Offer = £210.5/MWh
NIV Chasing	SIP = £131.6/MWh
Capacity Market	£8.40/kW/yr to £75/kW/yr depending on auction
Short Term Operating Reserve	£3.86/MW/hr £3.47/kW/month
Dynamic Firm Frequency Response	£13.08/MW/hr £6.49/kW/month
Static Firm Frequency Response	£4.85/MW/hr £2.13/kW/month
Enhanced reactive power service	No data
NGED* Sustain (LV zones)	£18.16/kW/season
NGED* Secure (HV zones)	£476MW/hr Availability £666/MWh Utilisation
NGED* Dynamic (HV zones)	£17/MW/hr Availability £750/MWh Utilisation
NGED* Restore (HV zones)	£600/MWh Utilisation
Local Constraint Markets	£198/MWh (average accepted bid May-September 2023)
MW Dispatch Service	No data
Demand Flexibility Service	£4,559/MWh (average 2022-23 live event price)

Service/ revenue stream	Average service price
Slow Reserve	No data
Quick Reserve	No data
Balancing Reserve	No data
Electricity Restoration Services	No data
Dynamic Containment Low	£5.26/MW/hr £2.06/kW/month
Dynamic Containment High	£3.56/MW/hr £1.43/kW/month
Dynamic Regulation Low	£12.65/MW/hr £2.19/kW/month
Dynamic Regulation High	£3.59/MW/hr £0.54/kW/month
Dynamic Moderation Low	£3.72/MW/hr £0.26/kW/month
Dynamic Moderation High	£5.45/MW/hr £0.55/kW/month

**The NGED values come from volume weighted averages of requirements from its August tenders.*

Source: various data points and Cornwall Insight analysis. DSO data taken from NGED procurement results for Cycles 1&2 2022. Data on the ESO's services published by ESO. Data on the Capacity Market results from the EMR Delivery Body.

Likelihood will be based on FSP experience in the markets and historic utilisation rates. As an example of how this interplays, BM prices exhibit some of the highest values, however due to payment only by utilisation, and low utilisation rates for very small assets, the BM can be a relatively unattractive service for small DER.

Generally, transparency is improving for all services. DSO information would benefit from: data availability across all DNOs, consistent format, and inclusion of units in all reported data.

3.3. Marketplace and requirement

A regularly tendered service requirement provides certainty to FSPs in the maturity of the market and the sustained requirement, which can support decisions to strategically invest more time and resources into providing services and recruiting customers (in the case of aggregators).

Some DNO service procurement across the country currently lacks resolution and doesn't have a strong track record of consistent need, which would give aggregators confidence. However regular procurement is occurring in parts of the market, especially in procurement of peak load avoidance.

Market transparency – excellent data and information sharing/ visibility – is essential for supporting FSPs in understanding typical values and the size of the requirement. Standardisation of tender result data across procurement platforms and across DSOs will help to improve the clarity of service value for providers. Some FSPs we have spoken to noted they don't know where to price services for the DSO market given difficulty in obtaining information.

Additionally understanding the decision making behind accepted and rejected results will support provider confidence in the market. This could be an approach similar to reason codes provided as part of ESO procurement.

Improvements to the above will support providers and aggregators to decide when and how to develop a commercial push.

3.4. Access

FSPs have noted access to balancing services could be improved. An example of this would include better alignment of Application Programming Interfaces (APIs) across DNOs and the ESO services such that an FSP needs to interface with as few APIs as possible. This becomes increasingly relevant going forwards, as APIs are especially important for small assets to interface and engage.

Alignment of rules and terminology will support FSPs in joining services as it reduces the timeframe between interest and engagement, as well as expense engaging legal input. We note progress has been made in

development of a standard agreement, which has now reached *version 2.1* that we understand the DNOs and ESO will use for their Autumn 2023 tenders. Baselining could also be more consistent across services for providers to help understand the assumed default position prior to flexible dispatch.

FSPs have also noted that T&Cs can be onerous, particularly in instances of varying insurance or liability clauses which make them less attractive to FSPs and aggregators. Complex and costly administration can make it difficult to estimate the opportunity cost for participating in services, and FSPs noted that this is one area where longer-term procurement can help understanding. However, generally FSPs are in favour of short-term procurement and shorter delivery windows to support stacking.

3.5. Penalties

Penalties for non-delivery of a service will influence how attractive they are to FSPs. DSO services offered by NGED currently have no penalties beyond the lost revenue of providing the service, which is supportive for stacking the service alongside other ESO services. However contractual terms that expose FSPs to significant financial risk in the event of an issue or non-delivery will also influence how an FSP perceives them. This should be balanced against value for money and the reliability of the service.

3.6. Flexible services – stacking and summaries

Stacking across services is essential to support their adoption in a marketplace crowded by a range of different ESO and DSO products. FSPs have highlighted that this is crucial to the business case for investing time in understanding the service. An attractive service would have alignment of delivery windows allowing assets to jump between them at will. This means, if a product experiences a decline in value, FSPs can routinely transition into and out of services.

4. Conclusion

This section briefly concludes the main points of the report.

4.1. Progress against the previous report

As noted in the executive summary, many of the recommendations from the *previous report* remain relevant today. They can be summarised as:

- Flexible asset providers remain able to move between revenue streams in different time periods much more readily than they are able to stack multiple revenue streams in the same time period. NG ESO's new Enduring Auction Capability (EAC) is supporting the optimal assignment of assets MW into reserve and response services (optimally splitting from a least cost perspective of the ESO), which will support in improving access and optionality for FSPs
- Contract terms or regulatory arrangements continue to cause an unnecessary barrier to revenue stacking in instances. The Capacity Market rules include a series of services which an asset may provide without risk of penalty under the Capacity Market, but this does not include a number of available balancing services which have been recently introduced by the ESO or services procured by DNOs
- There remain opportunities for greater coordination across services being procured by the ESO and DNOs and the timescales for procurement and dispatch – e.g. using day ahead procurement over EFA block periods. Participants have also highlighted that the ESO and DNOs could work together to standardise contracts further. Progress has been made in development of a standard agreement, which has now reached version 2.1 that we understand the DNOs and ESO will use for their Autumn 2023 tenders
- However, DNOs and the ESO have made progress on co-ordination and a hierarchy of services through the primacy workstream. Due to the relatively limited number of technically suitable assets in a suitable location to provide DNO services, DNO services tend to have primacy over a range of ESO services where there is a conflict. This has now been formalised for voltage management, thermal constraint and system inertia instructions in the BM and the ESO's Transmission Constraint Management service procurement for all DNO products except Restore
- Generally, newer services and procurement rounds are learning lessons from previous generations and generally improving in terms of access and ability to jump between services, DSO services being a good example. However, there are examples where this is not the case, (DFS, MW Dispatch) and this could be improved

4.2. Other key findings

Access to the relevant supporting information is important for FSPs in determining their trading strategies. Fundamentally, at present:

- The ease of access to information on stacking is low
- Interactions can be unclear and open to interpretation
- There may be misunderstanding in how services can be stacked
- Services could be clearer on the eligibility of assets with non-firm connections. Currently asset owners can take a view of when they face the greatest risk

of curtailment based on local conditions, experience, and information provided by the DNO and plan entry into services accordingly. Estimated levels of curtailment, and curtailment limits as set out in the *Access Significant Code Review* final decision, should support this

- Alignment of availability or utilisation windows will support FSPs in participating in a wide range of markets
- Rules and compatibility vary between ESO and DSO services
- ESO services and procurement platforms are evolving, and the interaction with DSO services should be an explicit consideration in its development
- Existing services for very small scale assets can have high levels of exclusivity; is this a suitable approach for the future?
- Improved data access to value opportunities, as well as providing feedback on the reasons behind decision making, is essential in providing awareness of the opportunity available
- Alignment of contractual terms and standardisation of both interfaces and terms would support FSP participation in markets. This includes improved alignment of Application Programming Interfaces (APIs) and T&Cs. On the latter point we note progress has been made in development of a standard agreement, which has now reached version 2.1 that we understand the DNOs and ESO will use for their Autumn 2023 tenders. Baselining could also be more consistent across services for providers to help understand the assumed default position prior to flexible dispatch

4.3. Final thoughts

It is clear that the ESO and DNOs have made a concerted effort to improve and integrate their services as they have evolved. When compared to the 2020 report, this includes:

- Making progress on aligning contract terms
- Shorter procurement timescales for DSO services
- Establishing primacy for services that could interact in a manner that is mutually deleterious or negates the service provision
- Improved communication between the ESO and DSOs on interacting services and availability of FSPs for alternative services
- Establishing jointly delivered services, such as MW Dispatch

While some of these changes have yet to be implemented into live services, the network companies have developed the changes in an open manner via the Open Networks program, allowing participants to contribute changes. However, having completed a bottom-up and top-down assessment of the service terms, their interaction, and consulting a limited number of market actors, it is clear that there remains a great deal of potential to improve the stacking of the services, as well as transparency in both how they interact and procurement information for newer services.

5. Appendix 1 | Services available in GB

5.1. Service summaries

The following sections explore stacking in more detail. They summarise each of the revenue sources available for flexible assets, specific caveats around their availability, and highlight their interaction with other revenue streams.

The revenue streams explored are all available to DERs and include:

- Wholesale power
- Balancing Mechanism
- Net Imbalance Volume (NIV) chasing
- Capacity Market
- Short Term Operating Reserve
- Firm Frequency Response
- Enhanced Reactive Power Service
- DSO services
- Local Constraint Market
- MW Dispatch Service
- Demand Flexibility Service
- Slow Reserve
- Quick Reserve
- Balancing Reserve
- Electricity Restoration Services
- Dynamic Containment
- Dynamic Moderation
- Dynamic Regulation

Appendix 2 | *Glossary* provides explanation of a number of acronyms found in the report

Appendix 3 | *New services in development in the GB market* outlines those services being developed

Appendix 4 | *Service update: Enduring Auction Capability* summarises the evolving Enduring Auction Capability (EAC) for procurement of ESO response and reserve services

Appendix 5 | *Services no longer available in GB* summarises those services noted in the previous report but no longer available to FSPs

Appendix 6 | *Balancing services exclusive to transmission assets* provides a brief summary of flexibility services available to transmission connected assets only

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6. Wholesale

Summary

Response time: N/A

Duration: Duration of contract, down to half hourly level

Service windows: N/A

Payment type: £/MWh for contract duration

Stacking: High – limited explicit rules preventing stacking, but operational and imbalance considerations are important

Other FSP considerations

- Final Physical Notifications versus Contracted position important
- Interaction with imbalance exposure and consideration of ABSVD required in determining stacking

Under the British Electricity Transmission and Trading Arrangements (BETTA), wholesale contracts for electricity are agreed in forward and futures markets, between several years and 24 hours ahead of a given half hour delivery period. Short-term power exchanges and energy brokers also give participants the opportunity to fine-tune their contract positions within 24 hours before delivery, and through to the intra-day market. All such deals are bilateral and are settled at the price registered on the power exchange, or agreed bilaterally or through a broker.

The wholesale electricity price typically represents the main revenue stream for generators for their electricity production, and investors decide to invest based primarily on their expectation of recovering the costs of this investment through selling electricity in the wholesale electricity market. However, other revenue streams might be available in the market depending on the asset type and eligibility. There are no formal or informal rules that limit a generator's ability to freely price its offers in the wholesale market.

Pricing is based on a marginal pricing mechanism – the last plant to meet demand on the system sets the wholesale price. This is typically a gas fired generator in GB, but may vary every half hourly settlement period. This is how the auction platforms/ exchanges work, while forward markets through OTC brokers are generally priced to the expected marginal plant.

Prices can vary significantly depending on underlying supply and demand fundamentals, and global commodity prices. The wholesale market will typically represent a significant proportion of the value stack for an FSP, while many flexibility services see their prices follow the wholesale power market due to the opportunity cost of not receiving wholesale prices. Since 2020, annual average day-ahead prices have ranged between £37/MWh and £216/MWh, while average daily hourly prices have ranged from –£10/MWh to £597/MWh.

There is no official Baseline in wholesale markets; however, assets are liable for imbalance on deviations between contracted and actual metered positions. The baseline regarding wholesale trading is therefore essentially a party's contracted position.

6.1. Requirements/ eligibility

Generators and consumers require 'market access' to trade in wholesale markets, determined by what party type(s) they fall under within the Balancing and Settlement Code (BSC), where a party will typically need to be registered as a form of Trading Party. This enables parties to submit and notify energy contracts to Elexon, the BSC company. Trading Parties are also responsible for paying imbalance (i.e. difference between contracted and physical/ metered position (but adjusted for Applicable Balancing Services Volume Data (ABSVD), discussed later)).

Large generators that are licenced market participants tend to access the wholesale market directly ('Trading Party – Generator'), trading the electricity from their asset(s) themselves. Licensed electricity suppliers are also signatories to the BSC as a 'Trading Party – Supplier' and have wholesale market access.

Smaller assets that are unlicenced tend to access wholesale markets via a third party's trading desk, with service providers taking some benefit and some risk for the provision of such a service. These arrangements include Power Purchase Agreements (PPAs). Some large licensed generators may also opt for this route to market.

6.2. Opportunities and risks for FSPs

The main risk regarding wholesale trading is falling into imbalance (explained below). If a trading party delivers or consumes a different amount of electricity than was contracted for, it will generally need to pay imbalance prices for the difference. However, its imbalance position may be adjusted for Applicable Balancing Services Volume Data, where it will not be exposed to imbalance pricing if the difference between its metered profile and contracted position is due to providing an Applicable Balancing Service.

6.3. Stacking with other revenue streams

While there are no explicit rules in trading arrangements preventing assets from making wholesale market trades whilst participating in other Balancing Services, there may be commercial reasons or operational requirements from other services which prevent assets from stacking wholesale revenues with other revenues, while impact on imbalance pricing exposure needs to be considered.

Providing other services may impact on your ability to deliver on your wholesale contracted position (and vice versa) and make an asset subject to imbalance – if the Balancing Service is subject to ABSVD then this should be corrected for; however, careful consideration needs to be given to the interaction between making trades and also delivering a Balancing Service even if subject to ABSVD.

Wholesale trades for the same MW in the same time period (i.e. co-deliverable) as utilisation for a balancing service are more likely to result in potential imbalance and generally deemed not acceptable under the terms of most Balancing Services. Making wholesale trades for different MW in same time period (i.e. splitting) is more likely to be stackable, depending on the requirements of any other services, while revenue jumping with wholesale is almost always viable.

Operational and performance baselining for Balancing Services will also be an important consideration, and may need to align with a party's contracted position in the market.

Imbalance pricing

Generators are generally expected to deliver their contracted volume of electricity and suppliers are expected to use their contracted volume of electricity. However, there are no rules to say they must do this, but should they produce/ consume electricity differently to their contracted position, they will be subject to imbalance pricing arrangements.

A party's imbalance position is simply its metered volumes compared to contracted volumes. An adjustment is made for any accepted Bids and Offers or delivery of Applicable Balancing Services.

Applicable Balancing Services Volume Data

ABSVD quantifies the volumes of energy associated with providing **Applicable Balancing services.** This way, imbalance charges associated with providing an Applicable Balancing Service are removed for service providers. ABSVD and the associated Applicable Balancing Services have an important impact on FSPs, as if FSPs provide a service the ABSVD process ensures they are not charged imbalance costs for their actions. If a Balancing Service is not listed as an Applicable Balancing Service, it may disincentivise participation in such a service.

Figure 5: Stacking summary for wholesale market

Revenue stream/ Service	Stacking
Balancing Mechanism	Splitable and jumpable. Cannot co-deliver same MW in same direction, but utilisation in opposite direction possible
NIV Chasing	Splitable and jumpable, not co-deliverable
Capacity Market	Co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Jumpable, but implicitly not splitable due to STOR baselining requirement (PN <0 required). Not co-deliverable
Firm Frequency Response	Splitable with operational considerations, and jumpable. Not co-deliverable
Enhanced Reactive Power	Co-delivering active and reactive power not applicable. Splitable and jumpable
DSO services	Co-deliverable as assets may need to trade wholesale to deliver DSO service to avoid imbalance. Implicitly not splitable but depends on baselining & performance monitoring requirements. Jumpable
Local Constraint Markets	Not co-deliverable but utilisation in opposite direction possible. Implicitly splitable but service terms unclear. Jumpable
MW Dispatch Service	Not co-deliverable but utilisation in opposite direction possible. Jumpable. Splitting is not applicable as all or nothing
ESO Demand Flexibility Service	Not co-deliverable. Not splitable as baselining requirement for DFS and ABSVD makes short-term wholesale trading for profit unviable. Jumpable
Slow Reserve	Not co-deliverable but utilisation in opposite direction possible. Splitable and jumpable, based on design to date
Quick Reserve	
Balancing Reserve	Not co-deliverable but utilisation in opposite direction possible. Splitable and jumpable, based on design to date
Electricity Restoration Services	Co-deliverable (i.e. replaceable) and jumpable. Splitable is not applicable
Dynamic Containment	Not co-deliverable but replaceable. Splitable and jumpable
Dynamic Moderation	
Dynamic Regulation	

7. Balancing Mechanism

Summary

Response time: Variable, as submitted in dynamic data
Duration: Variable depending on instruction and dynamic data
Service windows: Bid & offers provided half-hourly
Payment type: £/MWh for duration of instruction
Stacking: Medium – cannot stack capacity reserved for BM
Other FSP considerations

- Dynamic data considerations
- Cannot deviate from Final Physical Notifications unless instructed
- Many Balancing Services dispatched through the BM

The Balancing Mechanism (BM) is National Grid's primary short-term (intra-day) tool in its role as Electricity System Operator (ESO) to match power generation and consumption.

After gate closure for each 30-minute settlement period, the ESO will review the state of the market and whether enough power will be delivered to meet demand. It will then give instructions to generators to turn up or down, to manage both overall system balance, and to make sure that system constraints are not breached. Under the provisions of the BM, such actions should be secured by the ESO in the most economically efficient way possible, by dispatching the cheapest plant first, but taking into account a wide range of other considerations such as location and plant dynamic characteristics.

Owners of large assets and Balancing Service Providers (BSPs) submit prices and technical data to the ESO for each half hour period. This 'Bid' and 'Offer' data needs to be submitted prior to Gate Closure. In addition, a BMU must submit a Final Physical Notification (FPN). The FPN acts as the baseline for delivery of Bids and Offers. The BM runs for 90 minutes, from Gate Closure until the end of the Settlement Period. Pricing is a pay-as-bid mechanism, where you are paid what you entered into the BM.

Flexibility in the BM is offered on a 30 minute basis; however, the length of time you are called on may vary depending on the precise system needs at the time as well as an asset's dynamic data. An action may therefore be significantly below 30 minutes, or alternatively could require service delivery for multiple Settlement Periods. The BM effectively opens at gate closure and runs to the end of the Settlement Period of delivery – therefore it operates on a rolling 90 minute basis, although the ESO can take actions further ahead of time if it needs to.

Gate closure and bid & offers

Gate Closure occurs 1 hour before the start of a settlement period. Prior to Gate Closure, some Lead Parties of BM Units must submit (and some Lead Parties of BM Units may choose to submit) a Final Physical Notification (FPN) to the NETSO. This is a minute by minute profile of the expected power output or consumption of the relevant generation or demand across each Settlement Period.

Lead Parties of BM Units may choose to participate in the Balancing Mechanism, i.e. provide balancing services actions for a particular Settlement Period. This willingness to operate at a level other than their FPN is demonstrated with the use of Balancing Mechanism Bids and Offers. An Offer refers to participants turning up generation or decreasing demand, while the opposite is true for Bids.

7.1. Requirements/ eligibility

Virtual Lead Parties (VLPs) overview

VLPs have recently been introduced by National Grid ESO alongside other workstreams to help open up the BM to smaller-scale (embedded) generators. Embedded generators have already been able to participate in the BM for some time now, but have had to go through the Supplier Volume Allocation (SVA) route. A VLP is a new type of BSC Party that can register 'secondary BMUs' which can trade volumes in the BM without needing to be a licensed electricity supplier or licensed generator. In simple terms, the VLP is more of an 'aggregator' and the secondary BMU more like a 'virtual power plant'. A VLP is a BSC term but there are similar concepts in capacity and ancillary services markets.

All 'Large' and 'Medium' generators (approximately >50MW in England and Wales, 30MW in South Scotland and 10MW in North Scotland), alongside any 'Small' generators connected to the NETS (with respective sizes classified under the Grid Code and varying by location) are required to participate in the BM, but smaller market participants down to a minimum of 1MW may enter voluntarily. Assets may also be aggregated to meet the minimum size threshold for participation, provided they are in the same Grid Supply Point (GSP) region. Larger assets are registered via Central Volume Allocation (CVA), the system historically used for larger assets, whereas assets accessing via a Supplier BMU will be registered in the Supplier Volume Allocation (SVA) system.

To participate in the BM, FSPs also need to be part of an eligible BMU (registered with National Grid by submitting BSCP15) with the required status to inform the National Electricity Transmission System Operator (NETSO) of participation, and also be registered with a BSC Trading Party. There are a number of systems required before a unit can become active in the BM to ensure they have the ability to communicate with the Electricity National Control Centre (ENCC). BM participants require EDT/EDL comms or wider access API for VLPs enabling ESO to dispatch. In addition to communication systems and operational metering, providers also need to submit certain data sets for reporting purposes.

The BM is technology neutral and is therefore open to any technology types that are able to participate but success will vary depending on asset-specific characteristics. National Grid ESO has been reforming entry requirements to increase participation in the BM, particularly enabling smaller-scale assets to enter through its Wider Access workstreams, such as enabling SVA assets to participate while introducing a new type of participant, Virtual Lead Parties. However, the BM has numerous delivery requirements and is one of the more onerous flexibility revenue streams to gain access to.

Access to the BM, for smaller market participants that are not licensed or CVA registered, will generally require access via a third party that is both licenced (and therefore a signatory to the BSC), and has the necessary communications systems to interact with the ESO.

Although the BM is mandatory for certain market participants, and while those voluntarily participating must continuously submit bids and offers, the dynamic data submitted alongside the bids and offers can indicate to National Grid that an asset is unavailable. This could be due to providing another Balancing Service or operating in the wholesale market.

Baselining is against the Final Physical Notification provided at Gate Closure; this will usually match a providers wholesale contracted position but is not a requirement. No firm connection is required as your availability to the ESO should be submitted via your dynamic data.

7.2. Opportunities and risks for FSPs

Risks from participating in the BM include withholding capacity from the wholesale market or other Balancing Services, providing a bid or offer into the BM and subsequently not being called on, with generally the lowest cost stack used by the ESO.

There is also a risk that if you can't deliver, then you will be subject to a non-deliver penalty. Non-delivery of BOAs is dealt with as part of parties' BSC Trading Charges (via the Daily Party Non-Delivery Charge), and will not affect the imbalance position of the Balancing Responsible Party that bought volumes on the wholesale market. A non-delivery payment mechanism ensures a party is never better off having not delivered in the BM.

Further, there is the risk that profile is delivered different to what was instructed.

7.3. Stacking with other revenue streams

The BM is compatible with many other markets and services, however, there may be restrictive eligibility requirements and the BM is generally an onerous market in which to participate so may present operational challenges.

The BM is generally stackable with the wholesale market, subject to imbalance pricing arrangements and provided it's not for the same MW in the same direction. It is fully compatible with the Capacity Market. From a co-delivery perspective (i.e. stacking same MW), it is generally not compatible with most other balancing services – for capacity reserved for the BM, assets would not be able to participate in most other revenue streams.

Revenue jumping from or to the BM is compatible with the majority of other revenue streams, the exception being NIV chasing (discussed later) as BM participants are required to submit FPNs at gate closure which will limit an assets ability to respond to short-term price signals to capture high imbalance prices. Furthermore, the pre-requisite to be part of a BMU; the need to submit FPNs; and comply with the Grid Code can present limitations to participating in some other services which require an asset to not be BM participating.

It should also be noted that many balancing services are dispatched via the BM, however, we acknowledge that this would not constitute co-delivery.

For DNO Flexibility Services, there is no regulatory barrier to BM participation but there is a risk of penalty for non-delivery if an FSP is dispatched under both in the same time period. Unlike the CM, this is relatively likely to occur (unlike the CM, BOAs are issued in every Settlement Period), so we consider the two to be not stackable in the same time period. If a single FSP were to participate in both DNO Flexibility Services and the BM, it is not clear which party (DNO or the ESO) has the final "veto" on which service is provided if the FSP were dispatched by both. There is no restriction on participation in other services in other time periods.

Figure 6: Balancing Mechanism Overview

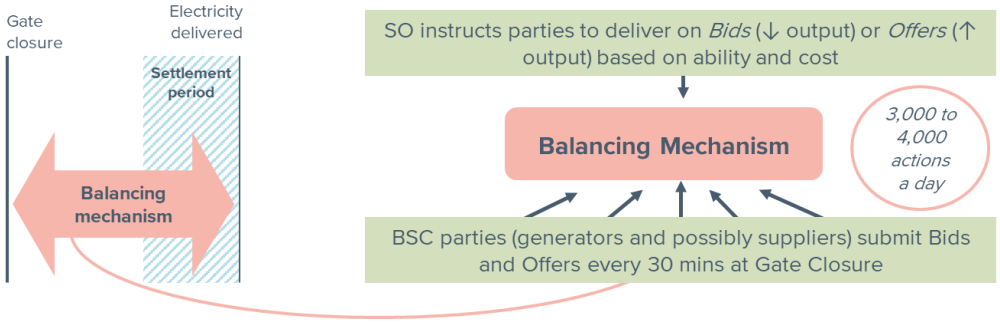


Figure 7: Stacking summary for the Balancing Mechanism

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable but utilisation possible in opposite direction. Splitable and jumpable
Balancing Mechanism	N/A
NIV Chasing	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BM participation and submit PNs makes NIV chasing unviable
Capacity Market	Co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Not co-deliverable (noting dispatch for BMUs is via BM). Not splitable due to (sub) zero STOR baselining requirements. Jumpable
Firm Frequency Response	Not co-deliverable. Splitable and jumpable.
Enhanced Reactive Power	Co-deliverable is not applicable. Splitable and jumpable
DSO services	Not co-deliverable. Not splitable as responding to real time signals would be against Grid Code, while scheduled services would still have operational implication to deliver. Jumpable
Local Constraint Markets	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BM participation and submit PNs makes LCM, MW Dispatch and DFS unviable
MW Dispatch Service	
ESO Demand Flexibility Service	
Slow Reserve	Not co-deliverable based on service design to date. Deemed splitable and jumpable based on service design to date and similar services
Quick Reserve	
Balancing Reserve	Not co-deliverable (but noting dispatch is through the BM). Deemed splitable and jumpable based on service design to date and similar services
Electricity Restoration Services	Co-deliverable (i.e. as replacement dispatch), and jumpable. Splitting not applicable
Dynamic Containment	Not co-deliverable. Splitable and jumpable
Dynamic Moderation	
Dynamic Regulation	

8. NIV chasing

Summary

Response time: N/A

Duration: Imbalance position aligned with half-hourly settlement periods

Service windows: N/A – imbalance position aligned with settlement periods

Payment type: £/MWh imbalance price

Stacking: Low – cannot deliver BM at same time, and impacts provision of balancing services (particularly baselining)

Other FSP considerations

- High level of uncertainty in NIV chasing revenues, will likely negatively impact ability to deliver Balancing Services as NIV is not an official service subject to ABSVD or adjustment baselining

Net Imbalance Volume (NIV) Chasing involves capitalising on high imbalance prices by deliberately taking the opposite imbalance position to system imbalance (the NIV) for which the cash-out price is paid. It is typically used to describe capacity that can respond to imbalance price signals in real time.

In theory, any BM Participant can have an intentional long position (by generating more or consuming less than they have traded in the ex-ante markets) and be paid the imbalance price for that imbalance. However, participants with BMUs (i.e. typically larger assets) must submit data to the ESO before Gate Closure (one hour before the start of the Settlement Period) including an FPN. This means that it cannot adjust its position after this point, so must base its decision to take a long imbalance position entirely on a pre-Settlement Period assumption on the imbalance price.

Conversely, flexible capacity which does not have to submit an FPN (i.e. is not a Balancing Responsible Party and is included within a supplier BMU for which an FPN is submitted) can decide whether to take an imbalance position during a Settlement Period. For example, if it observes the ESO accepting high Offers in the BM, indicating that the system is short and the cash-out price will be high, it can dispatch and, all else being equal, push the position of its BRP long. The BRP in question will then be paid the cash-out price for its long position, with the benefit typically shared with the FSP under the terms of its PPA.

8.1. Requirements/eligibility

Unlike other services considered, NIV Chasing is not a procured service; rather it involves assets self-dispatching in real time in response to forecasts of market signals. Typically speaking, you cannot chase real-time imbalance price signals if you are a BMU and required to submit FPNs at gate closure.

8.2. Opportunities and risks for FSPs

NIV Chasing is a high-risk revenue stream requiring accurate prediction of the system imbalance position and price. Inaccurate prediction of the overall system imbalance could result in an FSP pushing its BRP's imbalance position in the same direction as the system imbalance, with associated exposure to charges calculated based on the cash-out price.

As the price is known after delivery, there is also the risk that FSPs earn lower revenues compared with trading in the wholesale market ahead of time if they dispatch and the imbalance price is low.

NIV chasing is also not an official service, and the ESO has limited visibility of what assets which NIV chase are doing on the system. The ESO has hinted at requiring smaller scale assets submit Physical Notifications in the future which could impact the ability to NIV chase; however, this remains unclear.

8.3. Stacking with other revenue streams

Although not a procured service, NIV Chasing is exclusive from almost all other revenue streams except the Capacity Market.

You cannot participate in the BM and have NIV chasing in your trading strategy. The BM requires an FPN and Bids and Offers to deviate from that FPN; to actively NIV chase the provider needs the flexibility to change output in response to its expectation of the imbalance price in real time. Smaller assets that voluntarily participate in the BM could opt out; however, we understand it can take several weeks to leave the BM.

Generally assets cannot provide other balancing services or DNO Flexibility Services as this would result in losing the flexibility to self-dispatch, and may also impact on the baselines against which service delivery is assessed.

While participation in other services (e.g. DNO Flexibility Services) could result in the imbalance price being paid for volumes dispatched, we do not consider this "active" NIV chasing; rather it is simply a knock-on impact of providing another service – so they are not fully co-deliverable or stackable.

Figure 8: Stacking summary for NIV chasing

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable. Splitable and jumpable
Balancing Mechanism	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BM participation and submit PNs makes NIV chasing unviable
NIV Chasing	N/A
Capacity Market	Co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Not co-deliverable. Implicitly not splitable based on STOR baselining requirement but not confirmed by ESO. Jumpable for non-BMUs only
Firm Frequency Response	Not co-deliverable. Implicitly splitable but operational considerations. Jumpable
Enhanced Reactive Power	Co-delivery is not applicable. Implicitly splitable and jumpable
DSO services	Implicitly co-deliverable as delivery of DSO service could result in imbalance but is not active NIV chasing. Implicitly not splitable as could impact on DSO performance monitoring or impede ability to deliver service. Jumpable
MW Dispatch Service	Not co-deliverable. Splitting is not applicable as required to turn down to zero. Jumpable
Local Constraint Markets	Not co-deliverable. Implicitly not splitable as baseline requirement (although unclear in service terms) make real-time NIV chasing unviable. Jumpable
ESO Demand Flexibility Service	Not co-deliverable. Implicitly not splitable as baselining requirement and deviations subject to ABSVD making NIV chasing unviable. Jumpable
Slow Reserve	Not co-deliverable. Implicitly not splitable due to baselining requirement. Jumpable for non-BMUs
Quick Reserve	
Balancing Reserve	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BR participation and submit PNs makes NIV Chasing unviable
Electricity Restoration Services	Co-deliverable and jumpable. Splitting is not applicable
Dynamic Containment	Not co-deliverable. Implicitly not splitable due to baselining requirement of response services. Jumpable for non-BM assets only
Dynamic Moderation	
Dynamic Regulation	

9. Capacity Market

Summary

Response time: 4 hours' notice

Duration: Duration of event or technology

Service windows: N/A – system stress event

Payment type: £/kW/year for contract duration

Stacking: Very high – explicitly with a range of ESO services, implicitly with others as chance of a CM event is very low

Other FSP considerations

- Not explicitly stackable with DSO services or a number of Grid services
- Extended performance testing for BESS can be a challenge if not accounted for in application

The Capacity Market (CM) was introduced in 2014 as part of the wider Electricity Market Reform (EMR) package, with the goal of supporting investment in new dispatchable generation capacity. There were concerns that the rapid growth in intermittent renewable generation and the closure of ageing thermal capacity could have resulted in security of supply issues.

CM auctions are held annually, procuring capacity four years in advance (T-4) and one year in advance (T-1). A competitive bidding process sets clearing prices via a "descending clock" auction mechanism, with contracts typically available for between one year (for existing assets) and up to 15 years (for new build assets).

9.1. Requirements/ eligibility

The CM is accessible to all assets which can provide additional generation or turn down consumption, and which are not in receipt of other subsidy revenues. CM payments can also be stacked with all other relevant Balancing Services.

Assets aggregated or provided under the service by FSPs need to be able to respond within four hours and for the duration of a system stress event (subject to the kind of assets making up a CMU and their derating). There is a minimum size threshold of 1MW of aggregated units to enter the CM.

There is a DSR test process that must be undertaken for Unproven DSR Capacity Market Units (CMUs). CMUs must also demonstrate three Satisfactory Performance Days (SPDs) for each year under their agreement. Storage CMUs must meet an Extended Performance text every three years which requires them to deliver their derated capacity for their duration.

While the ESO has responded to bilateral communications that existing CMUs require firm connections, the registered connection capacity doesn't have caveats around non-firm connection. The CM may be available to assets with non-firm connections, although curtailment at a relevant system stress event (perhaps unlikely) could expose an FSP to non-delivery penalties. The FSP may be able to trade out of this position on the secondary market.

9.2. Opportunities and risks for FSPs

- Broadly stackable across majority of flexibility services
- Annual auctions offer fixed payments across one or multiple years
- Four hours' notice of system stress event, No actual events to date
- Need to check stacked services are "Relevant Balancing Services"
- Extended Performance testing for storage assets, as week as SPDs, or run risk of contract termination and fee

9.3. Stacking with other revenue streams

The service is broadly stackable with ESO flexibility services. Participants' obligations are reduced in line with any requirements to deliver flexibility

under a defined list of *Relevant Balancing Services* (RBS). However, these defined services are presently all ESO services and simultaneous provision of DSO services where the FSP was not exporting at its derated capacity would incur penalties.

The design of the CM means it is generally possible to stack it with the majority of other relevant revenue streams, although there may be some non-delivery challenges in certain situations. The CM rules state that participants' obligations are reduced in line with any obligations it has related to "Relevant Balancing Services" (RBS), which is a defined list. This list is regularly reviewed to reflect the launch of new services, although there may be a lag-time between their launch and them being included in the list.

Note that while the CM is stackable with DSO service revenues, the provider could be exposed to CM penalties payments for under-delivery if called upon for two services at once.

There is no obligation not to provide other services under the CM but providing a service that is not covered by Relevant Balancing Services could expose a CM provider to penalties should a CM Stress Event occur.

However, CM Stress Events are likely to be limited. Assets owners will typically consider the risk of participating in other services which may mean they fail to deliver a CM obligation to be an acceptable risk. This includes DNO Flexibility Services.

Splitting and jumping is not applicable for all services alongside the CM.

Figure 9: Stacking summary for Capacity Market

Revenue stream/ Service	Stacking
Wholesale	Co-deliverable, splitting and jumping not applicable
Balancing Mechanism	Co-deliverable, splitting and jumping not applicable
NIV Chasing	Co-deliverable, splitting and jumping not applicable
Short Term Operating Reserve	Co-deliverable – listed as an RBS. Splitting and jumping not applicable
Firm Frequency Response	Co-deliverable - listed as an RBS. Splitting and jumping not applicable
Enhanced Reactive Power Service	Co-deliverable although may be operational issues. Splitting and jumping not applicable
DSO services	May be considered co-deliverable although may be operational issues. Splitting and jumping not applicable
Local Constraint Market	Co-deliverable – listed as an RBS. Splitting and jumping not applicable
MW Dispatch Service	Potential to co-deliver although may be operational issues if constraint occurs during stress event
Demand Flexibility Service	Not stackable at all – asset cannot have a CM agreement and participate in DFS
Slow Reserve	Co-deliverable although may be operational issues, depending on final design and RBS
Quick Reserve	Co-deliverable although may be operational issues, depending on final design and RBS
Balancing Reserve	Co-deliverable - listed as an RBS
Electricity Restoration Services	Co-deliverable - need to be able to deliver ERS. Splitting and jumping not applicable
Dynamic Containment	Co-deliverable - listed as an RBS. Splitting and jumping not applicable
Dynamic Moderation	
Dynamic Regulation	

10. Short Term Operating Reserve

Summary

Response time: 20 minutes

Duration: Minimum of two hours

Service windows:

- Committed windows – change each STOR season to reflect time and length of peak demand periods
- Optional windows – outside of committed windows

Payment type: Availability (£/MW/hr) & utilisation (£/MWh)

Stacking: Low, committed STOR impacted by zero baseline

Other FSP considerations

- Stacking ability varies between STOR type provided

Short Term Operating Reserve (STOR) is used by the ESO to procure enough positive reserve to cover the largest loss on the system and effectively retains generators on standby to potentially provide low frequency response over key periods of the day. It is split into two key services: Committed and Optional STOR; Committed STOR is available for BM and non-BM units, while Optional STOR is available for non-BM providers only.

Both Committed and Optional STOR are procured through day-ahead, pay-as-clear auctions. Contract lengths for both services are day-long periods. Committed STOR requires the provider to be available during the 'firm' or 'committed' availability windows over the morning and evening demand peaks, while Optional STOR is for use in periods outside of the committed windows, decided at the ESO's discretion. The year is broken up into six STOR seasons, where the committed windows change in-line with morning and evening peak demand patterns.

The ESO's procurement volume varies with the single largest in-feed loss on the system – currently 1,600MW – however the ESO additionally holds pre-existing long-term STOR contracts of ~400MW which it retains until 2025. As a result, current daily volume requirements are ~1,300MW, however this will change as the pre-existing contracts expire, and the size of the largest in-feed loss changes. The majority of STOR volumes procured by the ESO are done through the committed service, with the optional service recently being tendered less often. At the time of writing in September 2023, the optional service has not been utilised by the ESO since February 2023.

For the committed service, payments are made through availability of the service provider (£/MW/hr) and, if called on, through utilisation payments (£/MWh). The optional service does not provide an availability payment, only a utilisation payment (£/MWh).

10.1. Requirements

To provide STOR, units must be able to provide at least 3MW of low frequency response (generation or demand reduction). Assets must be capable of responding to an instruction within 20 minutes and sustain this response for a minimum of 2 hours, while having a recovery period of less than 20 hours (1200 minutes). Additionally, the provider will need the correct systems in place for dispatch. For BM providers, this will be done through the Balancing Mechanism, but for non-BM providers, instructions and metering data will be provided through the Platform for Ancillary Services (PAS).

For Committed STOR, service providers must have a baseline of ≤0MW at the beginning of each committed window and be available to deliver their contracted volume during all contracted availability windows. Additionally, committed providers must confirm the technical parameters of the asset at least 90mins prior to the beginning of each committed window.

Optional STOR has no explicit baseline requirements like its committed counterpart. Providers of the optional service must submit their availability by no later than midnight prior to the beginning of the STOR service day. The MW capacity submitted by the asset must be the same for each optional window, however the associated £/MWh prices can vary between optional windows. Prices may be updated up to 90mins prior to the beginning of the optional window.

10.2. Opportunities and risks for FSPs

- The day-long contract with availability payment provides revenue certainty for the day
- Potentially stackable throughout most of the day – providers will need to check that stacking outside of committed windows will not impact their ability to provide STOR
- Risk of lower, or no, availability payments if the provider defaults during any availability period

10.3. Stacking with other revenue streams

Providers are required to be available to provide their contracted volume during both committed windows. As such, stacking is generally not available with other services during the committed windows. Outside of the committed windows, other services can be provided, so long as the provision of these other services does not affect the ability of the asset to be available for and provide their contracted STOR volumes. STOR is listed as a Relevant Balancing Service, so can be stacked with the Capacity Market.

Figure 10: Stacking summary for STOR (we split Committed and Optional STOR where possible)

Revenue stream/ Service	Stacking
Wholesale	Committed – Jumpable only Optional – Implicitly splitable and jumpable
Balancing Mechanism	Committed – Jumpable, splitting possible with bids and offers still allowed Optional – Implicitly splitable and jumpable
NIV Chasing	Jumpable only
Capacity Market	Co-deliverable. Splitting, and jumping not applicable
Short Term Operating Reserve	N/A
Firm Frequency Response	Committed – Jumpable only, not splitable or codeliverable
	Optional – Jumpable and implicitly splitable but operationally challenging or unviable
Enhanced Reactive Power Service	Committed – explicitly splitable and jumpable, but not co-deliverable Optional – implicitly splitable and jumpable
DSO services	Committed – Jumpable only Optional – Jumpable and implicitly splitable
Local Constraint Market	Committed – implicitly jumpable only Optional – implicitly jumpable only
MW Dispatch Service	Committed – implicitly jumpable only Optional – implicitly jumpable only
Demand Flexibility Service	No stacking capabilities
Slow Reserve	Committed – Jumpable only Optional – Jumpable only
Quick Reserve	Committed – Jumpable only Optional – Jumpable only
Balancing Reserve	Committed – implicitly not splitable, Jumpable only Optional – Jumpable only
Electricity Restoration Services	Committed – Replacement for co-deliverablilty, jumpable Optional – Replacement for co-deliverability, jumpable
Dynamic Containment	Committed – Jumpable only Optional – Jumpable only
Dynamic Moderation	Committed – Jumpable only Optional – Jumpable only
Dynamic Regulation	Committed – Jumpable only Optional – Jumpable only

11. Firm Frequency Response

Summary

Response time: 30 seconds (SFFR), 10-30s (depending on DFFR type)

Duration: Up to 30 minutes (SFFR), 10s-indefinitely (depending on DFFR type)

Service windows: EFA (SFFR), monthly (DFFR)

Payment type: Availability (£/MW/hr)

Stacking: Low to medium

Other FSP considerations

- DFFR ceased procurement in November 2023
- Limited SFFR procurement volume

Firm Frequency Response (FFR) is a service used by the ESO to manage grid frequency in real time. It is split into two individual services, Dynamic FFR (DFFR), where the response provided is proportional to the frequency deviation, and Static FFR (SFFR) where a set amount of low-frequency response is provided when frequency falls below 49.7Hz. DFFR is activated at three different frequency deviations. Primary response is initiated at a 0.2Hz, 0.5Hz, and 0.8Hz deviation, while secondary response and high frequency response are activated at a 0.2Hz and 0.5Hz deviation. For DFFR, the service provider will submit capacity for each product and each frequency deviation.

DFFR is procured through monthly tenders, where successful applicants enter into a month-long agreement, being paid-as-bid for their availability (£/MW/hr). Participants outline which EFA blocks they are willing to provide the service for working and non-working days. DFFR is split further into three categories: Primary, Secondary, and High.

The ESO is aiming to phase out DFFR by the end of 2023, by a phased monthly reduction of procured volume, in favour of faster responding dynamic response services.

SFFR volume is procured in daily auctions at the day-ahead stage. Contract windows are split into six 4hr EFA block periods each day, with prices in each block being settled on a pay-as-clear basis (£/MW/hr) for the service provider's availability. Currently, volume procured is limited to 250MW per EFA block; this may be changed in future but remains uncertain.

It is expected that the ESO will phase out SFFR in the future, in favour of a new static service – Static Recovery – however, there are no clear dates for its implementation.

11.1. Requirements

Across both FFR services, units must exceed a minimum of 1MW of capacity to be eligible. This may be from a single asset or from an aggregated unit.

11.1.1. DFFR requirements

Response requirements for DFFR vary depending on the type of DFFR being provided as follows:

- Primary response – response must be provided within 10 seconds of an event, which can be sustained for a further 20 seconds
- Secondary response – response must be provided within 30 seconds of an event, which can be sustained for a further 30 minutes
- High frequency response – response must be provided within 10 seconds of an event, which can be sustained indefinitely

Additionally, contracted volume in DFFR can vary with frequency deviation. For the different categories, volumes must be defined for the following frequency deviations:

- Primary response – 0.2Hz, 0.5Hz, and 0.8Hz

- Secondary response – 0.2Hz, and 0.5Hz
- High frequency response – 0.2Hz, and 0.5Hz

11.1.2. SFFR requirements

For SFFR, the unit must be able to provide response within 30 seconds of instruction and sustained for up to 30 minutes after the trigger frequency (49.7Hz) was reached.

11.2. Opportunities and risks for FSPs

11.2.1. DFFR

- Contract length provides revenue certainty for month-long periods
- Reducing procurement level increases likelihood market saturation and bid-rejection

11.2.2. SFFR

- Pay-as-clear mechanism allows for accepted providers to earn revenue above their own submitted bid prices
- Pay-as-clear mechanism increases risk of rejection for higher priced bidders
- Limited procurement level of 250MW per EFA block imposes further risk on higher priced bids

11.3. Stacking with other revenue streams

Like other frequency response services, both varieties of FFR are not co-deliverable with most other services during EFA blocks where either type of FFR service is being provided. Some services may be split, however splitting services must not impact the asset's ability to provide either type of FFR during the contracted window. The Capacity Market is the only exception to this, as both FFR services are listed as a Relevant Balancing Service.

Figure 11: Stacking summary for FFR

Revenue stream/ Service	Stacking
Wholesale	Splitable and jumpable
Balancing Mechanism	Splitable and jumpable
NIV Chasing	Implicitly splitable, jumpable
Capacity Market	Co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Can't co-deliver, not splitable, jumpable only
Firm Frequency Response	N/A
Enhanced Reactive Power Service	Splitable and jumpable
DSO services	Implicitly not splitable, jumpable
Local Constraint Market	Implicitly jumpable outside of committed LCM window declarations
MW Dispatch Service	Not co-deliverable, splitting not applicable, implicitly not jumpable depending on contract interpretation
Demand Flexibility Service	No stacking capabilities
Slow Reserve	Jumpable only
Quick Reserve	Jumpable only
Balancing Reserve	Implicitly not splitable. Jumpable
Electricity Restoration Services	Co-deliverable and jumpable
Dynamic Containment	Jumpable only
Dynamic Moderation	Jumpable only
Dynamic Regulation	Jumpable only

12. Enhanced Reactive Power Service

Summary

Response time: Two minutes

Duration: Continuous

Service windows: Agreements run in six-month increments, minimum of 12 months

Payment type: Available capability price (£/MVar/hr) and/ or synchronised capability price (£/MVar/hr) and/or utilisation price (£/MVArh)

Stacking: High, although co-delivery will use active MW for use in other services, so more splitable than fully co-deliverable

Other FSP considerations

- ERPS is not seen as a functioning market and is likely to be removed

The ERPS offers a route for generators to provide reactive power above the minimum requirements under the Grid Code. It also allows generators that are not under the scope of the Obligatory Reactive Power Service (ORPS) to generate or absorb reactive power.

12.1. Requirements

ERPS is a tendered service, with the process running every six months. The technical requirements are the same as for ORPS with providers generally being instructed to reach a target MVAr level within two minutes. Through the tendering process, providers can request an available capability price (£/MVar/hr) and/or a synchronised capability price (£/MVar/hr) and/or a utilisation price (£/MVArh). Providers can also choose the length of agreement in six-month increments, with a minimum period of 12 months.

12.2. Opportunities and risks for FSPs

The ERPS has seen little participation, with CUSC modification *CMP305* being raised in 2018 to remove the service. The ESO noted that no tenders had been submitted in over seven years, and said that the market was not functional. The modification was sent back by Ofgem so it could be considered alongside related modification *CMP304*, and work has been given a low priority due to the ESO's ongoing work on reactive power reform. As the ERPS is effectively not functional, it is not likely that this will be an attractive long-term revenue stream.

12.3. Stacking with other revenue streams

ERPS can be stacked in some form with most other balancing services except DFS, although co-delivery (i.e. for the same MW) is determined as generally not possible.

Figure 12: Stacking summary for Enhanced Reactive Power service

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable due to difference between active and reactive power. Explicitly splitable and explicitly jumpable
Balancing Mechanism	Not co-deliverable due to difference between active and reactive power. Explicitly splitable and explicitly jumpable
NIV Chasing	Not co-deliverable due to difference between active and reactive power. Implicitly splitable, and implicitly jumpable
Capacity Market	Not co-deliverable due to difference between active and reactive power. Splitting and jumping not applicable

Revenue stream/ Service	Stacking
Short Term Operating Reserve	Not co-deliverable due to difference between active and reactive power. Explicitly splitable and explicitly jumpable
Firm Frequency Response	Not co-deliverable due to difference between active and reactive power. Explicitly splitable and explicitly jumpable
DSO services	Not co-deliverable due to difference between active and reactive power. Explicitly splitable and explicitly jumpable
Local Constraint Market	Not co-deliverable due to difference between active and reactive power. Explicitly unsplitable, implicitly jumpable
MW Dispatch Service	Not co-deliverable due to difference between active and reactive power. Splitting not applicable. Implicitly unjumpable
Demand Flexibility Service	Not stackable.
Slow Reserve	Not co-deliverable due to difference between active and reactive power. Explicitly splitable, explicitly jumpable
Quick Reserve	Not co-deliverable due to difference between active and reactive power. Explicitly splitable, and explicitly jumpable
Balancing Reserve	Not co-deliverable due to difference between active and reactive power. Explicitly splitable, and explicitly jumpable
Electricity Restoration Services	Not co-deliverable due to difference between active and reactive power. Splitting not applicable. Explicitly jumpable
Dynamic Containment	Not co-deliverable due to difference between active and reactive power. Explicitly splitable, and explicitly jumpable
Dynamic Moderation	Not co-deliverable due to difference between active and reactive power. Explicitly splitable, and explicitly jumpable
Dynamic Regulation	Not co-deliverable due to difference between active and reactive power. Explicitly splitable, and explicitly jumpable

13. DSO Services

Summary

Response time: 15 minutes' notice of utilisation across all services, utilisation windows fixed within Sustain and Secure

Duration: Minimum requirement of 30 minutes. Duration varies depending on service windows and fault events.

Service windows:

- Sustain: One season long window of requirements. Activation can be rejected
- Secure: Varying requirements depending on need
- Dynamic: Availability windows published in advance
- Restore: Availability windows published in advance

Payment type:

- Sustain: Utilisation payment only
- Secure: Availability payment and utilisation payment
- Dynamic: Availability payment and utilisation payment
- Restore: Utilisation payment only, fixed price

Stacking: Medium – no exclusivity required, no non-delivery penalties, and windowed delivery supportive for some services. Optionality of Sustain delivery provides choice. But poor interface with CM and some ESO services. Transparency impacting perception by FSPs.

Other FSP considerations

- No exclusivity clauses on DSO contracts, meaning assets can participate in other services. However regular unavailability declarations impact terms and may lead to challenges.

DSO services are a combination of highly location-specific services to support in managing the local distribution network. While a wide number of ESO services can be delivered from across GB, DSO service regions may have a radius ranging from 1 to ~20 miles, depending on the characteristics of the local network and the DSO's requirements.

In 2020 the Open Networks Project Active Power Products group defined the standard definitions and parameters for the four active power products currently procured by UK DNO's and produced an implementation plan for embedding these within their networks

These services support the local DSO with management of its network in a number of ways:

- Sustain – a pre-fault service to generate or reduce demand over scheduled demand peaks in an area
- Secure – another pre-fault service to manage network loading
- Dynamic – post-fault constraint management service, requiring a response within 15 minutes
- Restore – a service designed to support system restoration following a fault condition event and reduce the stress on the network

This report focusses on and discusses the DSO services being procured by NGED through the *FlexiblePower* platform and makes comment where appropriate on other DNO approaches.

13.1. Requirements/eligibility

All DSO services require FSP assets to be physically located within the area that needs support. Minimum flexible capacity requirements vary between DSO. There are no exclusivity clauses in the contracts so there are no

primacy concerns in delivering the service, although unavailability declarations will negatively impact a DSO's confidence in FSPs' ability to deliver the service. Regular unavailability (in excess of 20% expected availability) will be classed a Service Failure, leading to the DSO being able to require explanation and rectification for the failure to deliver the agreed service level.

For NGED, all services except Sustain are procured at the HV level or above, and so require at least a 1kV connection.

13.1.1. Sustain

The Sustain service is scheduled over demand peaks in an area, therefore there is no requirement for a rapid response time, provided the service is delivered to time.

The Sustain service has started to be procured by National Grid Electricity Distribution (NGED) although the DSO expects to procure services over a longer term (6 months ahead). The service has common delivery windows that are identical across all service zones, and the Tranche 7a (September 2023 to March 2024) service is being secured 8am to 12pm, 4pm to 10pm weekdays.

Sustain is the only DSO service to currently be procured at the LV level.

Each asset is required to have a declarable set of capability parameters with a single point of communication and control.

Flexible or timed connections are permissible, subject to the terms of the connection.

Dispatch of the service is provided by a simple dispatch API that sends start/ stop signals and receive metering data. FSPs can opt to schedule their asset operations from the acceptance. A Utilisation Instruction is sent via the API 15 mins ahead of the requirement. Exclusivity is not required – providers can opt out of providing the service as the dispatch via API is optional.

13.1.2. Secure

Secure is operated by NGED and other DNOs to manage peak demand loading on the network and pre-emptively reduce network loading.

Once a trade has been accepted, the default position is that the service will be utilised. FSPs can opt to schedule their asset operations and a Utilisation Instruction is sent via the API 15 minutes ahead of the requirement.

13.1.3. Dynamic

For Dynamic, Utilisation is triggered by network conditions, after the acceptance of availability. A Utilisation instruction is sent via the API 15 minutes ahead of the requirement.

NGED procures this service only in the Dynamic EHV.HV Zone.

13.1.4. Restore

For Restore, Utilisation is triggered in response to network conditions. FSPs are expected to provide response as soon as possible, and in all cases no later than 15 minutes, following receipt of an instruction to deliver the service.

13.2. Opportunities and risks for FSPs

One of the challenges for FSPs is that DSO interpretation and implementation of each service are not necessarily aligned across all DNO regions. While the Open Networks programme has set the core parameters for each service type, the definitions include some room for DNOs to interpret them in a manner that best meets the challenges facing their network.

The ENA published the *Active Power Products Review* in August 2022, which noted the Secure and Dynamic services were those with the greatest variability between DSOs. The summary of implementation approaches across the DNOs can be found below in Figure 13.

Figure 13: Summary of DSO implementation of the different DSO products

Parameter	SUSTAIN DNO interpretation	SECURE DNO interpretation	DYNAMIC DNO interpretation	RESTORE DNO interpretation
Network constraint	Pre-Fault	Pre-Fault / planned outage	Network abnormality	Network abnormality
Procurement timescale	Annual/Season	Annual/Season	Annual/Season	Annual/Season
Payment mech	Utilisation only	Availability & Utilisation	Availability & Utilisation / Utilisation only	Utilisation only
Availability Agreement period	Pre-determined	Year ahead / 2 weeks ahead / Week ahead	No availability / Week ahead / 2 weeks ahead	N/A No availability
Utilisation Instruction	Scheduled contract stage	Week ahead / Real time / Within day	Real time / Within day / day ahead	Real Time
Dispatch mechanism	Scheduled / Self dispatch	API - 15 mins / Phone / Email	API - 15 mins / Phone / Email	API / Phone / Email

Source: ENA

A review of other DSO terms and services across DNO regions as of summer 2023 reveals differing approaches to:

- The services being contracted
- Minimum clip size requirements
- Payment types/ terms
- Connection voltage levels at which requirement is being procured
- Baselining

A further risk for FSPs is that baselining methodologies are aligned with network planning assumptions. Deviation between asset or user characteristics (where not individually taken) and the network planning assumptions can impact perceived delivery and therefore payment under service terms.

The baseline for stored energy is set at asset capacity – the guidance document and baseline values for February 2023 currently make it unclear whether this is set at import capacity or export capacity. If the latter, this makes the asset incapable of ramping upward to meet a service requirement.

Separately the location of DSO flexibility needs on two separate platforms – the Flexible Power and the PicloFlex platforms - with different API interfaces has been highlighted as an administrative barrier to participation.

13.2.1. Sustain

Service tender prices clear on a pay as clear basis, and competitive dynamics may pose a risk or opportunity depending on the type, size and maturity of the asset providing the service.

A utilisation fee is available to providers. No availability fee is linked to this service. However, once awarded the service will be utilised and therefore there is no delivery or requirement risk, so revenues will be stable.

Providers can choose not to respond to a utilisation instruction signal, providing FSPs with increased flexibility over other DSO services. For avoidance of doubt, providers would not be paid for this non-delivery.

13.2.2. Secure

Secure is procured on a longer-term basis (6 months ahead). Though we have seen the introduction of shorter-term weekly auctions recently launched. Again, the service prices are based on a pay as clear tendering round, presenting a commercial risk or opportunity for providers.

Secure typically offers a higher availability payment and lower utilisation payment. Availability payments for Secure and Dynamic products are based on delivery percentage across the events that occur in a month. Therefore, utilisation payments can be variable and are dependent on delivery, however the majority of revenues are known upon contract award.

13.2.3. Dynamic

The Dynamic service tender prices are also set on a pay as clear basis, with Availability payments adjusted for asset delivery during the events that occur in a month.

The Dynamic service is subject to an additional level of commercial risk that other services in that longer term contracts are subject to a Joint Utilisation Competition (JUC). This means participants in the long-term allocation will be competed against shorter term Dynamic participants at the week-ahead stage to minimise the cost to the DNO for provision of the service.

Payments are more variable than the other services discussed so far provided the service is post-fault and will therefore only be utilised in the event of a network fault. Delivery of the service therefore includes more commercial risk.

13.2.4. Restore

NGED sets the Restore service price, rather than running an auction to ensure timely usage of the service.

Restore Services are used in response to rare, high impact, network events. The nature of these events often restricts the Flexibility Services that could be use due to locational requirements. More information can be found in the accompanying *guidance document*.

13.3. Stacking with other revenue streams

Elements of DSO services support stacking, while others inhibit it. A lack of non-delivery penalties supports FSPs by providing optionality. NGED's services do not penalise over-delivery and, in fact, the Restore product financial renumerates over-delivery of up to 10%, which can be aligned with other services for a small element of co-delivery.

13.3.1. Sustain service

Figure 14: Stacking summary for Sustain service

Revenue stream/ Service	Stacking
Wholesale	Co-deliverable if you can trade delivery ahead of time. Splitable possible but operational considerations, jumpable
Balancing Mechanism	Challenge in deviating from Final Physical Notification for BM-registered assets.
NIV Chasing	Not strictly stackable as asset passively receives SIP rather than actively chasing NIV. Jumpable
Capacity Market	Potentially co-deliverable but not an RBS, while over-delivery is not penalised
Short Term Operating Reserve	Jumpable. Splitting unviable, static baseline
Firm Frequency Response	Jumpable. Splitting unviable, static baseline
Enhanced Reactive Power Service	Implicitly not co-deliverable, technical ability may be a challenge. Splitable and jumpable
Local Constraint Market	Implicitly jumpable between settlement periods committed to under Secure or Sustain-type services and SPs for LCM. Co-delivery and splitting unviable
MW Dispatch Service	Jumpable – DSO services take priority
ESO Demand Flexibility Service	Not stackable
Slow Reserve	Jumpable. Splitting unviable, static baseline
Quick Reserve	Jumpable. Splitting unviable, static baseline
Balancing Reserve	Jumpable. Splitting unviable, static baseline
Electricity Restoration Services	Co-deliverable, replacement in periods where grid goes down
Dynamic Containment	Jumpable. Deemed not splitable with operational challenges and likely unviable
Dynamic Moderation	
Dynamic Regulation	

13.3.2. Secure service

Figure 15: Stacking summary for Secure service

Revenue stream/ Service	Stacking
Wholesale	Co-deliverable if you can trade delivery ahead of time. Splitable but possible operational challenges, jumpable
Balancing Mechanism	Challenge in deviating from Final Physical Notification for BM-registered assets.
NIV Chasing	Not strictly stackable as asset passively receives SIP rather than actively chasing NIV. Jumpable
Capacity Market	Potentially co-deliverable but not an RBS, while over-delivery is not penalised
Short Term Operating Reserve	Jumpable. Splitting unviable, static baseline
Firm Frequency Response	Jumpable. Splitting unviable, static baseline
Enhanced Reactive Power Service	Implicitly not co-deliverable, technical ability may be a challenge. Splitable and jumpable
Local Constraint Market	Jumpable between days
MW Dispatch Service	Jumpable – DSO services take priority
ESO Demand Flexibility Service	Not stackable
Slow Reserve	Jumpable. Splitting unviable, static baseline
Quick Reserve	Jumpable. Splitting unviable, static baseline
Balancing Reserve	Jumpable. Splitting unviable, static baseline
Electricity Restoration Services	Co-deliverable, replacement in periods where grid goes down
Dynamic Containment	Jumpable. Deemed not splitable with operational challenges and likely unviable
Dynamic Moderation	
Dynamic Regulation	

13.3.3. Dynamic service

Figure 16: Stacking summary for Dynamic service

Revenue stream/ Service	Stacking
Wholesale	Trade of power will be difficult with less than or equal to 15 minutes notice
Balancing Mechanism	Not stackable - Challenge in deviating from Final Physical Notification for BM-registered assets
NIV Chasing	15 minutes notice means SIP value could be anything. Unstackable as not active NIV chasing
Capacity Market	Potentially co-deliverable but not an RBS, while over-delivery is not penalised
Short Term Operating Reserve	Jumpable outside of delivery days
Firm Frequency Response	Jumpable outside of delivery days
Enhanced Reactive Power Service	Jumpable outside of delivery days
Local Constraint Market	Jumpable outside of delivery days
MW Dispatch Service	Jumpable – DSO services take priority
ESO Demand Flexibility Service	Not stackable
Slow Reserve	Jumpable outside of delivery days
Quick Reserve	Jumpable outside of delivery days
Balancing Reserve	Jumpable outside of delivery days
Electricity Restoration Services	Co-deliverable, replacement in periods where grid goes down
Dynamic Containment	Jumpable. Deemed not splitable with operational challenges and likely unviable
Dynamic Moderation	
Dynamic Regulation	

13.3.4. Restore service

Figure 17: Stacking summary for Restore service

Revenue stream/ Service	Stacking
Wholesale	Trade of power will be difficult with less than or equal to 15 minutes notice.
Balancing Mechanism	Not stackable - Challenge in deviating from Final Physical Notification for BM-registered assets.
NIV Chasing	15 minutes notice means SIP value could be anything. Unstackable.
Capacity Market	Potentially co-deliverable but not an RBS, while over-delivery is not penalised
Short Term Operating Reserve	Jumpable outside of delivery days
Firm Frequency Response	Jumpable outside of delivery days
Enhanced Reactive Power Service	Jumpable outside of delivery days
Local Constraint Market	Jumpable outside of delivery days
MW Dispatch Service	Jumpable – DSO services take priority
ESO Demand Flexibility Service	Not stackable
Slow Reserve	Jumpable outside of delivery days
Quick Reserve	Jumpable outside of delivery days
Balancing Reserve	Jumpable outside of delivery days
Electricity Restoration Services	Co-deliverable, replacement in periods where grid goes down
Dynamic Containment	Jumpable. Not splitable due to nature of the service
Dynamic Moderation	
Dynamic Regulation	

14. Local Constraint Market

Summary

Response time: day-ahead market notified at 21:00 for activation during settlement periods between 5:00 and 5:00. Within-day market notified at 13:00 for activation during settlement periods between 17:00 and 5:00

Duration: continuous

Service windows: agreements run in six-month increments, minimum of 12 months

Payment type: pay-as-bid utilisation payment (£/MW/hr)

Stacking: assets cannot participate in the BM at any time, or in other balancing services during delivery periods

Other FSP considerations

- Currently limited to assets sited above the B6 boundary
- Distribution-connected, non-BM capacity only
- Initial participation has been from aggregated demand turn up, with some battery and onshore wind participation more recently

A Local Constraint Market (LCM) has been developed by National Grid ESO for the B6 boundary. The boundary is between the SP Transmission and National Grid Transmission networks, roughly following the border between Scotland and England. Due to growing levels of renewable generation in Scotland, flows at the B6 boundary from Scotland to England are increasing, leading to higher constraint costs. The LCM aims to tackle these by procuring generation turn down or demand turn-up from new sources of flexibility on a day-ahead basis, in competition with the BM. Third party Piclo was appointed as the platform provider for the service, managing the end-to-end process and providing engagement with providers. The B4 boundary between the SSEN Transmission and SP Transmission networks is also considered, as both boundaries are constrained and therefore actions north of the B4 boundary will also help to relieve the B6 boundary.

14.1. Requirements/eligibility

To participate in the LCM, participants must follow the *LCM Service Terms*. The terms require assets to be half hourly metered and be connected at the distribution level in the Qualification Area. Assets must not be registered as a BM Unit or be active in the BM. There is also a prohibition on participating in any other balancing and flexibility services during the settlement periods in which the Local Constraint Service is offered. Participants must also not be required to participate in any Active Network Management Scheme.

Under the LCM, FSPs upload notifications to the Piclo platform setting out their forecast output or demand in each settlement period during the upcoming service windows, and whether their assets will be able to provide generation turn down or demand turn up. Providers also submit their offered service volume for each period and the associated service utilisation fee in £/MW/hr. There are two service windows under the LCM. Window 1 is instructed at the day ahead stage, with FSPs providing notifications by 17:00 on a day-ahead basis for activation between 5:00 and 5:00. The providers will then receive instruction by 21:00. Window 2 runs on an in-day basis, with providers providing notifications by 9:00, being instructed by 13:00, and activation taking place between 17:00 and 5:00. Offered service volumes will be selected in merit order subject to system requirements. Assets above the B4 boundary are assessed and instructed first. Once instructed, service providers have one hour to respond to confirm that they will deliver.

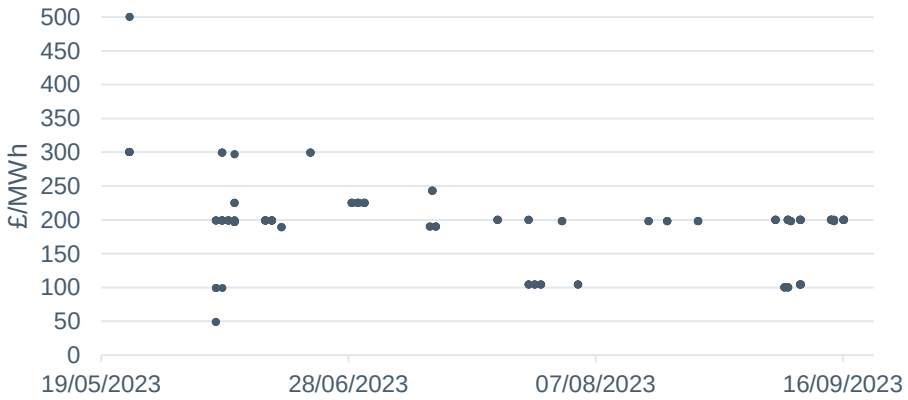
Payments are made on a pay-as-bid basis, reflecting either the lower of the actual volume delivered or the instructed service volume.

The LCM uses a nominated baselining approach, with providers uploading half-hourly forecasts of normal expected delivery. Once dispatch has taken place, FSPs will need to upload meter readings within five days.

14.2. Opportunities and risks for FSPs

- As the BM is not available to any asset registered as a BM Unit, participation will be limited to smaller scale assets and demand. Early *results* from the LCM show participation from aggregators providing demand turn up from heat pumps, EVs, and electric heating
- Participation will also be limited geographically to assets above the B6 boundary, with assets above the B4 boundary being instructed first and therefore being at an advantage to other units
- Initial accepted bid values in the first half of 2023 ranged between £50-500/MWh, with accepted bids since July 2023 falling in the range of £100-200/MWh

Figure 18: Accepted LCM bids as of September 2023



Source: *Piclo*, Cornwall Insight

14.3. Stacking with other revenue streams

As assets cannot be participating in the BM at any time, or any other balancing service during the delivery periods, opportunities for stacking will be limited. FSPs must also ensure that the delivery of generation turn down or demand turn up is not impaired by any other agreement with a third party.

Figure 19: Stacking summary for Local Constraint Market

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable, but payments in opposite directions possible. Implicitly splitable, explicitly jumpable
Balancing Mechanism	Assets cannot participate in the BM at any time. Explicitly not co-deliverable, explicitly unsplitable, explicitly unjumpable
NIV Chasing	Explicitly not co-deliverable. Implicitly not splitable as baseline requirement (although unclear in service terms) make real-time NIV chasing unviable. Explicitly jumpable
Capacity Market	Capacity Market units can register under the LCM Service Terms
Short Term Operating Reserve	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
Firm Frequency Response	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
Enhanced Reactive Power Service	Co-deliverability not applicable due to difference between active and reactive power. Explicitly unsplitable, implicitly jumpable
DSO services	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
MW Dispatch Service	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
Demand Flexibility Service	Explicitly not stackable with any other service
Slow Reserve	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
Quick Reserve	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage

Revenue stream/ Service	Stacking
Balancing Reserve	Explicitly not co-deliverable, explicitly unsplitable, implicitly unjumpable as assets declare availability per SP at the DA stage
Electricity Restoration Services	Explicitly not co-deliverable, unjumpable due to duration of ERS contracts
Dynamic Containment	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
Dynamic Moderation	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage
Dynamic Regulation	Explicitly not co-deliverable, explicitly unsplitable, implicitly jumpable as assets declare availability per SP at the DA stage

15. MW Dispatch Service

Summary

Response time: 2 minutes

Duration: Open-ended instructions

Service windows: Continuous availability

Payment type: Pay-as-bid utilisation payment (£/MW/hr), bids can change daily

Stacking: Low. Interoperability with DNO active power flexibility services as per primacy rules

Other FSP considerations

- Limited locational requirements – south east and south west
- Requires visibility and commercial control, which has been required since c. 2018 as part of connection agreements
- Choice between MW Dispatch and BM to meet these requirements

The MW Dispatch Service was developed as part of a Regional Development Programme, and initially applies to relevant Grid Supply Points in the South West DNO region. It places requirements on Distributed Energy Resources that have conditions in their connection agreement to provide visibility and commercial control over their assets (typically assets installed since 2018), where this has not been achieved by other means such as the BM and Wider Access. Under the service providers must reduce real power export to zero when instructed by the ESO.

15.1. Requirements/eligibility

DERs with the visibility and commercial control conditions in their connection agreement and that have had control equipment installed by their DNO will be required to participate in MW Dispatch or in the BM. The ESO is also considering opening the service up to participants that do not have the requirements in their connection agreement.

Key terms that the provider will need to meet include having an active response capability to turn to zero, and being able to respond to instructions and reduce output to zero within two minutes. If instructed, assets will need to maintain output at zero until a cease instruction is issued. Assets will need to have a minimum installed capacity of 1MW.

Under the service, the ESO will issue a dispatch instruction to the DNO, and this will be forwarded to the provider. The provider must then ensure that they reduce output within two minutes. There is no specified duration of the instruction.

Payments will be made based on the asset's utilisation rate, which the provider can update each day by 4pm for the following trading day. Baselining will be undertaken by the ESO using the metered output at the point of receipt of the instruction.

Baselining is established by using the metered MW output data at the point of receipt of the dispatch instruction acceptance from the DNO as the baseline for calculating the curtailed energy volume.

15.2. Opportunities/risks for FSPs

- The service is initially limited to 13 Grid Supply Points in the South West and South East regions, and so participation opportunities are likely to be limited. However, the approach may be expanded to other regions if required
- The service is targeted at smaller scale generators. Assets already participating in the BM will already be meeting their visibility and commercial control obligations, and so will not be required to participate

- Being a pay-as-bid service, the FSP would have a good degree of control over the returns they receive for being dispatched under the service
- The service is utilisation payment only, which means payments under the service are variable. However, the service is designed to compensate for the revenues lost reduce power generation, and so this is unlikely to have a significant impact on the commercial case for an FSP

15.3. Stacking with other revenue streams

The service does not have any explicit prohibitions around participation in other services (e.g. exclusivity clauses).

However, a contracted unit needs to be available at all times for the provision of active response, and providers will need to disclose the existence of any agreement or arrangement that could impact the ability to provide response. The exception is when, in accordance with Primacy Rules, the DNO informs the ESO that the contracted unit is unavailable to respond or that the DNO is planning to constrain the unit in accordance with its connection agreement.

The contract notes that primacy rules are available on the ESO and DNO websites, however the only primacy rules we were able to find at the point of review were those published by the Open Networks programme. These rules contain no mention of the MW Dispatch Service explicitly. However, they note that a DNO has primacy for its active power network services over the ESO transmission constraint management service, and it could be inferred that this includes the MW Dispatch service.

The contract also makes reference to “permitted services” in its glossary, but does not mention these services anywhere in the contract. These permitted services are therefore unknown.

Our interpretation of this is that an FSP can enter its active power response into both the MW Dispatch Service and DNO services but will effectively be unable to deliver MW Dispatch if being utilised by the DSO. The service is a continuously available service with assumed availability, meaning assets can’t jump between revenue streams outside of delivery windows. The mandatory reduce to zero requirement means FSPs can’t stack this with active or reactive power services.

Figure 20: Stacking summary for MW Dispatch service

Revenue stream/ Service	Stacking
Wholesale	Not explicitly co-deliverable, but payments in opposite directions possible. Not splitable. Assets will shift from wholesale to MW Dispatch and back so effective jumping.
Balancing Mechanism	Unstackable. Can’t be in the BM and in MW Dispatch at the same time.
NIV Chasing	Jumpable. Not co-deliverable or splitable.
Capacity Market	Yes – constraint management unlikely to occur simultaneously with system stress. Not an explicit RBS however.
Short Term Operating Reserve	Not stackable due to requirement to be available to reduce output to zero at all times
Firm Frequency Response	Not stackable due to requirement to be available to reduce output to zero at all times
Enhanced Reactive Power Service	Not co-deliverable due to difference between active and reactive power. Splitting not applicable. Implicitly unjumpable
DSO services	No co-deliverable. Splitting not applicable. DSO services take priority so effective jumping
Local Constraint Market	Not stackable due to requirement to be available to reduce output to zero at all times
Demand Flexibility Service	Not stackable under DFS arrangements
Slow Reserve	Not stackable due to requirement to be available to reduce output to zero at all times
Quick Reserve	Not stackable due to requirement to be available to reduce output to zero at all times
Balancing Reserve	Not stackable due to requirement to be available to reduce output to zero at all times
Electricity Restoration Services	Not stackable due to requirement to be available to reduce output to zero at all times
Dynamic Containment	Not stackable due to requirement to be available to reduce output to zero at all times
Dynamic Moderation	Not stackable due to requirement to be available to

Revenue stream/ Service	Stacking
	reduce output to zero at all times
Dynamic Regulation	Not stackable due to requirement to be available to reduce output to zero at all times

16. Demand Flexibility Service

Summary

Response time: participants notified of delivery time at 16:30 for the day-ahead

Duration: minimum of 30 minutes, but can be up to 3-4 hours

Service windows: minimum of 30 minutes, but can be up to 3-4 hours

Payment type: £/MWh utilisation payments to provider for demand reduction volumes. Provider free to determine own payments to participants

Stacking: None. Stacking with other services is not possible, and participants cannot have a Capacity Market contract or participate in balancing services for the ESO or third parties

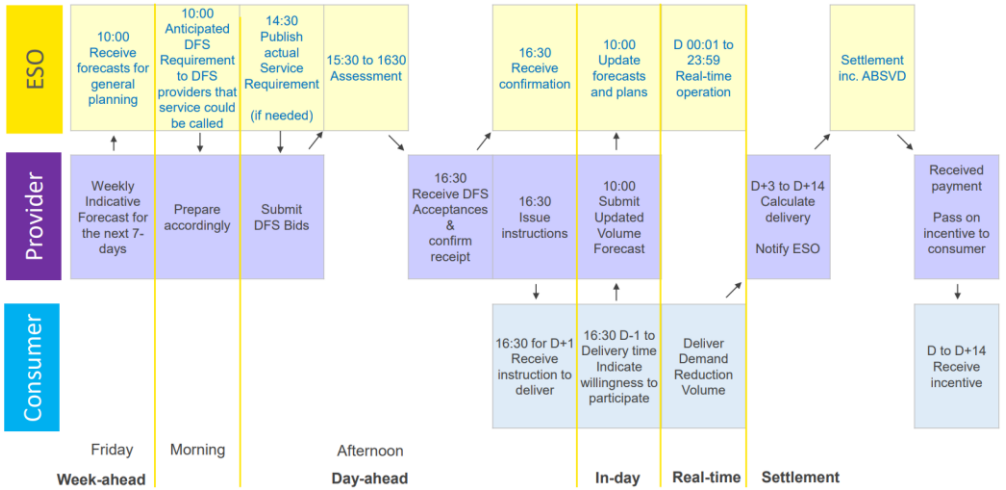
Other FSP considerations

- Targeted at domestic and small non-domestic customers
- Low revenues compared to other schemes

Through the Demand Flexibility Service (DFS) the ESO procures demand turn down from smart meter customers via suppliers and aggregators. The service was launched for winter 2022-23, and initially ran from November to March, returning for winter 2023-24.

Under the scheme, the ESO procures demand turn down on a day-ahead basis, notifying providers of the service requirement. Providers then submit bids for their DFS Units, and if the ESO accepts, consumers are notified of an upcoming event. Providers will then receive payments based on the actual amount of turn down, and the provider can then choose how to pass on benefits to consumers. The process is shown in Figure 21.

Figure 21: weekly DFS process



Source: National Grid ESO

16.1. Requirements/ eligibility

The minimum unit size for participation is 1MW, with a maximum of 100MW, with providers typically aggregating customer together into one unit. Multiple units can be registered by each participant. Consumers are required to have half hourly metering, but can be settled on a half hourly or non-half hourly basis. DFS Units cannot form part of a BM Unit other than a supplier base BM Unit. Assets with Capacity Market contracts and participating in balancing services for the ESO or third parties (other than Active Network Management Schemes) are excluded.

The minimum delivery period is 30 minutes, but live events can run up to 3-4 hours each. The DFS runs on a pay as bid approach, with £/MWh utilisation payments made for delivered demand reduction volumes. It is the provider

that receives the payments, and they are free to determine their own incentive for customers, with approaches seen including passing on the majority of payments, offering bill credit, or using a points-based system.

To determine the amount of demand reduction, data from the last ten working days or four non-working days, depending on the event day, is used to create a baseline profile curve. This curve is then compared to the actual metered output during service delivery. For 2022-23 there was an in-day adjustment which saw metered data from three to one hours before the delivery period used to adjust the baseline curve to account for all day specific effects such as weather conditions. However, this will be removed from 2023-24 due to gaming concerns.

16.2. Opportunities and risks for FSPs

- There are a number of limitations associated with the DFS. The prohibition of BM-dispatchable units and units that already participate in ancillary services or DNO services means that Flexibility Service Providers are not likely to be eligible. Additionally, the scheme is not likely to deliver significant revenues over the DFS year when compared to other revenue streams
- During the 2022-23 live events, the average acceptance price was ~£4,559/MWh

16.3. Stacking with other revenue streams

Stacking is not possible. Under the DFS arrangements, participants cannot be providing any other ESO balancing service, and this includes having a Capacity Market agreement. This is because the DFS is designed to procure additional capacity from sources that typically cannot participate in the existing markets. Availability and delivery must not be impaired by any agreement with a third party.

Figure 22: Stacking summary for Demand Flexibility Service

Revenue stream/ Service	Stacking
Wholesale	Implicitly jumpable
Balancing Mechanism	Not stackable under DFS arrangements
NIV Chasing	Implicitly jumpable
Capacity Market	Not stackable under DFS arrangements
Short Term Operating Reserve	Not stackable under DFS arrangements
Firm Frequency Response	Not stackable under DFS arrangements
Enhanced Reactive Power Service	Not stackable under DFS arrangements
DSO services	Not stackable under DFS arrangements
MW Dispatch Service	Not stackable under DFS arrangements
Demand Flexibility Service	Not stackable under DFS arrangements
Slow Reserve	Not stackable under DFS arrangements
Quick Reserve	Not stackable under DFS arrangements
Balancing Reserve	Not stackable under DFS arrangements
Electricity Restoration Services	Not stackable under DFS arrangements
Dynamic Containment	Not stackable under DFS arrangements
Dynamic Moderation	Not stackable under DFS arrangements
Dynamic Regulation	Not stackable under DFS arrangements

17. Slow Reserve

Two new services to replace STOR and Fast Reserve (Quick Reserve and Slow Reserve) were unveiled in *March 2021*, with the aim of replacing the existing Reserve services. These services are still being designed by ESO, with a focus on simplifying the reserve market, as well as allowing access to the market for smaller distribution connected and renewable assets. It is important to note that one of the stated goals is to allow a wider range of assets to participate in the scheme, likely increasing competition but potentially reducing prices.

In an update from *November 2021*, the ESO confirmed that it would be developing four services, two of which included the Positive and Negative Slow Reserve products. ESO's latest *update* contained the latest design:

- Positive Slow Reserve (PSR) – turn up generation/ turn down demand within 15 minutes
- Negative Slow Reserve (NSR) – turn down generation/ turn up demand within 15 minutes, with response lasting between 30 mins and 120 minutes

Slow Reserve auctions will be held on the ESO's new auction platform currently under development as part of the Enduring Auction Capability (EAC) project. The Slow Reserve Operational Day will run from 23:00 – 23:00 to align with other ESO balancing services and will be broken down into a series of Service Windows – one 8-hour window overnight and eight 2-hour windows during the day. All Service Windows will be available to pre-qualified Slow Reserve service providers to submit bids for the Firm Service at day-ahead or the Optional Service within-day.

As mentioned in May 2023's Future of Balancing Services newsletter, the ESO came to the decision to delay the delivery of the new Reserve reform products, Slow and Quick Reserve (originally planned for October and November 2023).

This decision was taken in light of the significant changes that would have been required in the ESO's existing, legacy balancing systems and processes, given the complexity of the new service designs. The service is now expected to go-live in Summer 2025.

17.1. Requirements/ eligibility

In line with the implementation of the recent dynamic response products, registration and pre-qualification for the new Slow Reserve services will be completed via the ESO's Single Market Platform (SMP). Participants will need to become a Registered Service Provider; meet minimum delivery requirements; pre-qualify Eligible Units to participate in auctions; and allocate Eligible Assets to Slow Reserve Unit(s).

For Firm versions of the services, assets would need to participate in the daily auctions for each of the Quick and/ or Slow Reserve services. The auctions would require the submission of bids for availability payments, while utilisation prices for non-BM participants will need to be submitted 90 minutes before service windows and for BM-providers by gate closure. However, instead participants might want to declare themselves available for the Optional Service, where non-BM utilisation price submissions would be required 90 minutes in advance. Availability payments will be made on a pay-as-clear basis, whereas utilisation payments will be on a pay-as-bid basis.

Slow Reserve, based on indicative product designs will have a minimum capacity requirement of 1MW of generation reduction/increase or demand reduction/increase from any technology (which can be a single asset or an aggregated unit comprising more than one constituent asset). Units can be aggregated at GSP Group level to meet the 1.0MW minimum participation threshold.

Providers must reach full activation within 15 minutes from instruction with specific ramp rates and be capable of sustaining full activation for a minimum of 120 minutes.

For Slow Reserve, BM providers should submit operational metering via the existing processes. Non-BM providers should submit operational metering via ASDP/PAS. Performance metering will also be specified at 1Hz granularity.

Regarding baselining, a 60-minute nomination baseline will be expected from both BM and non-BM participants for both Positive and Negative Slow and Positive and Negative Quick Reserve products. The service design proposal is that a unit can have also non-zero baseline (dependent on IT platform development).

17.2. Opportunities and risks for FSPs

The new Slow Reserve service represents a potential additional revenue stream for FSPs, although is intended to replace the current STOR service. It intended to be open to greater range of market participants than current reserve services.

Revenues achievable are unclear at this stage as the service has not yet launched, but could potentially be similar to that under the current STOR market or follow wholesale market prices due to the opportunity cost of not running wholesale.

Penalties are intended to be included for non-delivery of availability and utilisation. It is suggested penalties will apply for over (>120%) and under (95%) deliveries for performance monitoring.

17.3. Stacking with other revenue streams

The ESO has provided some stacking guidance regarding initial designs for Slow Reserve, however, this only covers likely rules for stacking with Quick Reserve and the Dynamic Response services. For the same service window, one unit is allowed to split its positive and negative capacity to provide different direction products of the same service, but not different services. The ESO also says the same MW cannot be sold twice.

In the same document, ESO said that Slow and Quick Reserve products cannot be co-delivered or split with Dynamic response services, while co-delivering and splitting MWs between Quick and Slow Reserve services will also not be possible.

Regarding most other Balancing Services (including DSO services), assuming similar rules apply, it is unlikely that Slow Reserve will be co-deliverable with, while splitting capacity is unclear and even unlikely at this stage and may have restrictive operational implications. We expect service stacking will be kept under review as the new services develop.

However, Slow Reserve will likely be splitable, but not co-deliverable, with the wholesale market and BM. Shorter within-day service windows means jumping between most services should be possible.

The increased connectivity which is anticipated to be in place between these reserve services and new frequency services (DC, DR, DM) compared to the old arrangements, may mean that it is easier to switch between these platforms in future. Again, this is not confirmed at the current stage.

Both the Slow and Quick Reserve services, however, should be stackable with the Capacity Market. Furthermore, volumes should be subject to ABSVD, and so not cause imbalance.

Figure 23: Stacking summary for Slow Reserve

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable but utilisation in opposite direction possible. Splitable and jumpable, based on design to date
Balancing Mechanism	Not co-deliverable, although bids in opposite direction may be viable. Deemed splitable and jumpable based on current design and similar services
NIV Chasing	Not co-deliverable. Implicitly not splitable due to baselining requirement. Jumpable for non-BMUs
Capacity Market	Expected to be co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Not co-deliverable. Not splitable due to (sub) zero STOR baselining requirements. Jumpable
Firm Frequency Response	Not co-deliverable or splitable. Jumpable
Enhanced Reactive	Co-delivery is not applicable. Splitable and jumpable

Revenue stream/ Service	Stacking
Power	
DSO services	Not co-deliverable. Implicitly not splitable - current SR service design allows for non-zero baseline; however, depends on precise service as responding to real time signals will impact baseline and any response may hinder delivery or performance monitoring of the other service. Jumpable
Local Constraint Markets	Not co-deliverable or splitable. Implicitly jumpable
MW Dispatch Service	Not co-deliverable. Splitting is not applicable. Jumping is implicitly not viable.
ESO Demand Flexibility Service	Not co-deliverable, splitable or jumpable
Quick Reserve	Not co-deliverable or splitable. Jumpable
Balancing Reserve	Not co-deliverable. Assumed not splitable based on recent similar service design and rules. Jumpable
Electricity Restoration Services	Co-deliverable and jumpable. Splitting not applicable
Dynamic Containment	
Dynamic Moderation	Not co-deliverable or splitable. Jumpable
Dynamic Regulation	

18. Quick Reserve

Quick Reserve – one of the two new services to replace STOR and Fast Reserve – was unveiled alongside its Slow counterpart in *March 2021*, and confirmed in an update from *November 2021*. The service is *designed* to replace Fast Reserve and will be split into Positive and Negative Quick Reserve products:

- Positive Quick Reserve (PQR) – turn up generation/ turn down demand within 60 seconds
- Negative Quick Reserve (NQR) – turn down generation/ turn up demand within 60 seconds

The ESO came to the decision to delay the delivery of the new Reserve reform products, Slow and Quick Reserve (originally planned for October and November 2023). This decision was taken in light of the significant changes that would have been required in its existing, legacy balancing systems and processes, given the complexity of the new service designs. Go-live is now expected in Summer 2024 for BM units and Summer 2025 for non-BM units.

18.1. Requirements/ eligibility

In line with the implementation of the recent Dynamic Response products, registration and pre-qualification for the new Quick Reserve services will be completed via the ESO's Single Market Platform (SMP).

Providers contracted for both Quick and Slow Reserve services will receive an availability payment (£/MW/hour) and a utilisation payment (£/MWh) when dispatched. The daily auctions would require the submission of bids for availability payments, while utilisation prices expected to be submitted closer to the delivery windows. Non-BM participants will be instructed through the Ancillary Service Dispatch Platform (ASDP) /Platform for Ancillary Services (PAS) dispatch system in line with current reserve products. BM participants will be dispatched via Bid Offer Acceptances (BOAs) through existing BM systems.

Quick Reserve Service Windows are still being designed at present, although 2-hour windows have been suggested. It is expected Quick Reserve will also be auctioned on the ESO's new auction platform currently under development as part of the Enduring Auction Capability (EAC) project. The Quick Reserve service will be procured daily at the day-ahead stage. Quick Reserve will also have a Firm service and an Optional service.

Quick Reserve products, based on *indicative product technical designs*, will have a minimum capacity requirement of 1MW. Providers must reach full activation within 1 minute from instruction. A maximum activation period of no less than 15 minutes and a minimum activation period of up to 5 minutes is planned. Providers are expected to be able to aggregate units within a GSP Group.

Operational and performance metering would need to be down to a 1Hz granularity. Where possible, the Quick Reserve technical design proposal has been kept as close to the Slow Reserve technical design for standardisation across products in Reserve Reform.

Regarding baselining, 60-minute nomination baselines will be expected from both BM and non-BM participants for both Positive and Negative Slow and Positive and Negative Quick Reserve products. The service design proposal is that a unit can have also non-zero baseline (dependent on IT platform development).

18.2. Opportunities and risks for FSPs

The new Quick Reserve service represents a potential additional revenue stream for FSPs, although is intended to replace the previous Fast Reserve service. It is intended to be open to greater range of market participants than previous reserve services.

Revenues achievable are unclear at this stage as the service has not yet launched, but could potentially be similar to that under the current STOR

market or follow wholesale market prices due to the opportunity cost of not being in the wholesale market.

Penalties are intended to be included for non-delivery of availability and utilisation. It is suggested penalties will apply for over (>120%) and under (95%) deliveries for performance monitoring.

18.3. Stacking with other revenue streams

The ESO has provided some stacking guidance regarding initial designs for Quick Reserve, however, this only covers likely rules for stacking with Slow Reserve and the Dynamic Response services. For the same service window, one unit is allowed to split its positive and negative capacity to provide different direction products of the same service, but not different services. The ESO also says the same MW cannot be sold twice.

In the same document, ESO said that Slow and Quick Reserve products cannot be co-delivered or split in the same time period with Dynamic response services, while co-delivering or splitting MWs between the Quick and Slow Reserve services will also not be possible initially.

Regarding most other Balancing Services (including DSO services), assuming similar rules apply, it is unlikely that Quick Reserve will be co-deliverable, while splitting capacity is unclear and even unlikely at this stage and may have restrictive operational implications. We expect service stacking will be kept under review as the new services develop.

However, Quick Reserve will likely be splitable, but not co-deliverable, with the wholesale market and BM. Shorter within-day service windows means jumping between most services should be possible.

The increased connectivity which is anticipated to be in place between these reserve services and new frequency services (DC, DR, DM) compared to the old arrangements, may mean that it is easier to switch between these services in future. Again, this is not confirmed at the current stage.

Both the Slow and Quick Reserve services, however, should be stackable with the Capacity Market. Furthermore, volumes should be subject to ABSVD, and so not cause imbalance.

Figure 24: Stacking summary for Quick Reserve

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable but utilisation in opposite direction possible. Splitable and jumpable, based on design to date
Balancing Mechanism	Not co-deliverable, although bids in opposite direction may be viable. Deemed splitable and jumpable based on current design and similar services
NIV Chasing	Not co-deliverable. Implicitly not splitable due to baselining requirement. Jumpable for non-BMUs
Capacity Market	Expected to be co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Not co-deliverable. Not splitable due to (sub) zero STOR baselining requirements. Jumpable
Firm Frequency Response	Not co-deliverable or splitable. Jumpable
Enhanced Reactive Power	Co-delivery is not applicable due to differences in active and reactive power. Splitable and jumpable
DSO services	Not co-deliverable. Implicitly not splitable - current QR service design allows for non-zero baseline; however, depends on precise service as responding to real time signals will impact baseline and any response may hinder delivery or performance monitoring of the other service. Jumpable
Local Constraint Markets	Not co-deliverable or splitable. Implicitly jumpable
MW Dispatch Service	Not co-deliverable. Splitting is not applicable. Jumping is implicitly not viable
ESO Demand Flexibility Service	Not co-deliverable, splitable or jumpable

Revenue stream/ Service	Stacking
Slow Reserve	Not co-deliverable or splitable. Jumpable
Quick Reserve	N/A
Balancing Reserve	Not co-deliverable. Assumed not splitable based on recent similar service design and rules. Jumpable
Electricity Restoration Services	Co-deliverable and jumpable. Splitting not applicable
Dynamic Containment	Not co-deliverable or splitable. Jumpable
Dynamic Moderation	
Dynamic Regulation	

19. Balancing Reserve

Balancing Reserve is a new Balancing Service still being developed to replace how the ESO currently procures Regulating Reserve, expected to go live in early 2024. Regulating Reserve is currently managed through the BM and used to manage energy imbalance between generation and demand.

Currently, Regulating Reserve is mainly made up of synchronised generators able to respond within standard BOA timescales (2 minutes). Requirements are set so that the risk of a loss of load event due to a reserve shortfall is uniform across all settlement periods in the year. ESO currently uses optional bids and offers for available headroom and footroom in the BM to create scheduled reserve in real time, which may require synchronising or desynchronising plant to be able to create sufficient margin.

However, due to the rise in BOAs recently, this has become a costly method of procuring the service. Balancing Reserve will allow the ESO to procure Regulating Reserve on a firm basis at day ahead. By procuring the service, reserve volume is locked in ahead of the day ahead energy market and the energy is not available to be sold into other continental markets over the interconnectors.

There are two types of payment for the BR service:

- Availability payment - this payment is for being available to provide the service within the service window
- Utilisation payment - this payment is for delivering the service when instructed by us. This includes the energy delivered in ramping up to and down from the contracted volume in accordance with the Service Terms

19.1. Requirements/ eligibility

Balancing Mechanism Units with minimum contract capacity of 1MW or above will be eligible to participate in the Balancing Reserve market, as currently planned. The latest proposed service design means assets will need to be able to reach full delivery within 10 minutes.

To participate in the Balancing Reserve market, providers must:

- Be a BM Unit and;
- Have control telephony during all contracted windows and;
- Be capable of providing 1MW or more of reserve volume in line with the service design

To participate in Balancing Reserve, assets will need to be registered in the Single Market Platform (SMP).

Providers can aggregate at the GSP Group level.

Proof of delivery is taken from metered data, which is taken automatically from the unit. Providers submit their prices for the committed availability window during the auction. The Power Available signal will be used to monitor performance of wind units. Regarding baselining, assets are baselined via Physical Notifications (i.e. at gate closure).

Balancing Reserve is being added to the Enduring Auction Capability suite of products. Electricity National Control Centre tools are being developed to enhance the dispatch capability of smaller assets.

19.2. Opportunities and risks for FSPs

The new Balancing Reserve service is an opportunity for new providers to provide Regulating Reserve that was previously not available to them.

Revenues are not yet clear as the service has not launched. Prices are likely to be a function of lost opportunity costs from participating in other markets, such as the wholesale market and the Balancing Mechanism.

Assets that make capacity available for the service will not be able to participate for the same MW in other services, and therefore providers may sometimes miss out on higher revenues. However, there may also be instances where lower revenues are seen by not participating.

19.3. Stacking with other revenue streams

The latest updates from the ESO have said that the same MW cannot be sold twice, meaning co-delivering (for the same MW of power) with other ancillary services is not expected to be permitted under the service. Stacking for different MW (splitting) is unclear at this stage; while in theory it may be more permissible (provided it does not impact the ability to deliver on the service), recent other product designs such as those for Slow Reserve and Quick Reserve have shown some limitation to splitting MWs between ESO services. However, we understand the ESO is expecting that providing bids for both the positive and negative versions of the Balancing Reserve service may be viable at the same time (i.e. a form of splitting).

Stacking with DSO services is also unclear at this stage, however, co-delivery is highly unlikely, while splitting MWs may be possible but has operational considerations. Baselining and performance monitoring requirements will need to be taken into consideration which may prove prohibitive.

Jumping between services will likely be highly accessible for the service, with some limitations due to the requirement to be a BMU for the service.

Figure 25: Stacking summary for Balancing Reserve

Revenue stream/ Service	Stacking
Wholesale	Not co-deliverable but replaceable. Splitable and jumpable, based on design to date
Balancing Mechanism	Not co-deliverable (but noting dispatch is through the BM). Splitable and jumpable
NIV Chasing	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BR participation and submit PNs makes NIV Chasing unviable
Capacity Market	Co-deliverable. Splitting and jumping not applicable
Short Term Operating Reserve	Not co-deliverable. Implicitly not splitable based on similar recent service designs but not confirmed by ESO. Jumpable for BMUs only
Firm Frequency Response	Not co-deliverable. Implicitly not splitable based on similar recent service designs but not confirmed by ESO. Jumpable for BMUs only
Enhanced Reactive Power	Co-deliverable is not applicable with differences between active and reactive power. Splitable and jumpable
DSO services	Not co-deliverable. Implicitly not splitable, however, depends on precise service as responding to real time signals will impact baseline and any response may hinder delivery or performance monitoring of the other service. Jumpable
Local Constraint Markets	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BR participation stacking unviable
MW Dispatch Service	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BR participation stacking unviable
ESO Demand Flexibility Service	Not co-deliverable, splitable or jumpable – the requirement to be a BMU for BR participation stacking unviable
Slow Reserve	

Revenue stream/ Service	Stacking
Quick Reserve	Not co-deliverable or splitable based on recent service designs and rules. Jumpable
Balancing Reserve	N/A
Electricity Restoration Services	Co-deliverable and jumpable. Splitting not applicable.
Dynamic Containment	Not co-deliverable or splitable based on recent service designs and rules. Jumpable
Dynamic Moderation	
Dynamic Regulation	

20. Electricity Restoration Services - Distributed ReStart/Black Start

Summary

Response time: Varied depending on phase

Duration: Varied depending on connection level and primary vs auxiliary units

Service windows: For contract length

Payment type: £/settlement period availability payment and the potential for a contribution sum towards new or refurbishing plant

Stacking: Fully stackable as system restoration events are expected to be extremely infrequent, as long as delivering other balancing services does not affect the FSP's ability to provide ERS, and other services do not require exclusivity in availability periods. Other services will not be required in the event of a black out

Other FSP considerations

- Tenders at the distribution level are locational

20.1. Overview and history

The Distributed ReStart[1] project was described as both innovative and transformative in nature. In a rapidly changing energy landscape, it looked to assess whether DER (Distributed Energy Resources such as solar, wind, storage, EVs, and hydro) can provide the Black Start service which has traditionally been supplied by large, carbon-intensive, fossil-fuelled generators and has operated from transmission to distribution network. Distributed ReStart involved a reversal, with network repowering being initiated from many small, distribution-connected assets. The project was a partnership between National Grid ESO, SP Energy Networks and TNEI, and was awarded £10.3 million of Network Innovation Competition funding.

As the electricity system transitions towards a more sustainable and low-carbon future, the project presents a step forward in rethinking how essential services can be provided, when the fundamental nature of the electricity system has shifted toward intermittent, renewable generation technologies. Unlike conventional power plants, most renewable generation plants are subject to fluctuations in weather, making grid stability a critical aspect. A key consideration is the provision of Black Start (this is the procedure to recover from a total or partial shutdown of the National Electricity Transmission System – NETS – which has caused an extensive loss of supplies and entails isolated power stations being started individually, without drawing electricity from the NETS, before being reconnected to form an integrated system). The project aimed to demonstrate the technical and commercial feasibility of using DER for Black Start, as well as to develop new standards and codes of practice for the industry.

The project achieved its objectives and milestones, including two live trials of DER Black Start capability (with a third taking place in summer 2023, which includes the use of a battery energy storage system to restart the network), developing a new restoration strategy based on DER clusters, and delivering recommendations for policy and regulatory changes. The project has covered a broad range of areas with objectives and outcomes achieved across Power Engineering and Trials, Organisation, Systems and Telecommunications, Procurement and Compliance and Knowledge and Dissemination.

[1] See https://www.nationalgrideso.com/future-energy/projects/distributed-restart

System restart services are now procured and delivered by the wider Electricity Restoration Services (ERS) tenders.

20.2. Requirements/ eligibility

DER can participate in NG ESO's tender processes for ERS (*see here*) provided they meet the requirements. Full details of technical requirements can be found in the *Appendix 1 – Technical Requirements and Assessment Criteria Document.*

Capability to deliver the service is tested once every three years.

20.3. Opportunities and risks for FSPs

Payments are applicable depend on the type, age, status, etc. of the DER(s). These primarily take the form of an Availability Payment (£/settlement period basis) which is made for the asset being available to provide restoration services. In addition, the DER may be eligible for a Contribution Sum which is available to new or refurbishing plant. If installation or refurbishment of DER assets at a contracted site would provide a valuable restoration service, NG ESO may contribute to the costs.

20.4. Stacking with other revenue streams

Any Black Start service is only needed in very specific circumstances in which all other services are effectively redundant. So, if any DER assets that are participating in the scheme are required to provide the service, the chance of any conflict with provision of services via other schemes or markets is remote. More generally, DERs may provide balancing services in addition to ERS if doing so does not interfere with their ability to restore the electricity system.

If the ESO makes an investment in assets or capability (for example, auxiliary generators), the provider will be able to offer other ancillary services using these assets subject to agreement from ESO. The expectation is that the provider will agree a reduction to the Black Start service fee. This is to avoid the end consumer 'paying twice', and to avoid market distortion of other services.

Figure 26: Stacking summary for Electricity Restoration Services

Revenue stream/ Service	Stacking
Wholesale	Co-deliverable*, but as replacement. Jumpable
Balancing Mechanism	Co-deliverable* and jumpable, but not splitable
NIV Chasing	Co-deliverable* and jumpable, but not splitable
Capacity Market	Co-deliverable*
Balancing Reserve	Co-deliverable* and jumpable, but not splitable
Short Term Operating Reserve	Co-deliverable* and jumpable, but not splitable
Firm Frequency Response	Co-deliverable* and jumpable, but not splitable
Reactive Power	Co-deliverable* and jumpable, but not splitable
Electricity Restoration Services	N/A
DSO services	Co-deliverable* and jumpable, but not splitable
Dynamic Containment	Co-deliverable* and jumpable, but not splitable
Dynamic Moderation	
Dynamic Regulation	
Local Constraint Markets	Not stackable
MW Dispatch Service	Co-deliverable*, jumping and splitting generally not applicable
ESO Demand Flexibility Service	Not stackable
Slow Reserve	Co-deliverable* and jumpable, but not splitable
Quick Reserve	Co-deliverable* and jumpable, but not splitable

* Availability payments may be made for system restoration services at the same time as providing other regular services. In the unique scenario where electricity system restoration services are required and used, assets generally would likely no longer be required to perform any other service and the restoration service requirements would take precedent.

21. Dynamic Containment

Summary

Response time: 0.5 seconds / max time to full delivery 1 second

Duration: 15 minutes

Service windows:

- Six four-hour EFA blocks per day

Payment type: Availability (£/MW/hr)

Stacking: Low to medium

Other FSP considerations

- Stacking largely limited to other Dynamic frequency response products

Dynamic Containment (DC) is designed to operate post-fault, i.e. for deployment after a sudden and significant frequency deviation, which has seen frequency surpass operational limits (±0.2Hz). The service will therefore look to contain frequency within the statutory range (±0.5Hz), with activation at ±0.2Hz and full contracted delivery at ±0.5Hz.

The service is procured on a day-ahead basis, with providers bidding in for EFA block service windows.

As with all the 'Dynamic Response' services, DC is spilt up into two products, a low product (DC Low) for increased export/decreased import, alongside and a high product (DC High) for increased import/decreased export, which are tendered for separately.

21.1. Requirements/ eligibility

Assets must provide between 1MW and 50MW of capacity and be capable of remote activation. Service provision is based on provision of deviation against a baseline, which is submitted via an API in advance, on a continual basis, for up to 90 minutes in the future. Note that only integer values are currently accepted (e.g. 1MW, 2MW etc.), and part-MW values are not permitted.

Providers must be able to respond to a change in frequency and deliver response within half a second, and have the ability to provide full response delivery in one second. The provider must be capable of sustained delivery for 15 minutes.

Service providers are required to provide monitoring data to ESO via API on a continual basis. This is on a 1Hz basis (i.e. measuring every second).

Performance Data needs to be submitted to the ESO by electronic transfer on an hourly basis throughout the service day, comprising at a granularity of 20 measurements per second (20 Hz).

Aggregation of assets is permitted to a Grid Supply Point (GSP) Group level, i.e., assets within the same one of the 14 distribution regions.

Participation is open to both Balancing Mechanism (BM) and non-BM registered assets. There are no restrictions on technology or on connection voltage. Units will need to comply with state of energy management rules.

Assets must be pre-qualified to be registered as Eligible Assets; these are allocated to Response Units which are bid into the daily auctions. Response Units can only be adjusted weekly. Eligible assets cannot be re-allocated to different Response Units dynamically.

21.2. Opportunities and risks for FSPs

- Pay-as-clear service, scope to obtain returns above submitted bid prices. However, risk for units with high operating costs with high bid submission levels
- Limited stacking options during the duration of your contracted window of availability
- Service need is inversely influenced by the level of synchronously-connected generation on the system
- A large service requirement compared to alternative response services, though has become increasingly oversubscribed
- While being a technology agnostic service, service provision has been met exclusively by battery storage units to date
- Opportunities to stack across DM and DR products in the Enduring Auction Capability which commenced in October 2023

21.3. Stacking with other revenue streams

Stacking is largely not available with other services during contracted availability windows, with the BM an option to providers. However, providers stacking must maintain an appropriate state of charge, and ensure that stacking doesn't impact the unit's ability to deliver their contracted response volume. Stacking with DM or DR products will be made available following the launch of the Enduring Auction Capability (EAC). The ESO will explore opportunities for co-optimisation of response and reserve services in the future within the EAC.

Outside of the contracted availability windows, other services can be provided, so long as the provision of these other services does not affect the ability of the asset to provide their contracted DC volumes. DC is listed as a Relevant Balancing Service, so can be stacked with the Capacity Market.

Figure 27: Stacking summary for Dynamic Containment

Revenue stream/ Service	Stacking
Wholesale	Splitable and jumpable. Not strictly co-deliverable except utilisation in opposite direction possible
Balancing Mechanism	Splitable and jumpable, not co-deliverable
NIV Chasing	Jumpable only
Capacity Market	Co-deliverable
Short Term Operating Reserve	Jumpable, not co-deliverable or splitable
Firm Frequency Response	Jumpable, not co-deliverable and implicitly not splitable
Enhanced Reactive Power Service	Splitable and jumpable
DSO services	Jumpable. Deemed not splitable with operational challenges and likely unviable. Not co-deliverable
MW Dispatch Service	Not stackable under MW dispatch requirements
Demand Flexibility Service	Not stackable under DFS arrangements
Slow Reserve	Jumpable only
Quick Reserve	Jumpable only
Balancing Reserve	Jumpable, not co-deliverable or splitable
Electricity Restoration Services	Co-deliverable and jumpable
Dynamic Containment	N/A
Dynamic Moderation	Splitable and jumpable
Dynamic Regulation	Splitable and jumpable

22. Dynamic Moderation

Summary

Response time: 0.5 seconds / max time to full delivery 1 second

Duration: 30 minutes

Service windows:

- Six four-hour EFA blocks per day

Payment type: Availability (£/MW/hr)

Stacking: Low to medium

Other FSP considerations

- Stacking largely limited to other Dynamic frequency response products

Dynamic Moderation (DM) is a pre-fault frequency response service, which rapidly delivers response to assist in keeping frequency within operational limits (±0.2Hz), particularly during more volatile system conditions. The service has an operational range of ±0.015Hz and 0.2 Hz.

Providers of DM will help manage sudden large imbalances between demand and generation such as due to erroneous wind forecasting by responding quickly when frequency moves towards the bounds of the operational range.

The service is procured on a day-ahead basis, with providers bidding in for EFA block service windows.

DM is spilt up into two products, a low product (DM Low) for increased export/decreased import, alongside and a high product (DM High) for increased import/decreased export, which are tendered for separately.

22.1. Requirements/ eligibility

Assets must provide between 1MW and 50MW of capacity and be capable of remote activation. Service provision is based on provision of deviation against a baseline, which is submitted via an API in advance, on a continual basis, for up to 90 minutes in the future. Note that only integer values are currently accepted (e.g., 1MW, 2MW etc.), and part-MW values are not permitted.

Providers must be able to respond to a change in frequency and deliver response within half a second, and have the ability to provide full response delivery in one second. The provider must be capable of sustained delivery for 30 minutes.

Service providers are required to provide monitoring data to ESO via API on a continual basis. This is on a 1Hz basis (i.e., measuring every second).

Performance Data needs to be submitted to the ESO by electronic transfer on an hourly basis throughout the service day, comprising at a granularity of 20 measurements per second (20 Hz).

Aggregation of assets has been permitted to a Grid Supply Point (GSP) Group level, i.e. assets within the same one of the 14 distribution regions.

Participation is open to both BM and non-BM registered assets. There are no restrictions on technology or on connection voltage. Units will need to comply with state of energy management rules.

Assets must be pre-qualified to be registered as Eligible Assets; these are allocated to Response Units which are bid into the daily auctions. Response Units can only be adjusted weekly. Eligible assets cannot be re-allocated to different Response Units dynamically.

22.2. Opportunities and risks for FSPs

- Pay-as-clear service, scope to obtain returns above submitted bid prices. However, risk for units with high operating costs with high bid submission levels
- Limited stacking options during the duration of your contracted window of availability
- Opportunities to stack across DC and DR products following the Enduring Auction Capability commencement in October 2023
- While being a technology agnostic service, service provision has been met exclusively by battery storage units to date
- The ESO still assessing future requirement for DM, and remains capped at 100MW per EFA block

22.3. Stacking with other revenue streams

Stacking is largely not available with other services during contracted availability windows, with the BM an option to providers. However, providers stacking must maintain an appropriate state of charge, and ensure that stacking doesn't impact the unit's ability to deliver their contracted response volume.

Stacking with DC or DR products will be made available following the launch of the Enduring Auction Capability. The ESO will explore opportunities for co-optimisation of response and reserve services in the future within the EAC.

Outside of the contracted availability windows, other services can be provided, so long as the provision of these other services does not affect the ability of the asset to provide their contracted DM volumes. DM is listed as a Relevant Balancing Service, so can be stacked with the Capacity Market.

Figure 28: Stacking summary for Dynamic Moderation

Revenue stream/ Service	Stacking
Wholesale	Splitable and jumpable. Not strictly co-deliverable except utilisation in opposite direction possible
Balancing Mechanism	Splitable and jumpable, not co-deliverable
NIV Chasing	Jumpable
Capacity Market	Co-deliverable
Short Term Operating Reserve	Jumpable, not co-deliverable or splitable
Firm Frequency Response	Jumpable, not co-deliverable and implicitly not splitable
Enhanced Reactive Power Service	Splitable and jumpable
DSO services	Jumpable. Deemed not splitable with operational challenges and likely unviable. Not co-deliverable
MW Dispatch Service	Not stackable under MW dispatch requirements
Demand Flexibility Service	Not stackable under DFS arrangements
Slow Reserve	Jumpable only
Quick Reserve	Jumpable only
Balancing Reserve	Jumpable, not co-deliverable or splitable
Electricity Restoration Services	Co-deliverable and jumpable
Dynamic Containment	Splitable and jumpable
Dynamic Moderation	N/A
Dynamic Regulation	Splitable and jumpable

23. Dynamic Regulation

Summary

Response time: 2 seconds / max time to full delivery 10 second

Duration: 60 minutes

Service windows:

- Six four-hour EFA blocks per day

Payment type: Availability (£/MW/hr)

Stacking: Low to medium

Other FSP considerations

- Stacking largely limited to other Dynamic frequency response products

Dynamic Regulation (DR) is a pre-fault service supporting the management of system frequency by trying to keep frequency within the operational limits (±0.2Hz) and close to 50Hz. The service provides constant response, albeit slower compared to DC or DM, responding to adjustments in generation or demand.

Service provides will respond continuously and proportionally to frequency as it deviates away from 50Hz, between 49.8Hz and 50.2Hz, reaching full service delivery at ±0.2Hz. Frequency is allowed to deviate within a small 'deadband' region of ±0.0.15Hz, before DR will be triggered.

DR is spilt up into two products, a low product (DR Low) for increased export/decreased import, alongside and a high product (DR High) for increased import/decreased export, which are tendered for separately.

23.1. Requirements/ eligibility

Assets must provide between 1MW and 50MW of capacity and be capable of remote activation. Service provision is based on provision of deviation against a baseline, which is submitted via an API in advance, on a continual basis, for up to 90 minutes in the future. Note that only integer values are currently accepted (e.g., 1MW, 2MW, etc), and part-MW values are not permitted.

Providers must be able to respond to a change in frequency and deliver response within two seconds, and have the ability to provide full response delivery in ten seconds. The provider must be capable of sustained delivery for 60 minutes.

Service providers are required to provide monitoring data to ESO via API on a continual basis. This is on a 1Hz basis (i.e., measuring every second).

Performance Data needs to be submitted to the ESO by electronic transfer on an hourly basis throughout the service day, comprising at a granularity of either 2 measurements per second (2Hz) or 20 measurements per second (20 Hz).

Aggregation of assets is permitted to a Grid Supply Point (GSP) Group level, i.e., assets within the same one of the 14 distribution regions.

Participation is open to both BM and non-BM registered assets. There are no restrictions on technology or on connection voltage. Units will need to comply with state of energy management rules.

Assets must be pre-qualified to be registered as Eligible Assets; these are allocated to Response Units which are bid into the daily auctions. Response Units can only be adjusted weekly. Eligible assets cannot be re-allocated to different Response Units dynamically.

23.2. Opportunities and risks for FSPs

- Pay-as-clear service, scope to obtain returns above submitted bid prices. However, risk for units with high operating costs with high bid submission levels

- Limited stacking options during the duration of your contracted window of availability
- Opportunities to stack across DC and DM products following the Enduring Auction Capability commencing in October 2023
- While being a technology agnostic service, service provision has been met exclusively by battery storage units to date
- As a biproduct of the phase out of the monthly Dynamic FFR service, the ESO is increasing the service requirement for DR from the previously capped 200MW per EFA block to 350MW by December 2023

23.3. Stacking with other revenue streams

Stacking is largely not available with other services during contracted availability windows, with the BM an option to providers. However, providers stacking must maintain an appropriate state of charge, and ensure that stacking doesn't impact the unit's ability to deliver their contracted response volume.

Stacking with DC or DM products will be made available following the launch of the Enduring Auction Capability.

Outside of the contracted availability windows, other services can be provided, so long as the provision of these other services does not affect the ability of the asset to provide their contracted DR volumes. DR is listed as a Relevant Balancing Service, so can be stacked with the Capacity Market.

Figure 29: Stacking summary for Dynamic Regulation

Revenue stream/ Service	Stacking
Wholesale	Splitable and jumpable. Not strictly co-deliverable except utilisation in opposite direction possible
Balancing Mechanism	Splitable and jumpable, not co-deliverable
NIV Chasing	Jumpable
Capacity Market	Co-deliverable
Short Term Operating Reserve	Jumpable, not co-deliverable or splitable
Firm Frequency Response	Jumpable, not co-deliverable and implicitly not splitable
Enhanced Reactive Power Service	Splitable and jumpable
DSO services	Jumpable. Deemed not splitable with operational challenges and likely unviable. Not co-deliverable
MW Dispatch Service	Not stackable under MW dispatch requirements
Demand Flexibility Service	Not stackable under DFS arrangements
Slow Reserve	Jumpable only
Quick Reserve	Jumpable only
Balancing Reserve	Jumpable, not co-deliverable or splitable
Electricity Restoration Services	Co-deliverable and jumpable
Dynamic Containment	Splitable and jumpable
Dynamic Moderation	Splitable and jumpable
Dynamic Regulation	N/A

24. Intertrips

We have included Intertrips within the main report as the commercial scheme is available to DER as well as transmission connected assets. However we have not provided a summary of stacking as provision of intertrips is likely to functionally mutually exclude and asset from providing all other services.

24.1. Overview

An “Intertrip” is the ability of a generator or demand user to automatically disconnect from the NETS. An Intertrip is triggered in response to a particular event on the network, that if left unaddressed could result in a wider network failure. Network events that result in an Intertrip response are usually localised and can encompass sudden fluctuations in renewable generation, equipment failure, excessive load, changes in system voltage/ frequency. They may also be needed to support the network more widely.

24.2. Opportunities for DER

DER assets such as DSR, energy storage systems and other flexible generation plant have the potential to harness value from Intertrips. With the ability to alter their energy export (or import) rapidly, they are able to respond to real-time grid conditions. There is also a part to play in maintaining grid stability and minimising disruptions arising from other sources.

Being able to successfully take advantage of the opportunities requires the asset owner or operator to consider:

- Technical capability/compatibility – the ability of the asset to seamlessly operate within the grid’s wider control systems
- Economic viability – whether the reward for participation fits within the overall value stack for the asset. Providing an Intertrip may result in other opportunities becoming unavailable as the asset is offline
- Availability – whether the asset can respond when needed

24.3. Intertrip service

The service is procured by the ESO and falls into two types:

- **Operational** – the ability to provide the service is a condition of connection to the transmission network
- **Commercial** – agreed at the time of connection or on an ad-hoc basis where the ESO identifies need for capability in a particular area

The commercial service is accessible to DER. These assets likely require transmission network access (because of their size/ desire to participate in the Balancing Mechanism) they will have an agreement with the ESO.

24.4. Payments

Fee levels are negotiated with the ESO directly and usually take the following structure:

- Arming fee – paid when the Intertrip is armed by the ESO (£/settlement period)
- Capability Payment – annual payment to cover the installation of the scheme and staff training costs (£/settlement period)
- Intertrip – fee to cover the cost of wear and tear and any appropriate fuel costs (£/Generating Unit)

If called, the asset will be disconnected from the network and so other energy-/ frequency service-related activities will be curtailed. The operator will have to weigh up the benefits of offering Commercial Intertrip service against the loss of value from other activities.

25. Appendix 2 | Glossary

Figure 30: Glossary

Name	Acronym	Explanation
Applicable Balancing Service Volume Data	ABSVD	Used to account for volumes dispatched by the ESO for balancing services
Balancing and Settlement Code	BSC	Electricity industry code covering the rules for the Balancing Mechanism and the settlement of imbalance charges in GB
Balancing Mechanism	BM	A mechanism that enables the ESO to instruct generators and suppliers to vary electricity production or consumption close to, or in, real time in order to maintain safe operation of the system
Balancing Mechanism Bid Offer Acceptance	BOA	Instruction issued by the ESO when accepting a Bid or Offer submitted by a BSC Party
Balancing Mechanism Unit	BMU	The units used under the BSC to account for all energy that flows on or off the Total System (the Transmission System and each Distribution System combined)
Capacity Market	CM	The government's flagship energy security scheme
Capacity Market Notice		The ESO publishes a Capacity Market Notice when either: (i) the ESO gives a Demand Reduction Instruction and/or an Emergency Manual Disconnection Instruction to one or more DNOs; (ii) an Inadequate System Margin is anticipated to occur in a Settlement Period falling at least 4 hours after the expiry of the current Settlement Period; or (iii) an Automatic Low Frequency Demand Disconnection takes place
Capacity Market Volume Reallocation		A notification of Traded Capacity Market Volume in relation to one or more Settlement Periods
Capacity Provider		A generator or demand side response provider that holds a Capacity Market Agreement
Demand Side Response	DSR	Allows businesses and consumers to turn up, turn down, or shit demand in response to signals from the wider system

Name	Acronym	Explanation
Distribution Network Operator	DNO	Companies licesned to distribute electricity in GB by Ofgem
DNO Flexibility Services		One of the four active power services procured by DNOs: Sustain, Restore, Secure and Dynamic
Enduring Auction Capability	EAC	The EAC has been developed by the ESO to host the bidding processes for its flexibility services inhouse using its own single platform. It will provide for a range of cross-compatibility and co-optimisation of bids across services.
Energy Contract Volume Aggregation Agent	ECVAA	The organisation that BSC parties submit their contract positions to
Energy Forward Agreement Block	EFA Block	A four hour period, identified by its start time, weekday/weekend and season, typically referenced regarding wholesale trading periods, but increasingly being used for balancing services
Energy Imbalance Volumes		The difference between the amount of electricity tht a compnay has contracted to generate or consume and the amount of electricity which the copmany generated of consumed
Fast Reserve	FR	A Balancing Service procured by National Grid ESO
Final Physical Notificiation	FPN	The level of Import or Export that the Party expects to Import or Export from a given BMU in a given Settlement Period, in the absence of any BOA from the ESO
Firm Frequency Response	FFR	A Balancing Service procured by National Grid ESO
Flexibility Service Provider	FSP	A provider of flexibility services, including BSPs and parties that are not BSPs, but not including BRPs
Gate Closure		For each Settlement Period, the spot time 1 hour before the spot time at the start of that Settlement Period
Grid Code		A technical specification which defines the parameters a facility connected to a public electricity network must meet to ensure sate, secure and economic functioning of the electricitiy system
Local Constraints Market	LCM	A Local Constraint Market (LCM) has been developed by National Grid ESO for the B6 boundary, where it procures support from distributed assets to support constraint management.
National Grid Electricity System Operator	ESO	Licensed operator of the GB Transmission system

Name	Acronym	Explanation
Net Imbalance Volume	NIV	The volume of overall System energy imbalance, as a net of all System and energy balancing actions taken by the ESO for the Settlement Period
Power Purchase Agreement	PPA	A contract between two parties, one of which generates electricity (the seller) and one which is looking to purchase electricity (the buyer)
Satisfactory Performance Days		A Capacity Provider in the CM must demonstrate capacity at a level equal to or greater than its Capacity Obligation for at least one Settlement Period on three separate days, each of which is a "Satisfactory Performance Day", during the Winter of the relevant year
Settlement Period		A period of 30 minutes beginning on the hour or the half-hour
Short Term Operating Reserve	STOR	A Balancing Service procured by National Grid ESO
System Stress Event		A Settlement Period in which an ESO Instigated Demand Control Event occurs where such event lasts at least 15 continuous minutes (whether the event falls within one Settlement Period or across more than one consecutive Settlement Periods, and where the event falls across multiple consecutive Settlement Periods, each of those Settlement Periods)
Trans European Replacement Reserve Exchange	TERRE	A balancing product implementation project, developed by a group of European Transmission System Operators, including National Grid
Virtual Lead Parties	VLP	An aggregator of SVA-registered generating units which can participate in the BM

26. Appendix 3 | New services in development in the GB market

This section summarises services in development in the GB market but that are not yet fully functional or commercial terms, or availability requirements are not yet fully understood.

26.1. Stability Market

Summary

Service windows:

- Day-ahead market: Six four-hour EFA blocks per day
- T-1 and T-4 markets: baseload availability

Payment type

- Day-ahead market: Utilisation (£/MW/hr)
- T-1 and T-4 markets: Availability (£/Settlement Period), Utilisation (£/MW/hr)

Stacking: TBC

Other FSP considerations

- Availability requirements may limit stacking opportunities

The proposed Stability Market is building upon the work stemming from the Stability Pathfinder, which have seen three phases to date, ran by the ESO, looking to procure inertia and short circuit level in specific regions of GB.

This service builds upon that, and looks at creating an enduring market solution, rather than ad-hoc pathfinders – in order to secure inertia, but to also provide an investment signal for more nascent technology types.

Overall, the service would be spilt into three markets, a day-ahead market – aimed at procuring inertia close to real-time, a year-ahead (T-1) market – to provide some long-term certainty for the ESO and service providers. Lastly, the long-term market (T-4) market. This market will be exclusively for new build sites, or existing assets undertaking additional investment for stability capability – e.g. an existing gas-fired site investing in a clutch to provide stability services.

26.1.1. Requirements/ eligibility

Participating assets must have the capability to provide stability at 0MW and be able to meet the varying availability requirements of 100% availability for the day-ahead market and 90% availability for the T-1 and T-4 markets.

The T-4 market will be exclusive to new build sites or existing assets investing in additional stability capability. The duration of contracts available in the T-4 market will differ based on the unit type. New builds will be awarded 10+ year contracts, while enhanced capability site can secure three year long contracts.

The indicative eligibility criteria for the T-4 market, proposed in the ESOs Request for Information concerning its introduction in late 2023, noted the following criteria.

Units must have an existing connection agreement (whether already connected or due to connect in time for contract start). Providers must also either be directly connected to the transmission system, or if embedded have a User System Entry Point of 132kV.

26.1.2. Opportunities and risks for FSPs

- Availability prices across all markets will be fixed for the duration of the contract
- T-1 and T-4 markets will operate via pay-as-bid for both availability and utilisation prices, while the day-ahead market will be pay-as-clear
- The T-1 and day-ahead markets would provide an opportunity to

pathfinder sites when their current contracts expire

- Uncertainty over stacking capabilities across the three markets at present. Though may be limited by availability requirements
- Day-ahead market may be preferable to participants who may not want or be able to commit themselves to extended periods
- T-1 market to undertake first auction in winter 2023-24

26.1.3. Stacking with other revenue streams

At the time of writing, no information has been provided on the stacking of the Stability markets with other revenue streams.

The precursor to these markets, the Stability Pathfinder, was not listed as a Relevant Balancing Service, so this could possibly indicate the ability to stack with the Capacity Market in the future.

Regarding the day-ahead market, activity in alternative services outside of a unit's contracted EFA blocks could be possible, providing that the provision of these other activities does not affect the ability of the unit to provide its contracted stability.

26.2. Reactive Power Market

Following on from the High Voltage projects, the ESO began developing the Future of Reactive Power project, with *Phase 1* of the project launched April 2022. This was later put on hold in September 2022 to accommodate the development of Balancing Reserve. In summer 2023, the ESO confirmed that Phase 2 of the project was recommencing, focusing on the feasibility studies, and is expected to run until December 2023.

The currently proposed market design will see procurement of pre- and post-fault injection and absorption occur across three auctions: T-4, T-1, and day-ahead. The T-4 and T-1 auctions will take place annually, being aimed at new/retrofitted builds and existing builds, respectively. Contract lengths will be limited to a year for the T-1 auction, while contracts in the T-4 auction will be up to 15-years for new build assets. The day-ahead auction will see EFA block contract lengths.

Payment structure is currently proposed to be pay-as-bid across all auctions, with payments being made on a £/MVAr/Settlement period-basis. Payments are expected be made in both the T-4 and T-1 auctions from availability of the asset, while the day-ahead auction is anticipated to have both availability and utilisation payments.

26.2.1. Requirements

All three markets are anticipated to require a nodal locational requirement, as requirements will be calculated and communicated on a per-node basis.

Long-term market (T-4)

Providers are expected to be eligible for long-term contracts if the providing asset is a new build asset, or one which is being changed to unlock additional MVAr capacity.

Additionally, a high baseload availability is expected to be required at 95% of the contract length.

Mid-term market (T-1)

Providers are anticipated to be eligible for the mid-term market if they're pre-built and fall into the following categories:

- Obligatory Reactive Power Service (ORPS) providers [outside of their Mandatory Frequency Response (MFR) Service Agreement (MSA)]
- Existing non-ORPS providers
- Closing assets

Like the long-term market, a high availability of 95% of the contract duration is expected to be required.

Short-term market (Day-ahead)

The current design proposal indicates that all providers (including existing ORPS providers and those within their MSA range) will be eligible and the ESO will procure when economically beneficial to do so.

Availability is expected to be 100% for each EFA block.

26.2.2. Opportunities and risks for FSPs

- Regular contracts across different timescales, providing revenue certainty for extended periods (1-15 years)
- Ability to earn revenue from capabilities not available under the grid code, or ones expected to close
- High availability requirements – provider expected to be charged at their rate per settlement period of unavailability that exceeds their contracted level of availability

However, we note that as the market design remains uncertain, it is not possible to outline the associated opportunities and risks around the market with certainty.

26.2.3. Stacking with other revenue streams

At the time of writing, no information has been provided on the stacking of the reactive power service with other revenue streams, as it is listed to be one of the outstanding items for further consultation and analysis.

Given the service is being procured for reactive power response, there is a good chance that it will be stackable with active power services.

27. Appendix 4 | Service update: Enduring Auction Capability

While not a service in and of itself, the roll-out of the EAC will have a significant impact on how the ESO procures its reserve and response services. Therefore we have provided a short summary of the latest on the EAC here.

Summary

Services auctioned:

- Dynamic Response services: DCL, DCH, DML, DMH, DRL and DRH
- Reserve services: PQR, NQR, PSR and NSR

Auction design

- Location: GB synchronous area
- Auction type: closed doubled-sided auction
- Pricing: uniform clearing price per product for each service window
- Overholding allowed

Auction Frequency

- Procured in a single, simultaneous day-ahead auction held daily

Other FSP considerations

- New market design features; co-optimisation, service splitting, negative pricing and overholding

Until now the ESOs balancing services use differing platforms to host the management of bidding and auction clearing. For example, participants active in the Dynamic Response services (DC, DM and DR) submit bids on a platform operated by EPEX.

The Enduring Auction Capability (EAC) has been developed by the ESO to host the bidding processes inhouse using its own single platform. Not only will the EAC replicate aspects of the existing processes for existing balancing services, it will also look to make improvements to how auctions are run by introducing new bidding functionality and enhancements to the clearing algorithm and wider platform design.

At the time of writing the EAC platform was due to go live on 16 October 2023, with the first auction commencing on 30 October 2023.

Frequency response services (DC, DM and DR) and Quick Reserve and Slow Reserve will be procured simultaneously in a single, day-ahead, pay-as-clear auction.

27.1. Requirements/ eligibility

EAC will only be open to DC, DM and DR when launch in October 2023. Quick Reserve, Slow Reserve and Balancing Reserve will be onboarded onto the EAC once they go live in 2024. Other existing balancing services (e.g. Dynamic FFR) will not be moved onto the EAC.

Looking forward, it is the expectation that future balancing services will also commence on the EAC.

27.2. Opportunities and risks for FSPs

The auction clearing algorithm will be able to select between alternative provider bids and alternate ESO requirements to better optimise the overall market clearing. This co-optimisation approach will allow for units capable of providing more than one of the eligible services to place multiple bids in the auction for different services and let the auction clearing algorithm allocate the unit to the service that will clear the market most efficiently.

The benefit of this approach will mean that the service provider doesn't have to choose in advance which of the services to bid into the auction for.

Therefore, from go-live, the EAC will allow for participants to offer delivery for more than one frequency response service simultaneously from the same unit. Such optionality will be extended to reserve services once they go live.

Alongside the cooptimised approach inherent in the new market design, the EAC will also enable providers to bid to deliver more than one service simultaneously from the same unit in the same service window, dubbed splitting (service stacking).

Splitting will be allowed between Dynamic Response products (DCL, DCH, DRL, DRH, DML and DMH), Quick Reserve products (PQR and NQR), or between Slow Reserve products (PSR and NSR). Initially service splitting will not be allowed between response and reserve products, and Quick Reserve and Slow Reserve products will not be allowed to be mixed.

Additionally, balancing services operating on the EAC will enable providers to submit negative priced bids into services, while the ESO will allow for negative clearing prices, enabling service providers to offer to pay the ESO to provide a balancing service. At present, balancing services limit bid submissions to a price of zero.

At times this option could prove advantageous to units providing high frequency response services or negative reserve services, notably storage assets which could charge at a cheaper rate than the wholesale price.

Overholding is also allowed in the auction algorithm, meaning that the cleared volume of accepted bids in a product can exceed the ESOs service requirement in a service window if this results in a more efficient solution overall (i.e. a lower clearing price).

Figure 31: Overview of EAC co-optimisation abilities compared to current arrangements

Feature	Response	Reserve	EAC
Co-optimisation	No	No	Yes
Mutually exclusive bids	No	No	Yes
Service splitting in same window	No	No	Yes
Overholding	No	Yes	Yes
Curtailable bids	Yes	Yes	Yes
Looped bids	Yes	No	Yes
Parent-child bids	Yes	No	Yes

27.1. Stacking with other revenue streams

An outline of the service splitting (stacking) possibilites via the EAC are outlined in the table below.

Figure 32: Generation asset classification by size and location

Service/Product		DC		DM		DR		QR		SR	
		Low	High	Low	High	Low	High	Positive	Negative	Positive	Negative
DC	Low		Yes	Yes	Yes	Yes	Yes	No	No	No	No
	High	Yes		Yes	Yes	Yes	Yes	No	No	No	No
DM	Low	Yes	Yes		Yes	Yes	Yes	No	No	No	No
	High	Yes	Yes	Yes		Yes	Yes	No	No	No	No
DR	Low	Yes	Yes	Yes	Yes		Yes	No	No	No	No
	High	Yes	Yes	Yes	Yes	Yes		No	No	No	No
QR	Positive	No	No	No	No	No	No		Yes	No	No
	Negative	No	No	No	No	No	No	Yes		No	No
SR	Positive	No	No	No	No	No	No	No	No		Yes
	Negative	No	No	No	No	No	No	No	No	Yes	

Source: National Grid ESO

28. Appendix 5 | Services no longer available in GB

This section summarises those services that were available in the previous report, yet are no longer available in GB due to their retirement or replacement by the procuring entity.

28.1. Replacement Reserve

Replacement Reserve was an initiative for a unified reserve service across the EU. Following the Brexit deal, GB is no longer able to take part in the wider service. As such, this service is not available in GB.

28.2. High Voltage Pathfinder

The High Voltage Pathfinders were aimed at addressing high voltage issues at various points of the network in GB through competitive procurement of reactive power services from distribution and transmission connected assets. To date, high voltage pathfinder tenders have been carried out in two regions of GB: Mersey (2020), and the Pennines (2021). The Mersey auction aimed to secure reactive power services for a nine-year term, beginning April 2022, while the Pennines auction tendered for services over a 10-year period from April 2024.

These pathfinders are no longer being tendered, and no more are scheduled to take place at the time of writing. While this is the case, the ESO has seen the benefits from this pathfinder project in having the ability to procure reactive power services and is looking at implementing a new and enduring services.

28.3. Demand Turn Up

Demand Turn Up (DTU) was a non-BM balancing service introduced in 2016 to encourage large energy users to increase demand or reduce generation.

This was a footroom service used to manage situations of high generation and low demand that typically occurred overnight and on weekends or bank holiday afternoons.

Individual sites had to be at least 100kW, and had to be aggregated with other sites to meet the 1MW entry threshold. The service was open to true demand reduction, CHP and any other type of generation, energy storage (such as batteries) and other technologies, providing they can offer the flexibility required.

Successful providers were paid an availability payment for firm windows and a utilisation payment for megawatts delivered.

The service required providers to be unavailable for DTU if they were also declaring availability for another balancing service, and so it was not stackable or splitable. It was not an RBS for the purposes of the CM.

29. Appendix 6 | Balancing services exclusive to transmission assets

The following sections summarise the additional balancing services available only for very large scale, transmission-connected assets. As this paper is focussed on the stacking of services available for distribution-connected assets, we have moved our summary of these unavailable services to the rear of the document. In summary, the services are:

- Mandatory Frequency Response
- Obligatory Reactive Power Service
- Transmission Constraint Management

29.1. Mandatory Frequency Response

Mandatory Frequency Response (MFR) is a service that some generation assets are required to provide in the GB market to National Grid ESO. It is a critical component of grid management, ensuring stability and reliability of the system and that the frequency remains within statutory and operational limits. It involves an automatic change in an asset's active power output in response to fluctuations in system frequency.

29.1.1. Service description

The service is characterised by the time it can be provided in (response time) and how long it can be sustained for. There are three categories of service[2]:

Primary response: asset responds with 10s of a frequency event and can sustain the response for a further 20s.

Secondary response: asset responds within 30s of a frequency event and can sustain the response for a further 30 minutes.

High frequency response: asset responds within 10 seconds of an event and can sustain the response indefinitely.

29.1.2. Requirement to provide MFR

Not all assets are required to provide MFR, and their location and size are determining factors. In the GB electricity market, assets are classified as small, medium, or large depending on their physical location (i.e., where they are connected) and capacity; see Figure 33. Those considered large are required to provide the service and there is no tender or competitive requirement as it is mandatory on generators classified as large, regardless of their location.

Technical capabilities are assessed by the ESO as part of the commissioning and energisation of a new-build (or modified) asset. Once its ability to provide the service confirmed, a Mandatory Services Agreement (MSA) is put in place between the ESO and the asset owner/ operator; this enables the ESO to instruct the service(s) as required.

Figure 33: Generation asset classification by size and location

Location	England & Wales	Scottish Power (South Scotland)	Scottish Hydro Electric (North Scotland)
Small	< 50MW	< 30MW	< 10MW
Medium	50MW ≤ Asset < 100MW	N/A	N/A
Large	≥ 100MW	≥ 30MW	≥ 10MW

Source: National Grid ESO

[2] See Mandatory Frequency Response (MFR) | ESO (nationalgrideso.com)

In England and Wales, most DER are unlikely to be required to provide MFR unless they are 100MW or larger. In Scotland, smaller assets are classified as large and so more DER are likely to be captured by the requirement to provide MFR. Only the largest BESS assets in England and Wales may be captured by the requirement, while in Scotland the likelihood of being required to provide the service is higher, with many more BESS assets likely to be classified as large.

29.1.3. Payments

Generators receive two types of payment:

- **Holding payment** (£/ hour) – made for the capability of the unit to provide response when the unit has been instructed into frequency response mode. Asset owners submit their own prices for this on a monthly basis via an ESO system
- **Response energy payment** (£/MWh) – made in respect of the amount of energy delivered to/ from the system when providing frequency response. Payments for this are set out in the *CUSC* (Connection Use of System Code)

Assets are free to participate in other markets (e.g., the BM, other frequency services) provided any MFR requirements can be met.

29.2. Obligatory Reactive Power Service

Summary

Response time: two minutes
Duration: continuous
Service windows: n/a – ongoing requirement
Payment type: utilisation - £/MVArh
Stacking: fully stackable with other services
Other FSP considerations

- Only open to >47MW generators
- New reactive power markets being developed under pathfinders

Reactive power is used to control voltage, with generators absorbing reactive power to decrease voltage and generating reactive power to increase voltage. The ESO has two established services for reactive power: the Obligatory Reactive Power Service (ORPS) and the Enhanced Reactive Power Service (ERPS).

29.2.1. Requirements

The ORPS is a mandatory service for >47MW generators, who will need to have reactive power capability as set out in the Grid Code. A Mandatory Services Agreement (MSA) is put in place as part of the transmission connection process, with generators receiving £/MVArh default payments for utilisation. Generators usually receive reactive power instructions via an electronic dispatch logging system, and typically need to reach a target MVAr level within two minutes. Payments are made regardless of whether the generator has been instructed for reactive power due to natural reactive power drift.

The ORPS requires generators to:

- Be capable of supplying their rated power output (MW) at any point

between the limits 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

29.2.2. Opportunities and risks for FSPs

- The ORPS is only open to >47MW generators, and as such smaller FSPs will not be able to participate.
- While reactive power services are one of the highest areas of ancillary services spend for the ESO (£350.49mn in *2022-23*), as the ORPS needs to be provided by all generators in scope, the value will be relatively low for those assets that are mandated to participate.

29.2.3. Stacking with other revenue streams

As the ORPS is a mandatory requirement, any generator in scope will need to provide it. There are not any restrictions around the provision of other balancing services alongside reactive power.

29.3. Transmission Constraint Management

Summary

Response time: Varied
Duration: Varied
Service windows: Varied
Payment type: Varied
Stacking: Low – varied terms, infrequent requirement, but assets can jump to other revenue streams outside contracted period
Other FSP considerations

- Transmission-connected assets only

The Constraint Management Pathfinder, which has since evolved into an enduring Transmission Constraint Management service, is procured by the ESO to manage bottlenecks on the transmission system. Therefore, delivery of the service has a strong locational component and the requirements vary depending on the physical needs of the network. The constraints can include thermal, voltage and stability issues.

There have been two main constraint pathfinders: the B6 Constraint Management Pathfinder 2024-25 and the EC5 East Coast Constraint Management Intertrip Service. The procurement of more mature services under this umbrella includes the 2023 Scotland and East Anglia TCMRNs and the Static Reactive Power procurement in Mersey and the Pennines.

29.3.1. Requirements/ eligibility

The requirements and eligibility for the constraint management services are varied, given the range of constraints and challenges faced in different parts of the network. It has included units running a Stable Export Limit (SEL) overnight to support voltage needs, generation turn up with a day to six hours' notice, and the tripping of assets with 150ms of notice under the B6

Constraint Management Pathfinder 2024-25.

The requirements are clearly outlined with each published Constraint Management Requirement Notification. They will outline required location, type and speed of response, volumes required, notification period, and payment types that providers can bid into. If there are only a limited number of providers that could potentially participate in the service, it may also outline the potential service providers with the capability to provide the service.

The service only appears to be available for transmission-connected assets and flexibility providers. As such it is not compatible with non-firm connections as these are presently only available to distribution-connected assets.

Examples of requirements include: the East Anglia April 2023 TCMRN-01-23 service required assets to be at least 25MW in size and allowed the ESO to ask an asset to increase its physical notifications from zero to the contracted amount; and the Scotland July 2023 TCMRN-07-23 service included a 300MW volume requirement. In both scenarios there were less than five recognised potential providers of the service.

29.3.2. Opportunities and risks for FSPs

Opportunities

- Typically limited number of providers that can support the requirement, meaning that competition levels are low. However, prices are functionally capped by the lowest costs of alternative means to alleviate the constraint
- Range of price, service and duration types provide flexibility
- Tendered in advance, typically with circa one month's notice of the opportunity

Risks

- Unknown and highly variable requirements over the longer term requires FSPs to be aware of and respond to tenders rather than factoring these revenues into business plans
- Variable payment types depending on nature of service procured, ranging from flat availability and utilisation fees to unit prices based on day-ahead spark spreads and a pre-agreed strike price
- Some service requirements limit output in ways that may not support revenue stacking or efficient optimisation
- Only available to transmission connected assets

29.3.3. Stacking with other revenue streams

Constraint management requirements are linked to specific system needs, so will be advertised ad hoc to match each requirement, rather than following a regular timetable. The ESO will contact potential providers and, where there is sufficient competition, will seek to contract via a tender. In other circumstances, the ESO will enter into bilateral contracts with service providers.

There are operational challenges in stacking with other revenue streams. Intertrips may cut out provision of service, operating at SEL strictly limits output for provision of other services.

The Transmission Constraint Management service sits alongside the Local Constraint Market for distribution connected assets.

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