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Western Power Distribution

Impact of DSO services on the market

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Contents

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1 Executive summary

This report was prepared by Cornwall Insight for Western Power Distribution (WPD) to consider the best way to minimise the impact of Distribution System Operator (DSO) services on the wider energy market through the trialling of shorter term flexibility markets via the NODES market platform.

WPD's Project IntraFlex is a Network Innovation Allowance (NIA) funded project with NODES (the independent market operator owned by Agder Energi and Nord Pool) and Smart Grid Consultancy. Flexible Power was created in 2018 to deliver the procurement of demand response services[1].

DSO products are procured from demand side and distributed assets, also known as Flexibility Service Providers (FSP). Because they are small and distributed, these assets typically access the wider market through the portfolio of a supplier, or other Balance Responsible Party (BRP)[2].

Because of how imbalance settlement in the wholesale electricity market works, unless adjustments are made to BRP positions, BRPs could face imbalance costs if they have an FSP in their portfolio and that FSP is dispatched to provide a service to WPD.

BRPs' positions are currently adjusted in two main ways:

- **Energy Contract Volume Notifications (ECVNs)** are used to account for trading in the wholesale market. Each BRP must submit ECVNs before each Settlement Period commences, setting out what its portfolio contracted for that half-hour
- **Applicable Balancing Service Volume Data (ABSVD)** are used to account for volumes dispatched by the ESO for balancing services. ABSVD is sent after the ESO dispatches BSPs, usually by 26 Working Days

Under current arrangements, no such adjustments are made to the position of BRPs for services dispatched by WPD. BRPs (i.e. suppliers in this instance) are likely to be negatively affected by unforeseen 'long' imbalances when WPD services are dispatched, but the actual impact will depend on each supplier's trading strategy and portfolio.

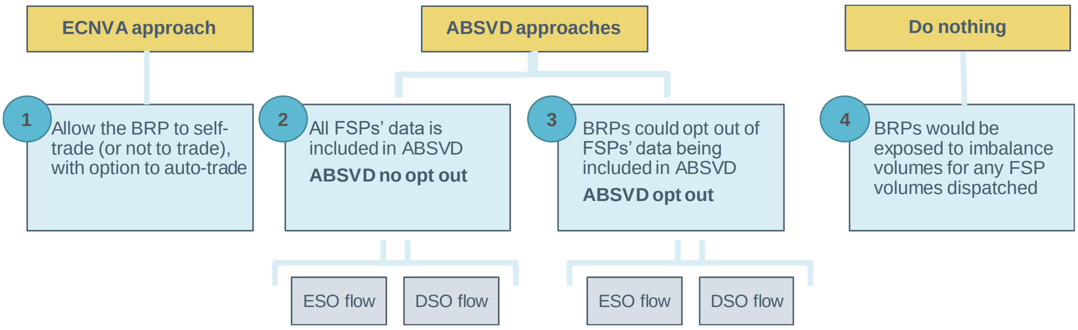
In this report, we assess using ECVNs or ABSVD to adjust BRP positions for WPD services, compared to 'do nothing' where no adjustments are made that these volumes are 'spilled' onto the system.

Our approach to assessment

We considered six options, which varied on whether ECVNs or ABSVD were used, and whether they are implemented by the Electricity System Operator (ESO) or the DSO.

[1] Flexible Power
[2] This is the European Terminology that means any party in the market that is responsible for a wholesale market position, and therefore will have an imbalance position.

Figure 1 - Overview of options (Cornwall Insight)



Cornwall Insight considered the various options (including do nothing) on the basis of:

- **Impact on consumers** – is the solution likely to result in value for money?
- **Interaction with WPD services** – how well do they fit with the timeframes for decision making and dispatch of each of WPD's services?
- **Complexity and process** – will the solution make the arrangements more or less complicated? Will implementation be more or less challenging, and will this have implications for timeliness or cost?
- **Impact on liquidity** – would the solution likely result in greater traded volumes on the ex-ante markets?
- **Impact on market participants –** generators, suppliers and aggregators?
- **Impact on network operators –** What will the likely impact be on the DSO and ESO?
- **Compliance with the Electricity Balancing Guideline (EBGL)** – how should DSO products be defined under the EBGL, and does this impact which solution is preferable?

Summary and recommendation

On the basis of our assessment we conclude:

- Both ABSVD and ECVNs could be used to adjust BRP positions for WPD services.
- The ECVN approach does not appear to be feasible for Dynamic volumes, as these are dispatched relatively close to delivery, leaving either no or a narrow window to make a trade and submit an ECVN.
- Conversely, ABSVD can be updated days after dispatch, so the deadline which exists for ECVN is not an issue.
- Interactions with the Balancing and Settlement Code (BSC) and ESO respectively will impact implementation timescales and costs:
    - Solutions implemented via the NODES project only are assumed to have the quickest implementation and lowest cost (i.e. an ECVN approach).
    - Solutions implemented with DSO-BSC interaction are assumed to have slower implementation and higher costs (i.e. an ABSVD-style approach delivered by the DSO).
    - Solutions implemented via the ESO are assumed to have the slowest implementation and highest cost (i.e. an ABSVD approach delivered by the ESO).

On this basis, two key options emerge depending on the time frame:

- In the short term the **do nothing** appears to be more suitable, as it would be possible to implement within the infra-flex project, and the given the small volumes the overall impact on suppliers is likely to be low
- In the long term an **ABSVD approach** with no opt out appears to be more suitable, on the assumption that DSO volumes increase, and treatment of these move towards a level playing field between DSO and ESO products.

2 Introduction

2.1 Purpose of study

As part of the IntraFlex project WPD is looking to minimise the impact of Distribution System Operators (DSO) services on the wider energy market through the trialling of shorter term flexibility markets via the NODES market platform. This involves the development of a new market that includes:

- Providing an information service to Balancing Responsible Parties' (BRPs) up until the intraday timeframe on any activation already committed by the DSO.
- Providing automatic rebalancing service in the intraday timeframe for trades that are being activated in the timeframe.

This trading function could be used to adjust BRPs positions to account for DSO services delivered by Flexibility Service Providers (FSPs).

Elexon has suggested WPD could achieve the same aim by treating DSO service procurement as part of the Applicable Balancing Service Volume Data (ABSVD) process. This is a fundamentally different approach to what WPD were originally proposing and as such they are keen to review the differences between the approaches. The aim would be to try and understand which option is most likely to provide best value to the end customer.

2.2 Flexible Power

WPD's Flexible Power was created in 2018 to deliver the procurement of demand response services[3]. WPD wish to enter into contracts with consumers within its distribution area to utilise demand and generation flexibility. Consumers who are able to reduce their demand for electricity during peak periods or increase energy supply using on-site power generation assets have the opportunity to enter into a demand response arrangement in return for financial payment from WPD.

Wide-scale electrification from the heat and transport sectors, combined with the growth in generation from renewables, have led to a change in demand and how power flows through the network[4]. WPD's Flexible Power is one of the solutions for balancing the changing load on the networks. Flexibility can reduce demand by utilising the consumer's ability to change their usage profile, whilst allowing consumers to reduce costs through managing peak load.

WPD currently procures for three flexibility services are outlined below in Figure 2:

Figure 2 – WPD flexibility services

Service	Requirement	Service details
Secure	To manage peak demand on the network, usually weekday evenings.	• Arming payment (max £125/MWh) • Utilisation payment (max £175/MWh) • Availability provided one week prior to delivery • Dispatch notice coincides with acceptance of availability
Dynamic	To support the network during fault conditions, often during maintenance work.	• Availability payment (max £5/MWh) • Utilisation payment (max £300/MWh) • Availability provided one week prior to delivery • Dispatch notice 15 minutes ahead of delivery

[3] Flexible Power
[4] Western Power Distribution – Flexibility & flexible power

Restore	To support the network during faults that occur as a result of equipment failure	• Availability payment (max £600/MWh) • Dispatch notice 15 minutes ahead of delivery

Source: WPD and Cornwall Insight

Under the Flexible Power scheme, WPD have held the following trials and procurement rounds:

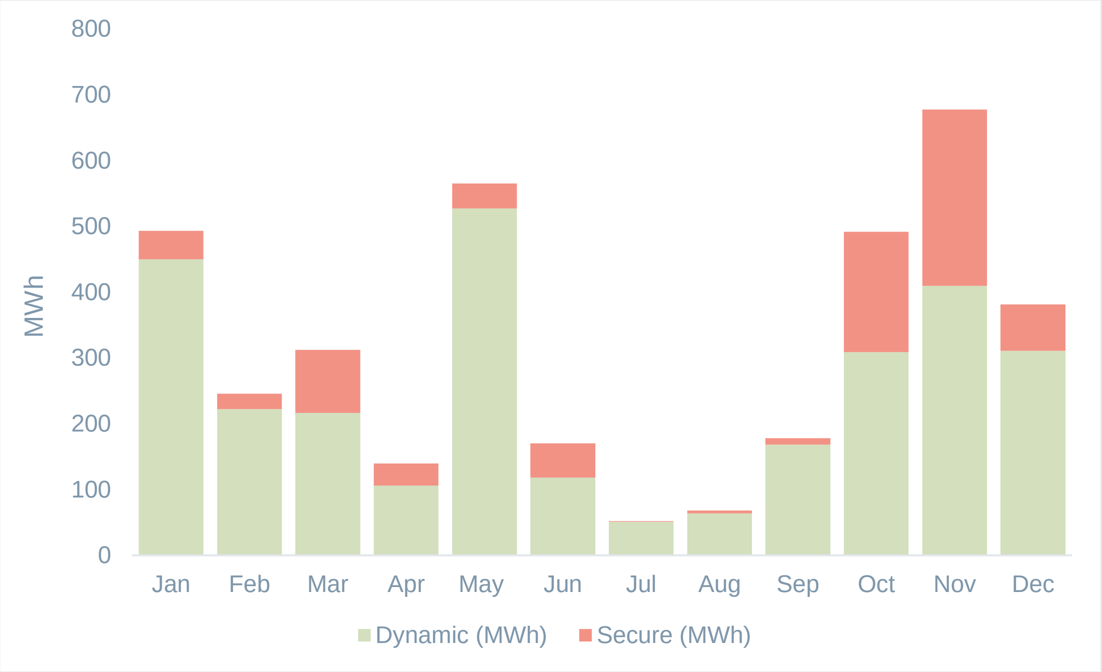
- 2017/18 – Midlands Trial
- 2018 Procurement
- 2019 Procurement Cycle 1
- 2019 Procurement Cycle 2

The next planned procurement cycles are set out below:

- 2020 Procurement Cycle 1 - January 2020
- 2020 Procurement Cycle 2 - June 2020
- 2021 Procurement Cycle 1 - January 2021

2021 Procurement Cycle 2 - June 2021 Expected volumes for WPD flexibility in 2020 are shown below

Figure 3 - Expected MWh by month and product (WPD)



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2.3 Project IntraFlex

WPD's Project IntraFlex is a Network Innovation Allowance (NIA) funded project with NODES (the independent market operator owned by Agder Energi and Nord Pool) and Smart Grid Consultancy. The two-year project (October 2019 – November 2021)[5] aims to address the disconnect between imbalance created on the electricity network by DSO flexibility service procurement.

[5] Western Power Distribution – IntraFlex

Through the NODES market platform, the project aims to create a flexibility market operating closer to real time for WPD and assist in imbalance mitigation. WPD procures active power reduction services to manage constraints under its Flexible Power. Services are procured on a week-ahead basis and this creates an opportunity to adjust the position of the flexibility providers in markets manually or automatically.

Two imbalance mitigation services will be offered in the new market:

- The first new service proposed would cover the period between week-ahead and day-ahead energy auctions, providing enhanced information on DNO actions to BRPs in these timeframes; and
- The second new service would cover the intraday timeframe, where imbalance caused by the DSO is automatically rebalanced by a trade on the intraday market.

By operating closer to real time, participants in the project will be able to procure flexibility on the IntraFlex market, whilst the day-ahead information services and auto-rebalancing function to the intra-day market will lower supplier exposure to imbalance and flexibility costs.

The project has been broken down into five work packages (WP), which are based around two trials:

1. **WP1: Project Management and reporting**
2. **WP2: Detailed Stakeholder Engagement and Market Design**

   This will refine the proposed market design through potential stakeholder engagement, validating any assumptions and value flows proposed. WPD released its *IntraFlex Initial Market Design* report in November 2019[5].
3. **WP3: NODES System and Process build**

   This will focus on the development of the NODES platform and its deployment within WPD.
4. **WP4: WPD system and Process build**

   This will include the design of new Payment Mechanics, creating a link between the NODES platform and dispatch processes, a review of procurement law and analysis on the ability to target future audits with existing data.
5. **WP5: Trial**

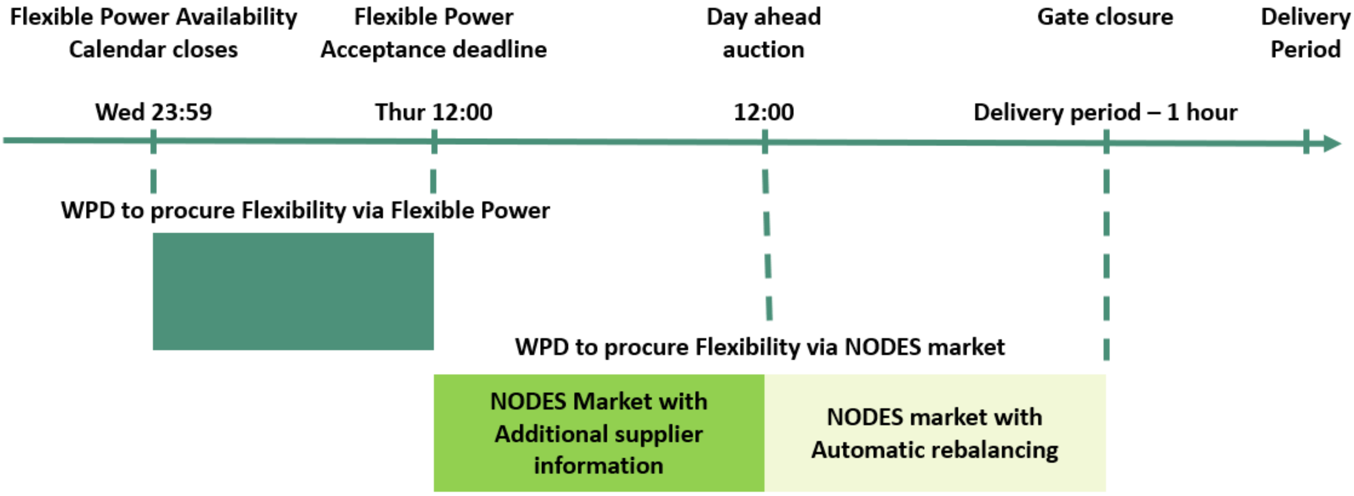
   The trial will be broken down into two sub-trials:

   1. In August and September 2020, an initial trial will test the procurement of services closer to real time, testing the basic technology and processes.
   2. In April and May 2021, a second trial will then test the project's full range of capabilities.

The Intraflex Project seeks to propose the following:

- The NODES market will be a continuous market that can be accessed at any time frame.
- WPD will use the NODES market after the current Flexible Power acceptance timeline, as per Figure 4 below.
- NODES might provide an information service to BRPs up until intraday timeframe on any activation already committed by the DSO.
- NODES will provide automatic rebalancing service in the intraday timeframe for trades that is being activated during this timeframe.

Figure 4: Market Timelines



Source: NODES

3 The wholesale market and settlement

3.1 GB wholesale market design

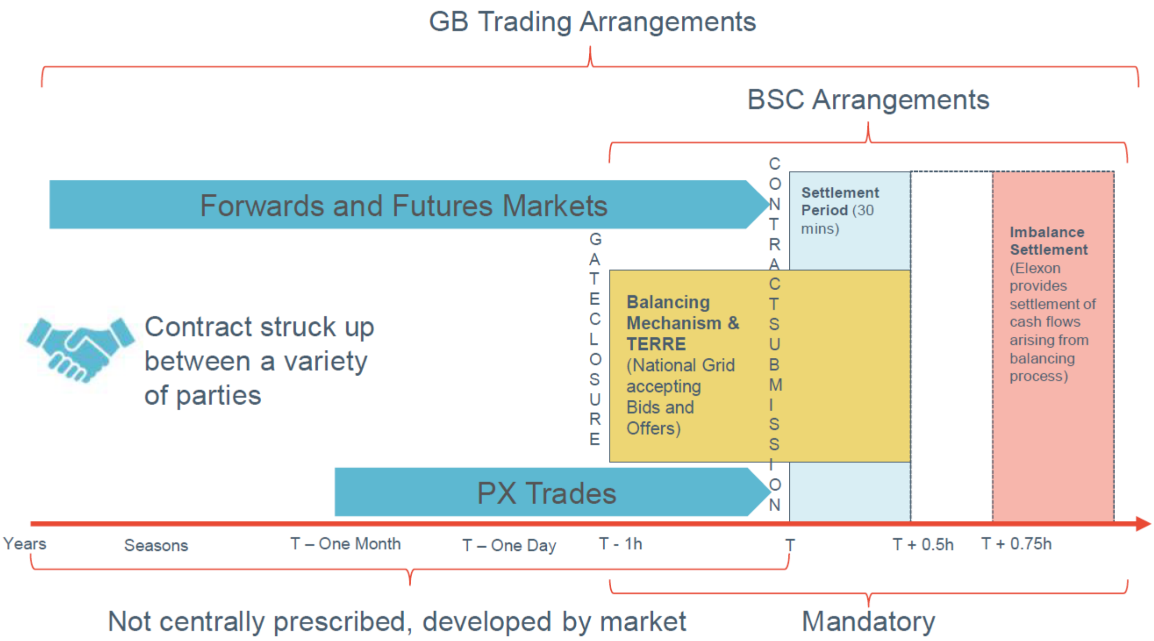
In this section we set out the key elements of the wholesale electricity market design, detailing how different market and balancing actions are accounted for in Settlement. This forms the basis for the question of how DSO flexibility products should be treated for the purposes of settlement.

3.2 Overview

The New Electricity Trading Arrangements for England and Wales (NETA) was introduced in 2001 (and then British Electricity Trading and Transmission Arrangements (BETTA) extended the arrangements to Scotland in April 2005).

As electricity is a unique product that cannot currently be stored in large amounts. Supply and demand for electricity must be matched, or balanced, at all times. This is primarily done by suppliers, generators, non-physical traders and customers trading in the competitive wholesale electricity market. Trading can take place bilaterally or on exchanges, and contracts for electricity can be struck over timescales ranging from several years ahead to on-the-day trading markets.

Figure 5: Overview of trading arrangements



Source: Cornwall Insight

Contracts can be agreed between Parties (over the counter contracts) or via an exchange e.g. APX Power UK (formerly UKPX) or N2EX. Trading is conducted anonymously on exchanges. The exchange does not seek to hold a physical position, i.e. it will always try and match sales to purchases. Once bilateral contracts are agreed, the volumes need to be notified to Elexon so these volumes can be factored into imbalance calculations via an Energy Contract Volume Notification Agent (ECVNA). This process is either conducted by one of the counterparties where the trade was bilateral (provided they have agreed which of the parties will be the authorised Energy Contract Volume Notification Agent to prevent fraud) or by the exchange.

Following gate closure for each Settlement Period, data is sent to BSC Central Services for Imbalance Settlement. Here Elexon will perform settlement calculations based on information from National Grid, metered volumes (for physical traders), registered data, contract notifications and market index data[6] from exchanges. This determines how much each party owes or is owed. This data is provided to each Party by the Settlement Administration Agent (SAA) in GB (a function performed by Elexon) in the form of electronic files with further potential adjustments possible for a period of 14 months following each Settlement Period.

3.3 Imbalance price calculation

The NETA arrangements were designed to minimise imbalances. There is notionally two kind of imbalance:

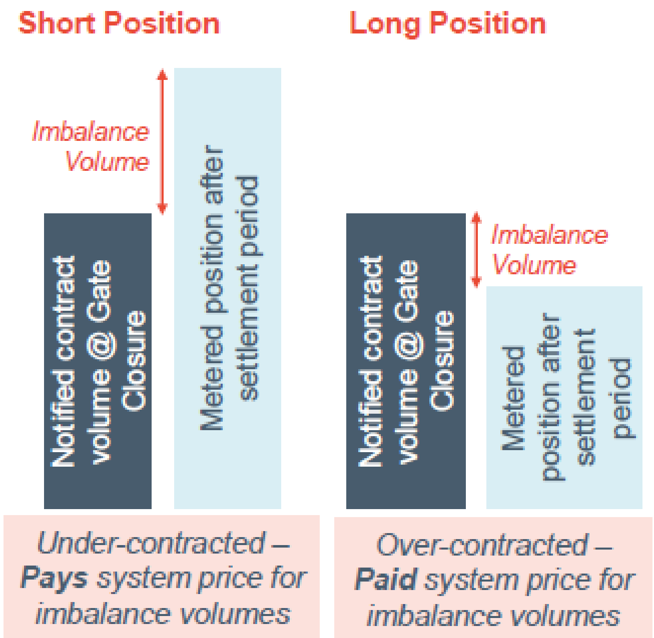
- The overall system imbalance, which must be resolved by the ESO in its role as residual balancer, using the Balancing Mechanism (BM), and other balancing tools.
- BSC party imbalances, which are differences between an individual BSC Party's traded position (as notified by Contract Notifications) and its metered position, adjusted for any balancing actions or Metered Volume Reallocation Notifications (MVRNs) (the Credited Energy Volume[7]). It is calculated on a portfolio basis.

A BSC party that is out of balance will face one of two energy imbalance prices for each Settlement Period. These are:

- System Buy Price (SBP)
- System Sell Price (SSP)

Where the BSC Party has a long imbalance (e.g. it has bought more in the market than it has consumed), it will be paid the imbalance price. Where the BSC Party has a short imbalance (e.g. it has bought less than it has consumer) it will pay the imbalance price. However, there is a single price calculation – so SBP will equal SSP in each settlement period. ELEXON apply these prices to Parties' imbalances to determine their imbalance charges.

Figure 6: Imbalance example for a supplier



[6] Market Index Data is market trade data that is used to calculate the Market Index Price (MIP), which is used in certain occasions to set the imbalance price.
[7] Credited Energy Volume (QCEiaj) is the allocation of metered volume from BM Unit to an Energy Account in Settlement Period, taking account of Transmission Loss Multipliers and applying any Metered Volume Reallocation Notices that are in force. Metered Volume Percentage Reallocations are applied after subtracting the Period BM Unit Balancing Services Volume (QBSij). This is set out in Section T4.5.1 of the Balancing and Settlement Code (BSC).

Source: Cornwall Insight

The BSC Central Systems calculate the energy imbalance price using balancing actions. These include Bid Offer Acceptances (BOAs), Balancing Services Adjustment Actions (BSAAs) and Demand Control Actions (DCAs).

The imbalance price calculation distinguishes between two kinds of balancing action that the ESO take:

- **Energy balancing actions** – balancing actions are taken purely to balance the half hourly energy imbalance of the Transmission System
- **System balancing actions –** taken for non-energy, system-management reasons, such as resolving thermal or voltage constraints.

Actions taken to resolve 'energy' imbalances are reflected in the imbalance price, whereas actions taken for system balancing reasons (i.e. network constraints) are not reflected in the imbalance price, using calculation steps know as flagging and tagging.

3.4 Energy contract volume notifications

Parties are required to notify the BSC systems of their contract positions to enable Energy Imbalance Volumes to be calculated. This is done by submitting notifications to the Energy Contract Volume Aggregation Agent (ECVAA). Notifications are submitted in relation to the relevant Party's Production and/or Consumption Energy Accounts[8]. There are two types of notification:

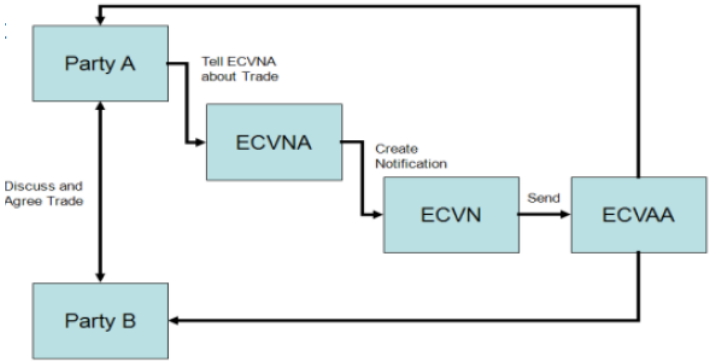
- Energy Contract Volume Notifications (ECVNs) notify the ECVAA of the volumes of energy bought and sold between two Energy Accounts. These Energy Accounts could belong to separate Parties or could both belong to the same Party.
- Metered Volume Reallocation Notifications (MVRNs) notify the ECVAA that the energy flowing to or from a particular BM Unit is to be allocated to one or more different Party's Energy Accounts for the purposes of Energy Imbalance calculations (This must be from Production Account to Production Account or Consumption Account to Consumption Account).

The process for EVCNs are outlined in the figure below. The provisions that apply to MVRNs are identical to those that apply to ECVNs except that:

- ECVNA is replaced by the MVRNA.
- In place of the Relevant Contract Parties and Energy Accounts, the MVRNA Authorisation must specify the Primary Balancing Mechanism Unit (BMU) to which it relates, the identity of the Lead Party of the Primary BMU and the identity of the Subsidiary Party and the Energy Account to which a fixed MWh or proportion is allocated

[8] Each BSC Trading Party has two energy accounts – a Production Account (historically used for generation volumes) and a Consumption Account (historically used for demand volumes).

Figure 7: EVCN process



Source: Elexon

ECVNAs and MVRNAs submit notifications to the ECVAA via an electronic data flow, an ECVAA-I004 for ECVNs and ECVAA-I005 for MVRNs. An ECVAA will receive a notification within 15 minutes confirming whether the notification has been accepted or rejected. This may create risk for parties wishing to trade 15 minutes ahead of the Settlement Period.

Elexon monitor the amounts of Contract Notifications that are rejected, with a target KPI of 2%.

Table 1 - Number of ECVNs submitted and % rejected (Elexon)

Year	Average daily number of Contracts Notified	Rejected Notifications (as percentage of total received)
2016	6,679	0.82
2017	7,009	1.71
2018	7,493	1.14
2019	7,918	1.11
2020	8,765	0.88

3.5 Metered volumes

How assets are treated for the purposes of calculating metered volumes depends on whether they are registered in the Central Volume Allocation (CVA) or Supplier Volume Allocation (SVA) systems. Transmission connection generation and large consumption sites are typically CVA, while assets connected to the distribution network are typically SVA. All CVA assets are half-hourly (HH) metered, whereas SVA assets may be half-hourly metered, or non-half hourly (NHH) metered.

Where we do not have half-hourly data (i.e. for non-half-hourly sites), we estate estimates, involving data profiling, based on consumer type (Profile Type) and overall demand.

Generally the 'bottom up' calculations of what each suppliers consumers have consumed does not match up with the amount of energy that flows into the GSP Group. This may happen for a number of reasons[9]. To true up the data, NHH consumers have their consumption scaled up or down, using the GSP Group Correction Factor. In a perfect world the demand would match the GSP Group Take and GGCF would equal 1.0. In practice, a GGCF between 0.9 and 1.1 is considered acceptable.

HH sites are able to provide accurate data so do not have GGCF applied.

[9] For example inaccuracies arising from the use of Profiles to allocate Non Half Hourly (NHH) metered volumes to a particular Settlement period; errors and approximations in the calculation of Line Loss Factors; metering system errors and meters that have the incorrect energisation status; incorrect actual or estimated Meter Advances; undetected theft and detected theft not settled; and errors related to Unmetered Supplies (UMS).

3.6 Managing imbalance

Energy market participants will have different strategies with regard to imbalance, including:

- Minimise imbalance exposure and seek to match contractual position to physical position.
  - This could be through trading in advance or adjustments ex post due to third party control of consumption or optimisation (such as Project TERRE or balancing services participation by a third party).
- Aim to match contractual position to physical position, but with a slightly 'long' position to avoid the risk of having a short imbalance and potentially higher prices
- Choose to be exposed to the imbalance price as it may be better than the market traded price, known as imbalance chasing or Net Imbalance Volume (NIV) chasing.

In reality the decisions on imbalance exposure will be determined by the governance and risk structure within the organisation. Many suppliers in the market have traditionally sought to minimise the level of imbalance exposure and be on the right side (long). Flexible and renewable generators have increasingly sought to target being in imbalance internationally, or, because of forecasting uncertainty, left the position open for imbalance. In addition, the metered position in any given settlement period will depend on the forecasting of the organisation or generation reliability of that party.

3.7 Interaction between imbalance and balancing cashflows

Imbalance and balancing are separate but related concepts and processes in GB. The ESO's energy balancing costs are reflected in imbalance charges, so there is a relationship, however they are separate cashflows and processes, governed by different parties.

Total ESO balancing costs are charged to parties via BSUoS charges; whereas any monies left-over after imbalance charges have been paid redistributed through the through the residual cashflow reallocation cashflow (RCRC).

Both RCRC charges/payments and BSUoS charges relate to imbalances on the system and, as such, are closely linked. Under the current market arrangements most Parties who pay BSUoS charges are also subject to RCRC[10].

Balancing Services Use of System (BSUOS) Charges are a half-hourly charge that National Grid ESO uses to recover its balancing costs for a given half-hour. It recovers off of ESO's balancing and operational costs, including the balancing mechanism, constraints, STOR.

RCRC is a separate but related cashflow to BSUoS, which covers the redistribution of the cashflow received by Elexon from energy imbalance charges. It is generally much smaller, and has usually been a payment to rather than charge to generators.

BSUoS and RCRC are seen as 'two sides of the same coin'. This is because some of National Grid's balancing costs are reflected in imbalance prices, which are charged to out-of-balance parties. By redistributing RCRC, this can be seen as a rebate to parties that were balanced in the market, by effectively reducing the balancing costs they pay.

The distribution of both BSUoS costs and RCRC is based on MWh used (also called Credited Energy Volumes in the BSC11). Trading Parties will often be liable for both BSUoS charges/payments and RCRC charges/payments simultaneously and will pick up the same proportion of each. The exception is when a

[10] An exception is embedded generators that do no currently pay BSUOS and instead receive an Embedded Benefit until 2021
[11] Credited Energy Volume (QCEiaj) is the allocation of metered volume from BM Unit i to Energy Account a in Settlement Period j, taking account of Transmission Loss Multipliers and applying any Metered Volume Reallocation Notices that are in force.

BMU is subject to a Metered Volume Reallocation Notification (MRVN)[12]. This is because BSUoS is covered by the Connection Use of System Charge (CUSC) and so tied to an individual generation asset rather than at the Trading Party level.

[12] Meter volume reallocation notifications (MVRNs) are an established BSC process that allows metered volume to be transferred from one BSC Party to another.

4 Applicable Balancing Services Volume Data

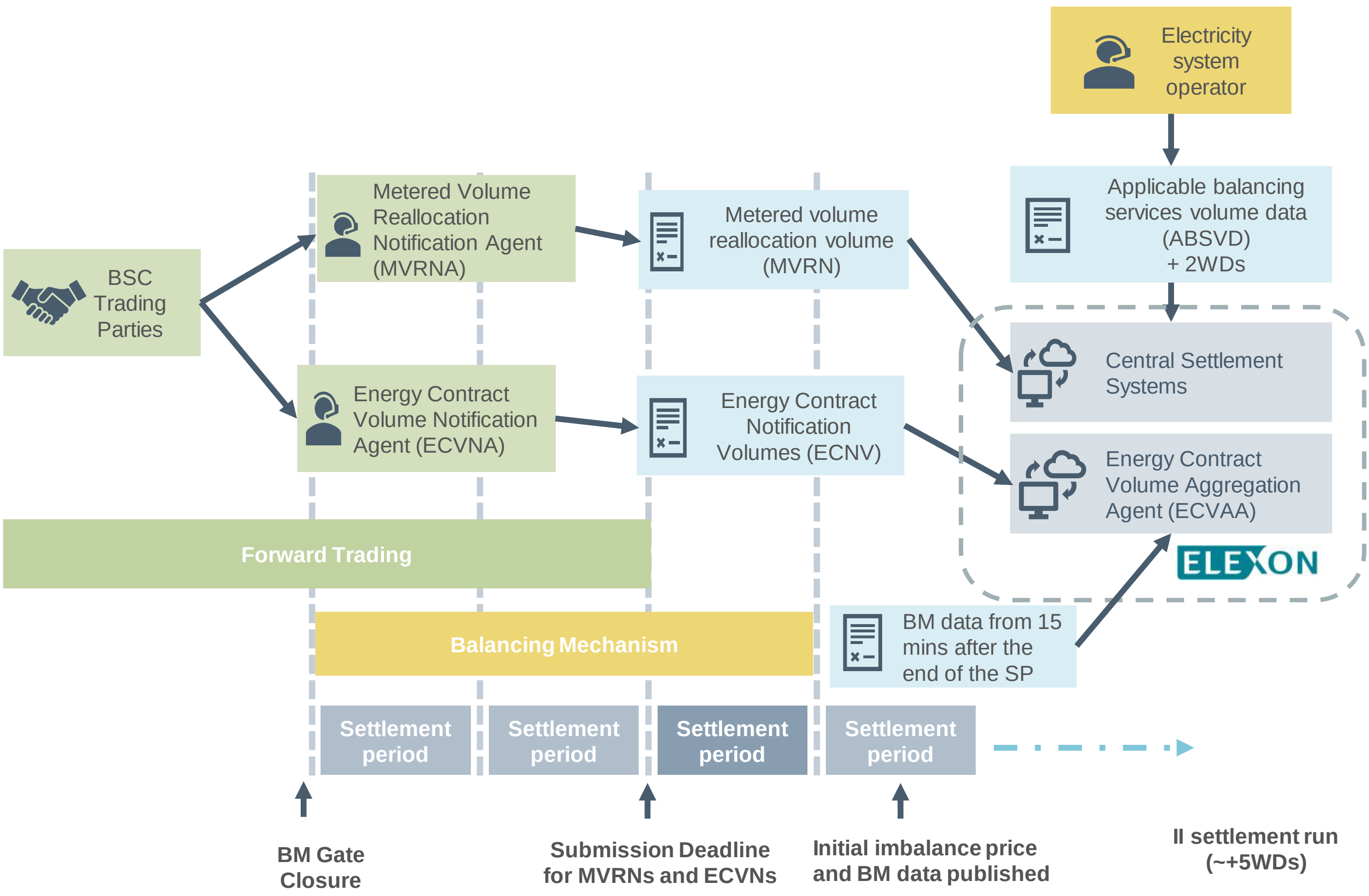
In this section we set out how Applicable Balancing Services Volume Data (ABSVD) is used to ensure that no party in the market is negatively affected by balancing actions taken by the ESO.

4.1 Overview

As the ESO, National Grid procures Balancing Services as part of its responsibility to ensure the network is operated safely and securely, whilst maintaining supply and demand.

When a Balancing Service Provider (BSP) delivers a balancing service for the ESO, these volumes are accounted for in the Energy Accounts of the associated Balancing Responsible Parties (BRPs) accordingly, ensuring that the relevant BRPs do not suffer or benefit through imbalance arrangements from actions taken by the associated BSP. This means that an ESO-instructed action to a BSP should never have an impact on a BRP.

Figure 8 - Overview of ABSVD and ECVNA data-flows



Source: Cornwall Insight

4.2 Who makes the adjustment?

There are two ways that Balancing Services are accounted for when calculating BSC imbalance positions:

- For BOAs taken in the BM, these adjustments are made automatically as part of the BM processes; and
- For balancing actions taken outside the BM, these adjustments are made as part of Applicable Balancing Services Volume Data (ABSVD).

Applicable Balancing Services Volume Data (ABSVD) refers to the data related to the Balancing Services volumes taken outside the BM, which are sent to the Settlement Administration Agent (SAA) or Elexon. The SAA then includes the ABSVD in the Settlement calculation as an adjustment to the imbalance position for the BMU's Lead Party[13]. This ensures that the affected BSC Parties' imbalance positions are calculated correctly.

4.3 What is contained in ABSVD applied?

Balancing Services are defined in the Transmission Licence, and National Grid is required to establish them in accordance with Standard Condition C16 of the Transmission Licence. Standard Condition C16 also required National Grid to maintain the ABSVD statement. The purpose of the ABSVD methodology statement[14] is to set out the kinds of Balancing Services National Grid that will be accounted for as part of the ABVSD process.

Applicable Balancing Services are, in general, those services required by the ESO for economic operation of the transmission system, that result in the service provider being exposed to imbalance charges whilst assisting in system balancing. For the avoidance of doubt, a consultation will be carried out prior to any further Balancing Services being included in the calculation of ABSVD.

The following Applicable Balancing Services contracts will be included in the calculation of the ABSVD as of 1 April 2020:

- Short Term Operating Reserve (STOR)
- Mandatory Frequency Response
- Fast Reserve
- Commercial Intertrips
- Fast de-load service (contraint management)
- Maximum generation service
- System to generator operational intertripping

Providers can opt-out from ABSVD when delivering mandatory frequency response.

Currently some of the Balancing Services are treated differently, depending on the mechanism used to dispatch and settle them. For example:

- Where the Balancing Service is dispatched using a BOA, an adjustment will always be made to imbalance, which is separate of ABSVD process.
- Where the Balancing Service is not dispatched using a BOA, and the Transmission Company (TC) is able to allocate the volume to a BMU, an adjustment may be made to imbalance depending upon whether the Lead Party opts out of having ABSVD allocated to their account.
- Where the Balancing Service is not dispatch using a BOA and the TC is not able to allocate the volume to a BMU, no adjustment can currently be made to imbalance.

DSO services are not covered by ABSVD under the Transmission Licence.

[13] means, in relation to a BM Unit, the Party registered or to be registered in respect of the BM Unit pursuant to Section K3

[14] https://www.nationalgrideso.com/document/89606/download

4.4 Adjustment

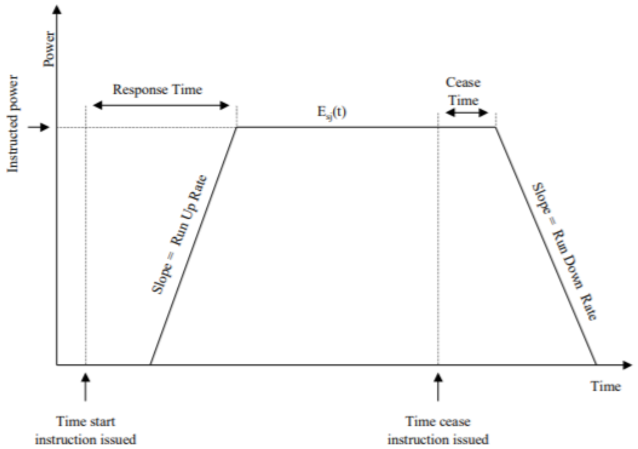
The ABSVD volume adjustment is made to the instructed volumes under the Balancing Service requirement and not to the actual delivered volume. If the BRP fails to meet the requirement or over deliver then they will be in imbalance and subject to system charges.

With regard to ramp up, ramp down and cease times, generally they are not part of the ABSVD calculation as they are specifically excluded from the calculation (ramp up or down) or set to zero response time.

The calculation for ABSVD for STOR and Fast Reserve is shown below. This is used to determine the volumes from individual BSPs to be applied to the accounts of the BRPs they are associated with. To do this, a 'slope' or 'ramp rate' is calculated on the basis of pre-agreed run up rates, run down rates, response time, and the instructions given to the BSP to provide a balancing service.

This volume is then included in the BSC calculation for 'Period BM Unit Balancing Services Volume', which represents all energy associated with balancing services (i.e. BM bids and offers as well as balancing services) used in the determination of imbalance of a BRPs position.

Figure 9: ABSVD Methodology for calculating volumes to be adjusted for STOR and fast reserve



Source: National Grid ABSVD Methodology

4.5 When is ABSVD applied?

The ABSVD for action taken in the BM is automatically provided by the TC. For non-BM actions the change under P354 ensured that the TC would provide ABSVD for each applicable Settlement Period to BSC Systems.

As per Section Q 6.4.1 of the BSC, the ABSVD data should be provided no later than the second business day after the settlement day. However, in practice, some data may not be provided until the SF, or the R1 settlement run at the latest[15]

4.5.1 Changes to ABSVD – P354: Use of ABSVD for non-BM Balancing Services at the MPAN level

As of April 2020, there is a limitation where Balancing Services are instructed by National Grid outside of the BM. There is no mechanism in place to enable ABSVD is assigned to the associated BRPs, potentially

[15] This was noted for non-BM data to be included in suppliers Settlement Positions as part of the development of P354. They are in part constrained based on the contractual terms of the non-BM Balancing Services contracts.

resulting in an additional payment or cost to the BRP for the imbalance created. In practice, this resulted in the emergence of 'spill' payments to the BRPs of the BSP (which were often passed onto the BSP).

In January 2017, ENGIE submitted a BSC Modification Proposal Form for P354[16]. The purpose of modification was to allow National Grid to provide ABSVD volume at the Meter Point Administration Number (MPAN) level and have the SAA allocate it to the appropriate Supplier BMU. P354 will remove the defect which currently means that BSPs that are not dispatched through the BM gain an additional payment that BM BSPs do not receive. ENGIE believed the current methodology is distorting STOR market competition and potentially increasing the balancing costs faced by consumers.

P354 seeks to address this defect by:

- Identifying and implementing a mechanism to identify the Suppliers responsible for the Metering Systems that contribute to the Applicable Balancing Services; and
- Allocating the appropriate energy volumes to their accounts which will then be included in the Settlement calculation, resulting in the affected BSC Parties' imbalance positions being calculated correctly.

P354 Proposed Modification will be implemented on 1 April 2020 as a standalone BSC Systems Release[17].

4.6 ABSVD application DSO services

4.6.1 Options

Currently ABSVD cannot be used for DSO services as it is a function that comes from the electricity Transmission Licence. Standard Condition C16 requires Applicable Balancing Services be taken into account under the BSC when determining imbalance volumes.

To implement ABSVD for DSO services the following changes or options could be made:

- Option 1: Include a requirement in C16 for the ESO to coordinate with DSOs when calculating ABSVD.
  - This would require new communication and systems within the ESO and DSOs and then reporting this data to Elexon for imbalance.
- Option 2: Create a "C16" condition within the distribution licence to create a DSO ABSVD methodology statement.
  - This would then need changes within BSC Section Q to accept and account for DSO ABSVD.
  - This would need new communication and systems within the DSOs and Elexon to share and calculate data.

Option 1 would most likely be quicker and demonstrate a collaborative approach with the ESO on all future services, but would likely create challenges for the ESO on coordination and managing their exposure to the changes.

Regardless of the options, changes would be required to the BSC Section Q to include new DSO service activities within the BSC which is separate of the changes in the options above.

4.6.2 Timeline

It is difficult to ascertain the exact timeline of the changes, but Cornwall Insight would expect it to take a minimum of one and a half years, but possibly up to four years based on the following changes.

- C16 licence consultation is in Winter 2020 – so potentially up to nine months before this can start, although it would be possible to start on the mechanisms to take this forward now.

16 Elexon – P354 Proposal Form

17 Elexon – P354

- Six months to one year for a workgroup in the BSC to be established and implement changes.
- System, licence and further code changes could add to this timetable.

4.6.3 Systems

The implementation of the ABSVD could likely be done in the same way as that implemented under P354, except that it would be the DSO providing ABSVD for each applicable Settlement Period to BSC Systems as a Delivered Volume for each Metering System Identifier (MSID) Pair (always one Import Meter and in most cases one Export Meter) at a Boundary Point (a "MSID Pair Delivered Volume"). The BSC Systems will aggregate the MSID ABSVD to Supplier BMU level and use this to correct the Supplier's Energy Imbalance position.

New DSO systems would be required to ensure that they can get the relevant ABSVD data to National Grid in time to be included in imbalance settlement calculations. As per Section Q 6.4.1 of the BSC, the ABSVD data should be provided no later than the second business day after the settlement day, so this would be expected to be the same timing for a DSO data provision.

4.6.4 Costs

The implementation of P354 was expected to cost £300k for central implementation to allow for changes to BMRS, Trading Operations Market Analysis System (TOMAS) system and other changes.

Given that this would require new parties and new modifications to the existing flows from a new participant then Cornwall Insight expect the cost for the changes in systems to be significantly higher due to the new links and six DSOs involved.

5 Market review of other balancing services and contracts

5.1 Introduction

This report is phase two of the intra-flex work that Cornwall Insight are carrying out for WPD. This report reviews balancing services and contracts in GB, and how they interact with the wider market, in particular imbalance settlement for Balance Responsible Parties (BRPs).

This work builds upon work done for WPD as part of phase 1 of this project, which looked at options that WPD could use to manage the exposure potentially caused by DSO balancing actions, as well as a report called *WPD DSO Services Revenue Stacking*, which provides an overview of all flexibility revenues, and how they fit together.

For each balancing service listed in this report, we set out:

- Overview of the service.
- How are they procured, by whom and when?
- When they are dispatched or incentivised to deliver.
- How data associated with the action is reflected in imbalance settlement calculations.

Please note the following services are excluded because they are either on hold or in the early stages of development (either Expression of Interest or Request for Information) in which the specific details around data flows are known, these include:

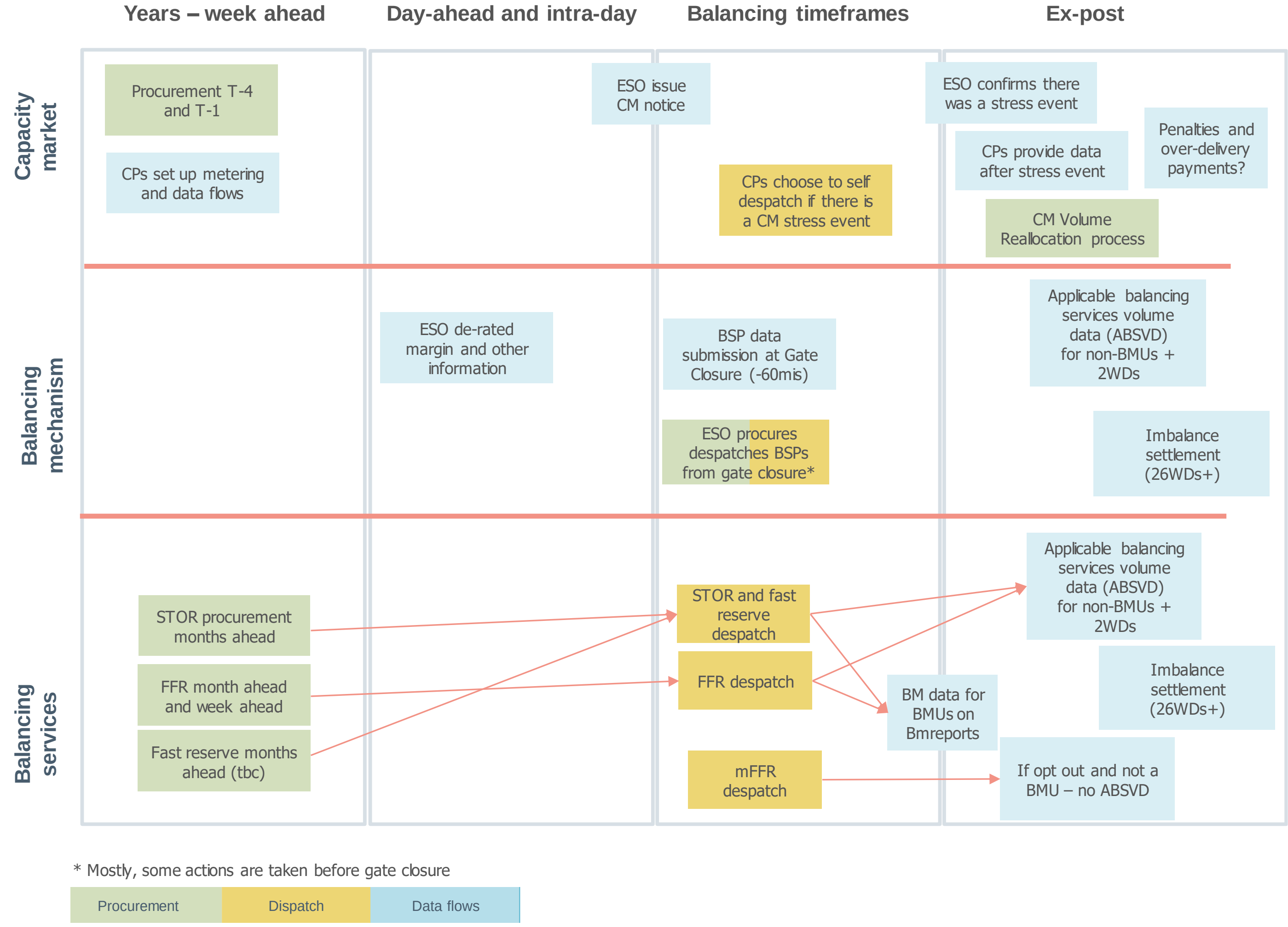
- Black Start – ReStart
- Pathfinders – Reactive, Constraint and Stability
- Reactive – via power potential

In Figure 10 we present an overview of the key services in GB – showing a timeline of when they are procured, despatched and how the data flows are accounted for. We will explain the detail of each of these activities in this report.

In summary:

- When capacity is procured (and paid for) differs depending on the service.
- For ESO Balancing Services there is a difference between how data for assets in the BM (BMUs) is treated, compared to assets that do not have BMUs. Data for BM activity is usually available within 15 minutes after the end of the Settlement Period.
- Not all Balancing Services result in adjustments to a BRP’s or a Capacity Provider’s position – Mandatory Frequency Restoration Reserve (mFRR) providers can opt out of ABSVD and only Balancing Services included in the list of Relevant Balancing Services will be reflected in a Capacity Provider’s CM obligation.
- Due to the imbalance process, BRPs’ imbalance positions are determined ~26WDs after the fact. Although some data is available at 15 minutes ahead, other data within 5WDs, imbalance calculations happen at a later stage.

Figure 10 - Overview of procurement, despatch and dataflows for key services



Source: Cornwall Insight

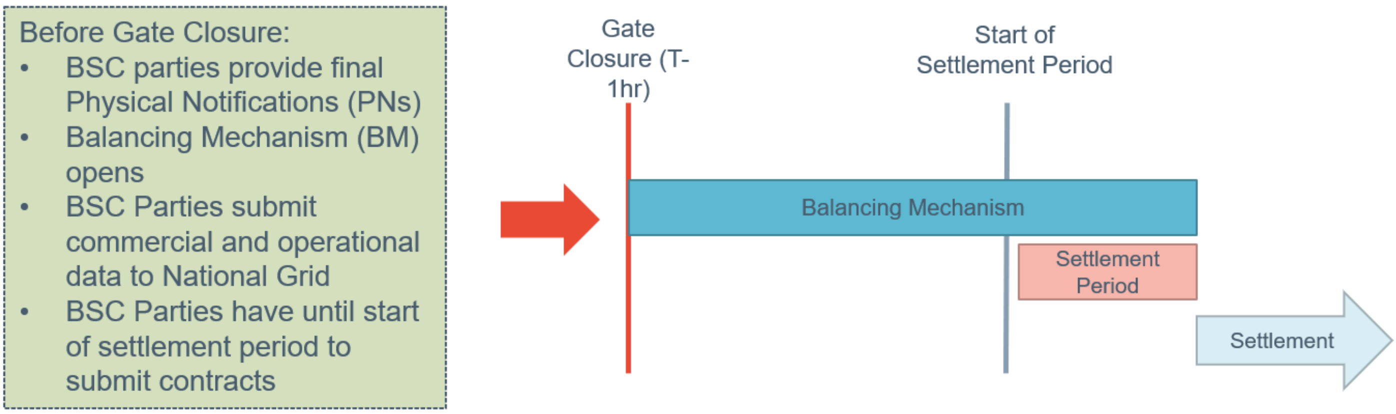
5.2 Balancing Mechanism (BM)

The Balancing Mechanism (BM) is the mechanism that the Electricity System Operator (ESO) uses to balance the system and manage transmission constraints in real time. The BM opens one hour before the start of the delivery period, although the ESO can also take early actions with generators bilaterally or by trading on power exchanges.

As well as being used to produce Bids and Offers, the BM is also used to dispatch other Balancing Services provided by Balancing Mechanism Units (BMUs), such as STOR.

A summary of the information required to be submitted for the BM and the timings are outlined in Figure 11 below.

Figure 11: Balancing Mechanism overview



Source: Cornwall Insight

5.2.1 Procurement and dispatch

Balancing Service Providers (BSPs) submit prices and technical data for Bids and Offers prior to Gate Closure, one hour before the start of the Settlement Period.

The BM runs for 90 minutes, from Gate Closure until the end of the Settlement Period.

In most instances, actions in the BM are procured in 'real time' as the ESO balances the system second by second. Some actions are dispatched in earlier timeframes, e.g. through BM Start up.

5.2.2 Data flows

Bid Offer Acceptances (BOAs) are instructed for individual BMU basis, on the basis of Final Physical Notification (FPN) data submitted at gate closure. FPNs are required by BMUs that are active in the BM.

BOAs taken in the BM are automatically accounted for in a Party's Credited Energy Volume usually (i.e. unless there are issues with the Central Systems) within 15 minutes of the end of the Settlement Period. BOAs are also published on the BM Reports Website. Data associated with balancing actions taken outside the BM (e.g. non-BM STOR) takes longer to be reflected in imbalance positions of BRPs (usually by 5 WDs).

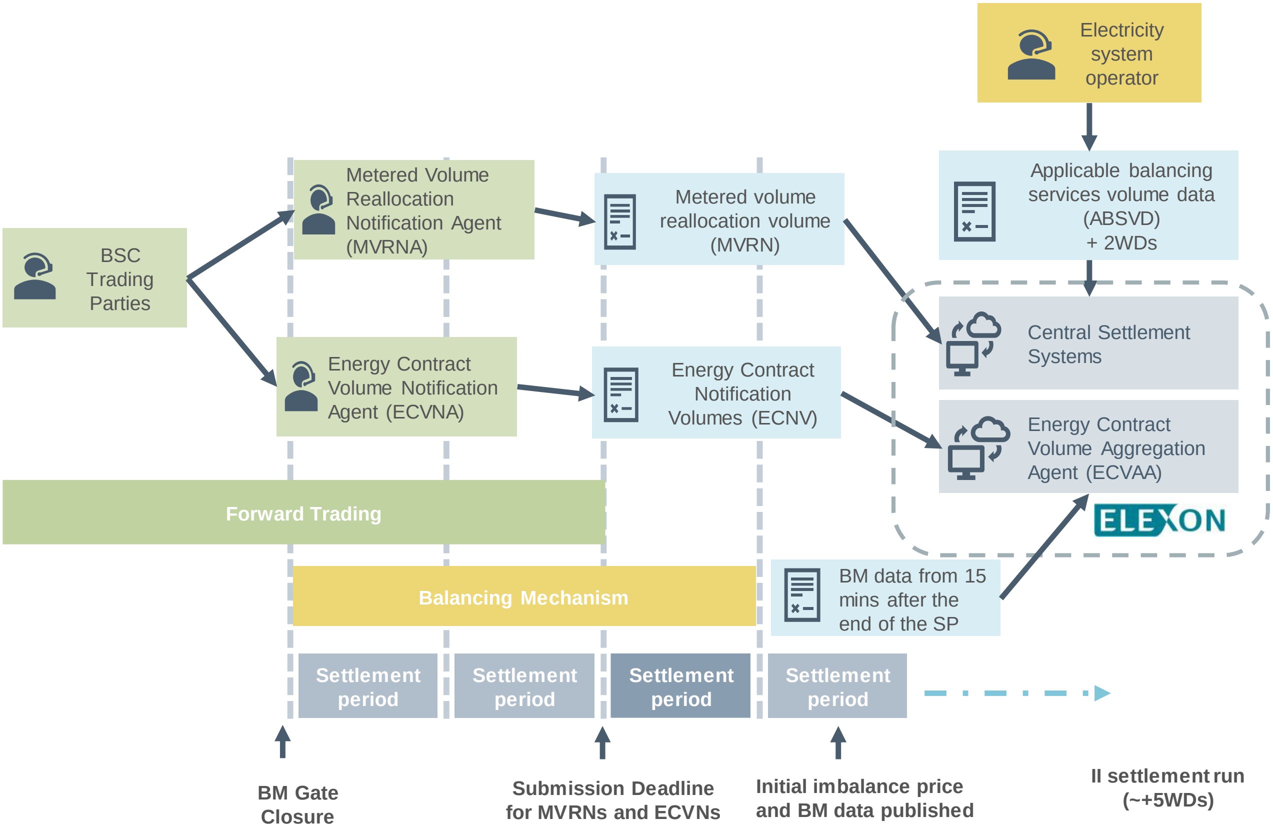
Imbalance positions are published 5 working days after the Settlement Day for information as part of the interim information (II) Settlement Run, and then 16 working days after the Settlement Day as part of the SF run. These imbalance positions are further adjusted until 292 working days after the Settlement Day, as part of the Settlement Process.

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 BRP that bought volumes on the wholesale market.

BM data flows sit alongside data flows from the energy market to determine a BRP's imbalance position, including ECVNs and MVRNs. As set out in Section3, ECNVs represent a BRPs wholesale traded position, and are used to calculate its imbalance position. This position will be adjusted for MVRNs, BOAs, and other balancing services, using Applicable Balancing Services Volume data (ABSVD)[18].

These are illustrated below in Figure 12.

Figure 12 - Overview of dataflows related to wholesale and balancing activities



Source: Cornwall Insight

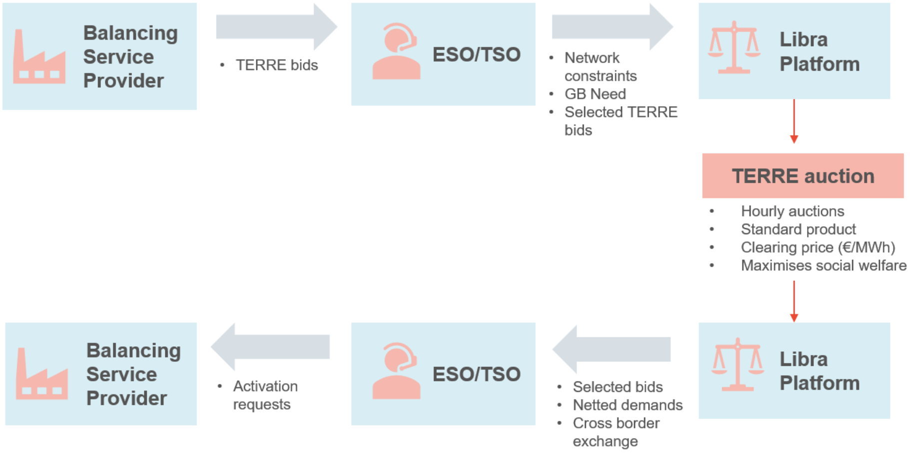
5.3 The Trans-European Replacement Reserve Exchange (TERRE)

The Trans-European Replacement Reserve Exchange (TERRE) is the harmonised procurement of balancing services across European TSOs. It is used to procure the Replacement Reserve (RR) balancing product, a standardised 15 minute product. It is used by the ESO as the first tool for "approximate" balancing which is refined through the BM.

The TERRE process is shown in Figure 13 below.

[18] The exception to this is mFRR where non-BMUs have the option to option out of having ABSVD applied.

Figure 13: TERRE process



Source: Cornwall Insight

5.3.1 Procurement and dispatch

BSPs submit prices for RR at Gate Closure, one hour ahead of the start of the Settlement Period.

The TERREf auction takes place 45 minutes ahead of the start of the Settlement Period, with data sent to the local TSOs 30 minutes ahead of the start of the Settlement Period. Dispatch for TERRE products (by issuing Replacement Reserve Instructions (RRIs), to match a Replacement Reserve Schedule[19] (RRS) happens from 30 minutes ahead of the Settlement Period, ahead of delivery.

Participation can be via a Virtual Lead Party (VLP) or Balancing Mechanism Unit (BMU).

5.3.2 Data flows

The RRS is used to adjust a party's Credited Energy Volume in in a similar way to how BOAs are accounted for – with TERRE actions accounted for in a party's Credited Energy Volumes within 15 minutes of the end of the Settlement Period.

If the party is a VLP then it may be providing flexibility from an asset within another parties Credited Energy Account and therefore impacting that parties imbalance position, without knowing in advance.

5.4 Capacity Market (CM)

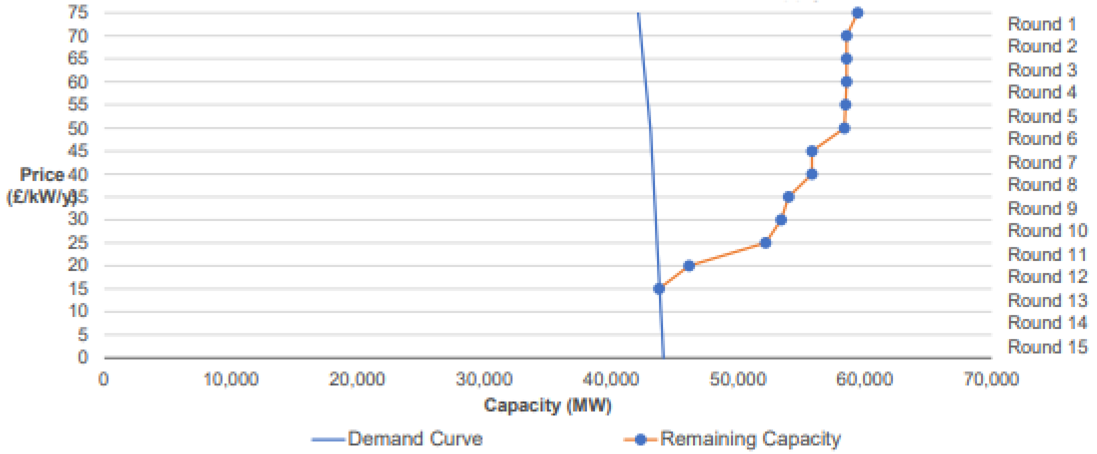
The CM provides Capacity Providers (CPs) with long-term contracts to fix the "missing money" problem – the gap between the energy only price and the price needed to incentivise investment in new generation capacity.

Capacity Auctions procure MW of capacity, with a single £/kW/year clearing price per Delivery Year, based on an auction process. The auction is 'pay as clears' with all parties receiving the same clearing price. If successful that party gets a capacity agreement that outlines the volume, price, technology de rating and delivery year that the CP must be available when required.

An example of the supply and demand curve from the 2019 T-4 (delivery year 2023/24) is shown below which cleared at £15.97/kW/year.

[19] The Replacement Reserve Schedule (RRS) is the MW profile that a BMU would need to follow to meet the RRI, and assumed delivery for settlement

Figure 14: Capacity Market supply and demand curve



Source: EMR Delivery Body

5.4.1 Procurement and dispatch

The actions are normally procured 4 years (T-4) and 1 year (T-1) out, but there have been developments during its life that resulted in different timing.

Using the example of the 2019 T-4 auction the times for the procurement were as follows:

- Prequalification open – July 2019 to September 2019
- Auction – March 2020
- Start of delivery year – October 2023

Under the Capacity Market, there is no direct dispatch, but with penalties if there is a CM Stress Event[20] and the Capacity Provider is unable to meet its obligation.

CPs are incentivised to match or exceed their obligation for a Settlement Period when there is a CM Stress Event to their Adjusted Load Following Capacity Obligation (ALFCO)[21]. Capacity Providers that do not deliver sufficient metered volumes to meet their Capacity Obligation during a System Stress Event, and are unable to reallocate volume from another CMU, are required to pay a penalty.

Penalties are calculated on a monthly basis based on the CMUs overall underdelivered volumes. Penalties for a single month are capped at 200% of the CMUs monthly Capacity Payment, however, the total penalties a CMU receives in a year are capped at 100% of its annual Capacity Payments

5.4.2 Data flows

If there has been CM Stress Event in a given month, settlement activities begin on the first working day of the following month. CPs have a number of requirements to submit data, and failure to do so could result in

[20] Capacity Market Stress Events are defined as a System Stress Event that has occurred at least four hours after a Capacity Market Notice has been issued and post-event analysis by National Grid ESO has confirmed that a System Stress Event has occurred

[21] Adjusted Load Following Capacity Obligation (ALFCO) is what Capacity Providers are required to deliver during a Capacity Market Stress Event. It is based on the Capacity Obligation of the CMU but is then adjusted to take into account the percentage of peak demand that is needed during the Capacity Market Stress Event and the capacity of the CMU which has already been committed to balancing services to manage the Capacity Market Stress Event.

data default[22]. Some of this data can be collected directly from BM Reports, such as BOAs and metered output for BMUs.

The key activities from the start of the month after the CM Stress Event month are:

- WD3: To ensure timely ALFCO calculations, Capacity Providers should submit Balancing Services data.
    - CPs must submit their own Balancing Services data to National Grid EMR Delivery Body within three WDs of the start of the month. This is because of commercial restrictions that prevent the National Grid ESO from sharing information with the EMR Delivery Body. To do this, the Delivery Body has created a Capacity Market Stress Event Capture Tool.
- WD9: Deadline for Capacity Providers to submit Meter Data.
    - Missing this deadline would put the Capacity Provider in Data Default.
- WD10: EMRS publish the Capacity Volume Register (CVR).
- WD11 to WD19: Window for Volume Reallocation.
    - EMRS will publish updated an updated CVR at the end of each WD in this window.
- WD20: EMRS publish final CVR.
- WD21: EMRS issue penalty invoices.
- WD26: Deadline for penalty payments (if penalties are not paid they will be deducted from the Capacity Provider's future Capacity Payments).

Over-delivery payments can also be made to CPs, if they have over delivered compared to their ALFCO. Over delivery payments are calculated annually, based on how many penalties were paid in the year.

Figure 15 - Overview of CM procurement, despatch and data

Source: Cornwall Insight

[22] Data Default means that Capacity Providers have failed to supply the metered data required following a Capacity Market Stress Event by the 9th Working Day after the last working day of the month in which the relevant Capacity Market Stress Event occurred.

5.5 Firm Frequency Response (FFR) – tender and auction

Firm Frequency Response (FFR) is a service provided by energy users to National Grid, which uses approved assets to quickly reduce demand or increase generation to help balance the grid and avoid power outages.

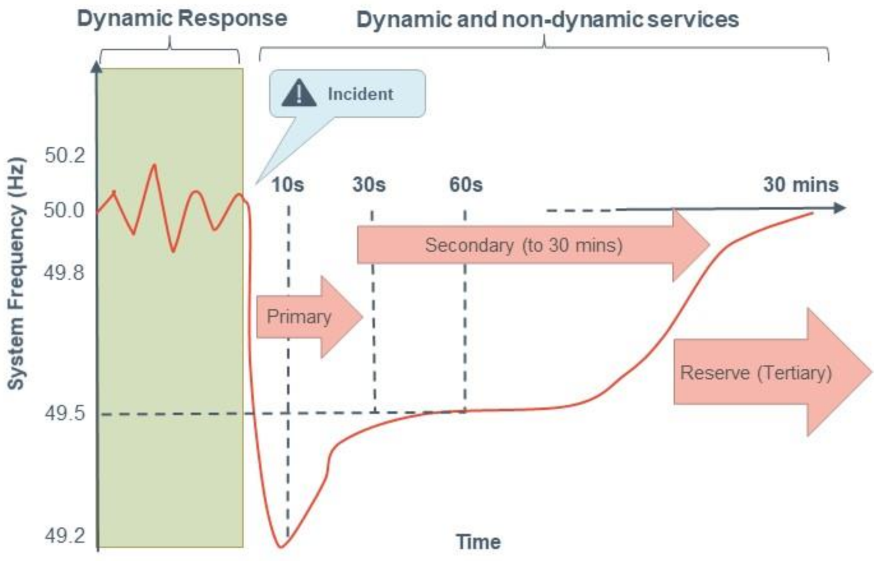
There are two FFR categories of service:

- **Dynamic frequency response:** continuous second-by-second service.
- **Static (non-dynamic) response**: fixed service triggered by a defined frequency deviation.

National Grid requires three Frequency Response services:

- **Primary response**: Energy provided within 10 seconds of an event and sustained for 20 seconds.
- **Secondary response**: Energy provided within 30 seconds and sustained for 30 minutes.
- **High frequency response**: Reduction in power within 10 seconds and sustained indefinitely.

Figure 16: Frequency Response overview



Source: National Grid

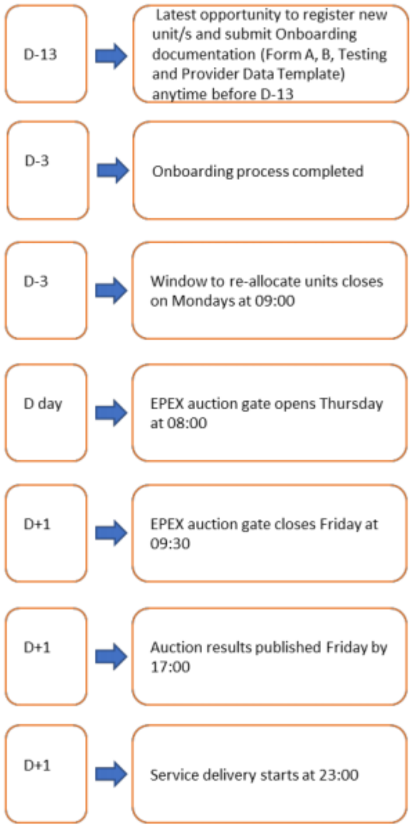
National Grid is currently reforming its response services and shall be introducing new products referred to as Dynamic Containment, Dynamic Moderation, Dynamic Regulation and Static Containment. The first to be introduced is Dynamic Containment, which is a fast-acting post-fault service to contain frequency within the statutory range of +/-0.5Hz in the event of a sudden demand or generation loss. The service delivers very quickly and proportionally to frequency but is only active when frequency moves outside of operational limits (+/- 0.2Hz). It will seek to procure 250MW initially and 1,000MW later.

5.5.1 Procurement and dispatch

FFR is procured currently via two methods:

- Monthly auction
  - Procuring only for the following month delivery period.
  - Dynamic and static, providing primary secondary and high.
- Weekly auction (phase 2) – see Figure 17.
  - Via the EPEX auction platform procured day ahead for week ahead Electricity Forward Agreement (EFA) 4 hour blocks.
  - Dynamic (low and high) and low static.

Figure 17 - Auction timetable



Source: National Grid

5.5.2 Data flows

The data flows for Frequency Response are treated differently, depending on the mechanism used to dispatch and settle them:

- Where the FFR is dispatched using a Bid Offer Acceptance (BOA), an adjustment will always be made to imbalance.
- Where the FFR is not dispatched using a BOA, and the Transmission Company (TC) is able to allocate the volume to a BMU, an adjustment may be made to imbalance depending upon whether the Lead Party opts out of having ABSVD allocated to their account.
- Where the FFR is not dispatched using a BOA and the TC is not able to allocate the volume to a BMU, no adjustment can currently be made to imbalance.

5.6 Mandatory Frequency Response (MFR)

Mandatory Frequency Response (MFR) is an automatic change in active power output in response to a frequency change. The service helps us to keep frequency within statutory and operational limits. Providers can offer one or a combination of the following:

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

5.6.1 Procurement and dispatch

When a generating unit is built or modified, its capability to provide MFR must be tested. Once the generator has successfully met the minimum requirements, a Mandatory Service Agreement (MSA) can be put in place, or amended if a unit has been modified.

Generators submit their own prices for holding payments on a monthly basis via the Frequency Response Price Submission System (FRPS). FRPS is available between the 5th and 15th working day of each month. Previously submitted prices are published on the National Grid ESO website.

5.6.2 Data flows

As the dispatch signal for mandatory responses is through the BOA process an adjustment will always be made to imbalance.

5.7 Short Term Operating Reserve (STOR)

At certain times of the day access to sources of extra power may be needed to help manage actual demand on the system being greater than forecast or unforeseen generation unavailability, where it is economic to do so, National Grid will procure sources of extra power ahead of time through the STOR service. Providers of the service help to meet the reserve requirement either by providing additional generation or demand reduction.

Both BM and non-BM participants with a connection to either the electricity transmission or distribution network are able to provide STOR. The service is open to any technology with the ability to increase generation or reduce demand by at least 3MW.

Current STOR providers are located throughout Britain, although providers closer to high demand areas, including south east England and Wales, are more desirable. There are particular times of the day when the STOR service is more likely to be required. These are known as ‘availability windows’. Providers are required to be available to operate at their contracted volume during these windows, subject to dispatch instructions.

There are two possible routes to market for STOR:

- **Committed service**
    - Route to market open to both BM and non-Balancing Mechanism participants.
    - A committed service provider must be available to deliver STOR during all availability windows. The only acceptable reason for unavailability is when the unit or site is technically unable to provide the service.
- **Flexible service**
    - Route to market is only open to non-BM reserve providers.
    - A commitment to deliver STOR is submitted at the week-ahead stage.

Flexible service providers have more freedom around how many hours and when they wish to make the service available. The advantage of the flexible route is that it offers the ability to change availability frequently to reflect site and market conditions.

5.7.1 Procurement and dispatch

Interested parties must first fulfil the pre-qualification by signing onto a STOR framework agreement. This will capture the unit’s technical and operational details. Once a framework agreement has been signed, potential providers will be able to participate in tenders via the online platform, Ariba.

For the STOR service, the year is divided into six ‘seasons’. Each tender round covers particular seasons, incorporating the technical and price details for that period. Providers are able to submit tenders for one or more seasons, up to a maximum of two complete financial years.

Tender rounds are envisaged by National Grid ESO to be held three times a year, although sometimes they are two times a year. The service commences two months after the start of the 'Market Day. For example the Tender Round 39 period is outlined below

- Framework Agreement Deadline: 17:00 hours on Friday 2 August 2019
- Market Day: 17:00 hours on Friday 9 August 2019
- Results Day: Friday 20 September 2019
- Market Report Published: Friday 11 October 2019
- Service Commencement: 05:00 hours on Monday 28 October 2019.

5.7.2 Data flows

- BM STOR – BM STOR utilisation volumes are treated in a similar way to Offers in the BM, and so volumes from these generators will be accounted for in a Party's Credited Energy Volume, usually within 15 minutes of the end of the Settlement
- Non-BM STOR – Non-BM STOR utilisation volumes are part of the Applicable Balancing Services Volume Data (ABSVD). The provision of this data is slower compared to BM data, and this data is not published on BM Reports, so these volumes will usually be reflected in a BSC Party's imbalance position within 5WDs for information as part of the II Settlement run (National Grid send the data 2WDs after the Settlement Period).

5.8 Fast Reserve (FR)

The ESO use Fast Reserve, in addition to other energy balancing services, to control frequency changes that might arise from sudden, and sometimes unpredictable, changes in generation or demand.

The fast reserve service is open to both BM and non-BM providers who can meet the technical requirements.

For active power delivery, providers must meet the following criteria:

- Active power delivery must start within two minutes of the dispatch instruction;
- A delivery rate in excess of 25MW/minute;
- The reserve energy should be sustainable for a minimum of 15 minutes; and
- Must be able to deliver minimum of 25MW.

5.8.1 Procurement and dispatch

Potential providers must succeed in a pre-qualification assessment and sign onto a framework agreement. Providers will then be given a login for the electronic tender platform, where they can submit their tenders for the Fast Reserve service.

Fast Reserve is procured via a competitive monthly tender process. Once service providers succeed in the pre-qualification assessment and sign onto a framework agreement, they will be provided with a login to an electronic tender platform. Providers can then tender in for a single month or multiple months.

Tenders must be submitted by the first business day of each month for services starting the following month.

5.8.2 Data flows

BM Fast Reserve – BM Fast Reserve utilisation volumes are treated in a similar way to Offers in the BM, and so volumes from these generators will be accounted for in a Party's Credited Energy Volume, usually within 15 minutes of the end of the Settlement.

Non-BM Fast Reserve – Non-BM Fast Reserve utilisation volumes are part of the Applicable Balancing Services Volume Data (ABSVD). The provision of this data is slower compared to BM data, and this data is not published on BM Reports, so these volumes will usually be reflected in a BSC Party's imbalance position within 5WDs for information as part of the II Settlement run.

5.9 Black Start

A total or partial shutdown of the national electricity transmission system (NETS) is an unlikely event. However, if it happens, the ESO is obliged to make sure there are contingency arrangements in place to ensure electricity supplies can be restored in a timely and orderly way. Black Start is a procedure to recover from such a shutdown.

Irrespective of the type of generating plant providing black start services, providers need the following technical capabilities:

- The ability to start up the main generating plant (at least one unit/module) of the station from shutdown without the use of external power supplies, and be ready to energise part of the national electricity transmission system or, if appropriate the distribution network, within two hours of receiving an instruction from National Grid.
- The capability to accept instantaneous loading of demand blocks, ideally in the range 35 to 50 MW, and control frequency and voltage levels within acceptable limits during the block-loading process. Under these conditions, frequency can be within the range of 47.5 to 52 Hz.
- The ability to provide at least three sequential black starts. This is to allow for possible tripping of the transmission or distribution systems during the re-instatement period, or trips during the station's own starting sequence.
- Back-up fuel supplies (e.g. distillate fuel), if appropriate, to enable the power station to run for a minimum duration (ideally in the range of three to seven days) following a Black Start instruction.
- Facilities to ensure that all generating units can be safely shutdown without the need for external supplies, and can be maintained in a state of readiness for subsequent start up.
- The ability to maintain high service availability on both the main and auxiliary generating plant. National Grid typically require availability of 90%.
- The reactive capability to charge the immediate transmission and/or distribution systems. This capability will depend on the local system configuration, but generating plant connected at 400kV or 275kV with a capability of at least 100MVAr leading (as measured at the commercial interface) should almost invariably meet this requirement. The generator must also be capable of withstanding the magnetic inrush and transient voltages associated with this charging duty.

Traditionally Black Start has been provided by large scale generation and the distributed ReStart explores how Distributed Energy Resources (DER) in Great Britain can be used to restore power in the highly unlikely event of a total or partial blackout of the National Electricity Transmission System. Examples of DER include:

- Natural gas turbines
- Biomass generators
- Embedded hydro-power stations
- Wind turbines; and
- Solar panels

5.9.1 Procurement and dispatch

The procurement of Black Start has traditionally not been public.

In 2019 competitive procurement was trialled in the South West, Midlands, North West, North East and Scotland.

5.9.2 Data flows

In the event of Black Start being required there is unlikely to be any electricity on the system and therefore it is not expected that any adjustment takes place to the units as they will be instructed directly rather than through the Electronic Dispatch Logging (EDL) system.

5.10 Obligatory Reactive Power Service

The Obligatory Reactive Power Service (ORPS) is the provision of varying reactive power output. At any given output generators may be requested to produce or absorb reactive power to help manage system voltages close to its point of connection. All generators covered by the requirements of the Grid Code are required to have the capability to provide reactive power.

Generally, all power stations connected to the transmission network with a generation capacity of over 50MW are required to have the capability to provide this service, as set out in the Grid Code CC 6.3.2.

The reactive power provider must:

- 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; and
- 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.

5.10.1 Procurement and dispatch

Instructions for reactive power are normally sent from us to the generator via an EDL system. This is a mandatory service for large generators and therefore there is no tender process.

Generators are generally instructed to reach a target MVAr level within two minutes. This target will sit within the reactive performance capability of the generator, outlined in their performance chart.

5.10.2 Data flows

Reactive power is not part of the energy volume for BSC parties.

5.11 Intertrips

Intertrip services are required as an automatic control arrangement where generation may be reduced or disconnected following a system fault event.

The system to generator operational intertrips service may be required as a condition of connection.

Commercial intertrips

An additional service negotiated on an ad-hoc basis. Allow a higher level of generation onto the system during times of system stress and tight margin. Used to manage GB’s electricity transmission system following credible unplanned faults that need to be secured against in accordance with security and quality of supply standards.

The automatic operation of an intertrip generally requires the monitoring of all transmission circuits in a zone, which are linked with system protection arrangements. If a selected circuit trips, the logic process will then trigger activation of the scheme to disconnect (trip) generation.

Intertrip schemes generally operate typically in less than 100 milliseconds, allowing them to be used to resolve both thermal and stability issues.

When the ESO issues a request to the station to arm, the station will be required to switch in the intertrip scheme to allow signals to pass from the intertrip scheme to the relevant circuit breakers. Once the scheme is armed, the station could then trip (cease output) in response to a fault on the relevant circuits.

It is difficult to forecast the likelihood of arming, as a number of factors will influence this. These are the prevalence of constraints within the relevant part of the transmission network and the effectiveness and economics associated with the operational tools available for managing these at any given time. Instances of tripping are very infrequent and should reasonably be considered to be very low risk.

5.11.1 Procurement and dispatch

Instructions for reactive power are normally sent from us to the generator via an electronic dispatch logging (EDL) system. This is a mandatory service for large generators and therefore there is no tender process.

Generators are generally instructed to reach a target MVAr level within two minutes. This target will sit within the reactive performance capability of the generator, outlined in their performance chart.

5.11.2 Data flows

Intertrips are included within the ABSVD calculation and therefore adjusted after the event through settlement.

5.12 Summary of services

In this report we have set out the key elements of balancing services. These are summarised in Figure 18 and Figure 19.

There are a number of key points that can be drawn out:

- When capacity is procured (and paid for) differs depending on the service – some are procured and dispatched ahead of time, others are dispatched in 'real time' and this has implications for payments and dataflows.
- For ESO Balancing Services – there is a difference between how data for assets in the BM (BMUs) is treated, compared to assets that do not have BMUs. Data for BM activity is usually available within 15 minutes after the end of the Settlement Period, whereas non-BM data is sent to Elexon by 2WDs. This has implications for transparency of balancing actions.
- Not all Balancing Services result in adjustments to a BRP's or a CP's position – mFRR providers can opt out of ABSVD and only balancing services included in the list of Relevant Balancing Services will be reflected in a Capacity Provider's CM obligation.

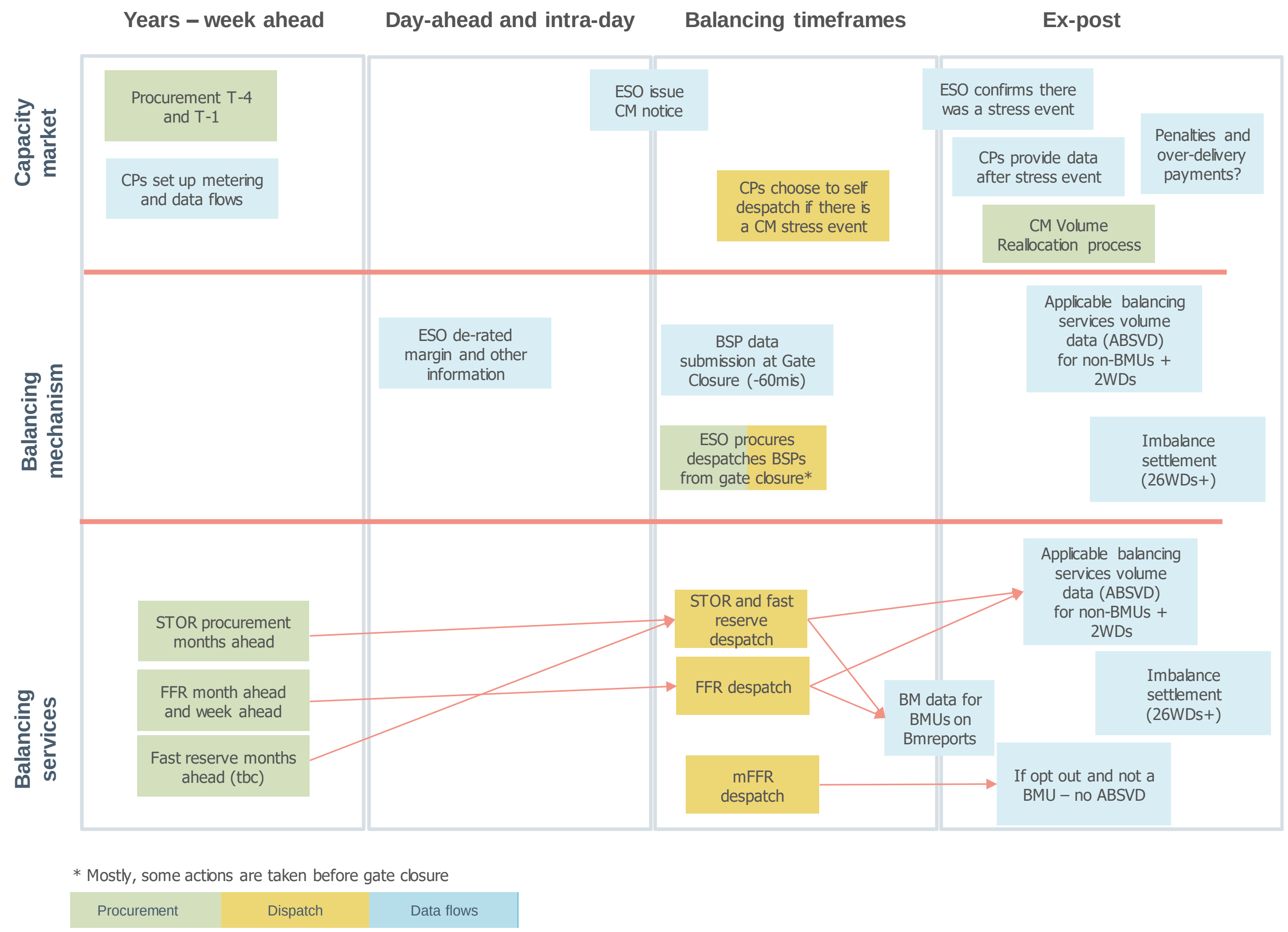
Due to the imbalance process, BRPs' imbalance positions are determined ~26WDs after the fact. Although some data is available at 15 minutes ahead, other data is published within 5WDs, imbalance calculations happen at a later stage.

Figure 18: Overview of services in this report

Service	Procurement	Dispatch	Data flows
Balancing Mechanism	90 mins from gate closure to end of settlement period	Via ESO	Automatic adjustment of positions
Capacity Market	T-4 or T-1 in most cases	No dispatch	Automatic adjustment of positions and self-provided
Firm Frequency Response	Monthly and weekly tenders	Automatically dispatched based on system frequency	If there is a BMU then it is adjusted, otherwise volumes not adjustment for service
Mandatory Firm Frequency Response	No tender	Dispatched by ESO	Automatic adjustment
Short-term Operating Reserve	2-3 tenders per year	Dispatched by ESO	Adjusted through BM or ABSVD
Fast Reserve	Monthly Tender	Dispatched by ESO	Adjusted through BM or ABSVD
Black Start	Bilateral with competition coming	Dispatched by ESO	No adjustment
Obligatory Reactive Power Service	Bilateral with competition coming	Dispatched by ESO	No adjustment
Intertrips	Bilateral with competition coming	Dispatched by ESO	Adjusted by ABSVD

Source: Cornwall Insight

Figure 19 - Overview of key procurement, dispatch and data activities



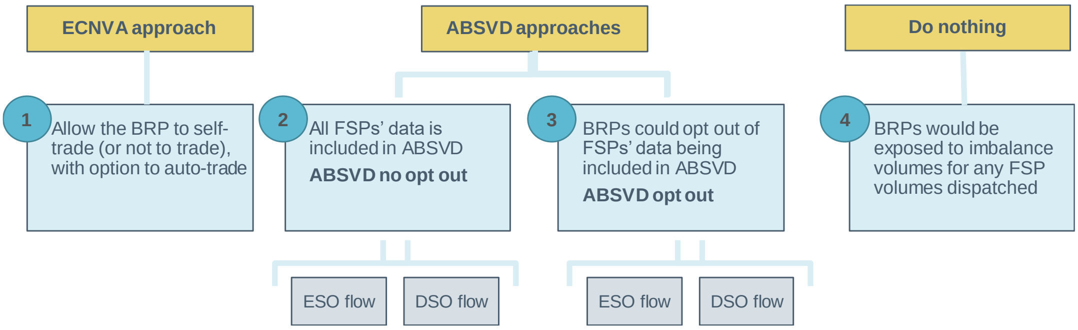
Source: Cornwall Insight

6 Qualitative assessment of options

In this section we set out as assessment of the options available to WPD for reflecting volumes from the intra-flex project in the wholesale market (i.e. ensure BRPs are not impacted by actions from FSPs).

The key options for doing this broadly vary depending on whether trading is used to account for volumes (also known the ECVNA approach) or whether dataflows are automatically accounted for (the ABSVD approach[23]), and whether volumes are accounted for at all (do nothing). Within the ABSVD approach, you could allow BRPs to opt out of having their volumes included in ABSVD, similar to how mFRR is treated currently.

Figure 20 - Overview of options



Source: Cornwall Insight

In this section we will product an assessment of each options in terms of:

- **Interaction with WPD services** – How well do they fit with the timeframes for decision making and dispatch of each of WPD's services?
- **Complexity and process** – Will the solution make the arrangements more or less complicated? Will implementation be more or less challenging, and will this have implications for timeliness or cost?
- **Visibility** – Does the solution give useful information to the market about DSO and market activities?
  - Would the solution have better or worse implications for data transparency, and the other principles/objectives of the Energy Data Task Force?
- **Impact on liquidity** – Would the solution likely result in greater traded volumes on the ex-ante markets
- **Impact on consumers** – Does the solution have an impact on consumers in terms of greater or less overall cost?
- **Impact on flexibility service providers** – How will flexibility service providers interact and see information?
- **Impact on independent aggregators** – Will the solution impact third party aggregators who are not a party to the wholesale market?
- **Impact on suppliers** – How will suppliers as Balance Responsible Parties (BRPs) be impacted in terms of needing to react, impact on their imbalance position, and information available?
- **Impact on different technologies providing the service** – Would the solution impact certain kinds of technologies more than others?
- **Impact on the DSO** – How would DSO activities expect to be impacted?

[23] Implementation of the solution could using ABSVD or a similar solution which could see DSOs send data directly to the BSC Central Systems.

- **Impact on the ESO –** would the solution require input from the ESO? What would this look like?
- **Compliance with on Electricity Balancing Guideline –** how should DSO products be defined under the EBGL, and does this impact which solution is preferable?

6.1 Assessment of options

Based on the criteria above, we set out an assessment of the two options, using a rating scheme of: negative (-2); slightly negative (-1); neutral or on balance neutral (0); slightly positive (1); positive (2).

We provide a written assessment of criteria. There is a full summary table in Figure 29.

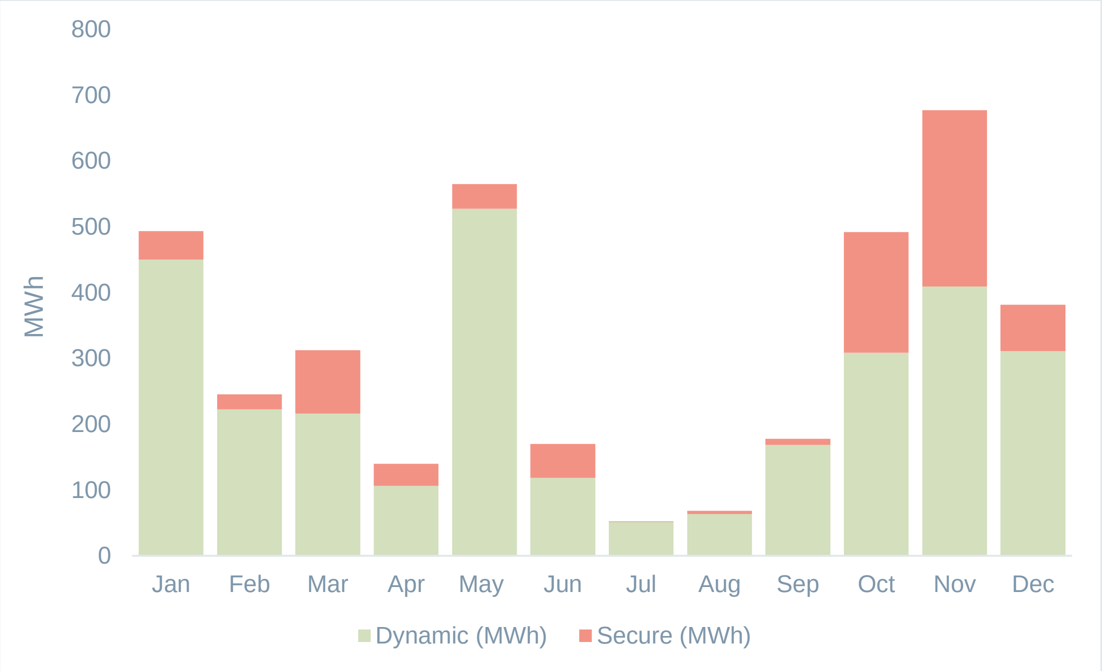
6.1.1 Interaction with WPD services

When services are dispatched will have an implication for how their volumes can be treated for the purposes of imbalance settlement.

The Secure product is procured and effectively dispatched ahead of time, the expected volumes are known ahead of time. This allows opportunities to trade these volumes ahead of time. However, these volumes are expected to be low, with an average of 60MWh, but varying depending on the month

The Dynamic product is dispatched 15 minutes ahead of delivery of the DSO product, rather than ahead of the Settlement Period or wholesale Contract Submission deadline. This may mean some volumes are tradable, but would rule trade for some volumes out [24]. Therefore the ABSVD or 'do nothing' approach may be more suitable for these services.

Figure 21 - Expected MWh by month and product (WPD)



[24] This may depend on the speed of NODES systems. The time taken to submit Energy Contract Volume Notifications (ECVNs) was one reason the deadline for submission of these was moved from one hour ahead of the Settlement Period to the start of the Settlement Period. While it may be possible, there could be more risk associated with submitting ECVNs at short notice.

Allowing an opt out from ABSVD should be compatible with any WPD service, provided the data flow could be implemented.

Figure 22 - Interaction with WPD services

Assessment criteria	ECVNA approach	ABSVD no opt out	ABSVD with opt out	Do Nothing
Interaction with WPD services	Positive for Secure Negative for Dynamic Overall: neutral (0)	Compatible with any WPD service Overall: positive (2)	Compatible with any WPD service Overall: positive (2)	Compatible with any WPD service Small risk that spill payments could distort competition but unlikely given small volumes Overall: slightly negative (-1)

Source: Cornwall Insight

6.1.2 Impact on consumers

The impact on end consumers relates primarily to the overall cost, which is a function of the implementation cost, and impact of impacts on the overall efficiency of the arrangements – efficient market and balancing arrangements should lead to the most efficient dispatch of assets across the system.

Options with lower implementation costs are deemed to have a better impact on consumer, however these must be balanced against the potential for greater efficiencies in the market during operation, or learnings for the future consumer.

Efficiencies in the market during operation will be related to the most efficient balancing outcomes. In GB, we incentivise the market to balance its own position through imbalance charges, with the ESO acting as a 'residual balancer' to resolve unforeseen imbalances. It will be more efficient for the market to resolve those imbalances that it is best placed to manage (e.g. GB-wide, half-hourly energy imbalances) and the ESO to resolve those imbalance that it is best placed to balance (e.g. real-time, second-by-second physical imbalances on the system).

There may be costs and unintended consequences that lead to higher cost for consumers – for example, 'do nothing' may lead to inefficient market outcomes in the wider market, although it has lower costs of implementation.

In addition, under the ECVNA or do nothing approach there is risk of inefficient allocation may results in higher costs for the consumer too.

Assessment criteria	ECVNA approach	ABSVD no opt out	ABSVD with opt out	Do Nothing
Impact on consumers	Greatest overall cost given the greatest cost for implementation and level of additional activity needed in operation. **Overall: Negative (-2)**	2a. Higher implementation time and cost. **Overall: Negative (-2)** 2b. Lower implementation time and cost. **Overall: slightly negative (-1)**	Potentially higher cost due to inefficiency of BRP imbalances and cost of implementation. 2a. Higher implementation time and cost **Overall: Negative (-2)** 2b. Lower implementation time and cost but potential for inefficiencies & additional complexity from opt out.	Lowest cost to implement, however, risk of inefficient outcomes in the wholesale market and other flexibility markets because of spill payments paid to BRPs (however these volumes are expected to be small and depending on the scale this assessment may change). **Overall: Neutral (0)**

			Overall: Slightly negative (-1)	

6.1.3 Alignment with the Electricity Balancing Guidelines (EBGL) and Clean Energy Package (CEP)

Under the definition of balancing services under the EBGL, they are defined as those procured by the Transmission System Operator (TSO), or in GB's case the ESO). On this basis, it is assumed that DSO products do not need to adhere to the same requirements as ESO balancing products under the EBGL. Further, the NODES project is an innovation project, so some derogations may be allowed.

However, there are a number of general principles of the EBGL which can be drawn out:

- Our market design and the supporting settlement process must provide incentives to BRPs balance their own positions or help the system to restore its balance.
- Imbalance prices should reflect the value of real-time energy.
- Actions from BSPs shouldn't be negatively affect positions of BRPs.
- There should be a level playing field between different kinds of capacity and market participants.

The Clean Energy Package (CEP) builds upon the EBGL, to establish the principle of greater TSO-DSO coordination, and to strengthen the principle of balance responsibility.

While all elements of the CEP are not yet binding (and there is a degree of uncertainty about which will apply post-Brexit), there are two key factors which we reflect in our assessment:

- Options which favour alignment between how TSO and DSO products should be favoured over those that do not; and
- Options which expose parties to risks that they are best placed to manage should be favoured over those that do not

Figure 23 - EBGL compliance

Assessment criteria	ECVNA approach	ABSVD no opt out	ABSVD with opt out	Do Nothing
EU regulation compliance	DSO actions are not seen as balancing products under the EBGL. However, this would not ensure TSO-DSO alignment and could expose a BRP to an imbalance that it did not create **Overall: Slightly negative (-1)**	DSO actions are not seen as balancing products under the EBGL. Ensures TSO-DSO alignment and prevents imbalances **Overall: Positive (2)**	DSO actions are not seen as balancing products under the EBGL Does not ensure TSO-DSO alignment **Overall: Negative (-2)**	DSO actions are not seen as balancing products under the EBGL However this approach would create imbalances for BRPs that they did not create **Overall: Slightly negative (-1)**

Source: Cornwall Insight

6.1.4 Complexity and process

In this section we consider complexity from the perspective of how difficult the solution is to implement, and how complex the arrangements would be once operational.

Process to implement – do nothing would have the easiest solution to implement, as no effort would be required on behalf of Elexon or the ESO. Solutions that involve Elexon are assumed to have a shorter implementation time than ESO, however timings for both will be subject to consultations and timings of systems releases. The ECVNA solution can be implemented entirely within the NODES project so is assumed to be easier to implement than those requiring effort from the ESO or Elexon (however this applies to the innovation project, we do not make an assessment of the cost of rolling out NODES to all of the DSOs).

Operation – the ECVNA is the most complex solution to operate, as it would require additional trading activities to ensure WPD service volumes are accounted for, as well as the submission of the ECVNA data flow to notify these trades. Under this approach, suppliers will have the option to trade themselves on the intra-day market or opt for the 'auto-balancing' function. Arguably this creates an additional decision point for suppliers.

Figure 24 – Impact on complexity

Assessment criteria	ECVNA approach	ABSVD no opt out	ABSVD with opt out	Do Nothing
Complexity and process	More complexity as ex-ante trades are required, although these can be auto-trades or BRP-led. Auto-traded options would be lower complexity for BRPs. Implementation would be part of the intra-flex project, so likely easier to implement compared to an option that relies on the ESO. **Overall: Negative (-2)**	An ESO option would be more timely to implement. However once operational, the ABSVD would be a simpler solution to operate compared to one that required ex-ante trades. DSO solutions would be more straight-forward to implement but would require more ongoing effort on the part of WPD. **Overall: Slightly negative (-2)**	An ESO option would be more timely to implement, require input from the ESO. However once operational, the ABSVD would be a simpler solution to operate compared to one that required ex-ante trades. DSO solutions would be more straight-forward to implement but would require more ongoing effort on the part of WPD. **Overall: Negative (-2)**	No impact on the complexity of processes. **Overall: Neutral (0)**

Source: Cornwall Insight

6.1.5 Impact on liquidity

Under the ECVNA approach, Secure volumes could be traded on the intra-day market, either through an auto-balancing service offered by NODES, or by allowing BRPs to self-trade on the market. This should lead to a small increase in volumes traded on in the intra-day market. However, these volumes are expected to be low (see Figure 21 - Expected MWh by month and product (WPD)

Dynamic volumes could be traded in the 15 minute window before trading ends and Contract Submissions must be submitted. However, this assumes that there will be sufficient volumes available to trade in the appropriate timeframes (and at appropriate clip sizes and bid-offer spreads), and it exposes these volumes to the risk of ECVN rejection, which may result in imbalances

Options using ABSVD should have a neutral impact on liquidity. This method would not require ex-ante trades to be made in order to account for the volumes from the WPD services, so would not lead to more liquidity, but neither should it lead to less.

The 'do nothing' approach or ABSVD with opt out could lead to BRPs having long imbalances where they have FSPs within their portfolio that are dispatched to deliver. This may lead them to trade slightly less on the wholesale market, so could have a negative impact on liquidity. However this impact appears unlikely given how small the utilisation volumes are expected to be for the WPD services.

Figure 25 - Impact on liquidity

Assessment criteria	ECVNA approach	ABSVD no opt out	ABSVD with opt out	Do Nothing
Impact on liquidity	Will drive a degree of greater liquidity on intra-day markets, however this assumes there are adequate volumes to trade at appropriate times. Given the likely small volumes this is assessed as neutral **Overall: Neutral (0)**	Assumed to be no change to liquidity **Overall: Neutral (0)**	Potential for small imbalances from FSPs that opt out. **Overall: Neutral (0)**	Some BRPs respond to unforeseen long imbalances by trading less. **Overall: Neutral (0)**

Source: Cornwall Insight

6.2 Impact on different parties

In this section we consider the impact on the different roles involved. We focus on roles rather than organisations. In practice a single organisation may be a flexibility service provider, an independent aggregator, a supplier

6.2.1 Impact on flexibility service provider (balancing service provider, BSPs)

Flexibility service providers and generators are balancing service providers (BSPs). They may be directly impacted or via the commercial contracts that they have with their BRPs.

The ECVNA option allows generators in theory to capture the scarcity price in the market the time of the action being taken. However, scarcity on the distribution network may not correlate with scarcity in the power system overall. Likewise, with the auto-trade option under the ECVNA option, there is a risk that if the liquidity in the market is low and there is a substantial range in the bid-offer spread, then the FSP may not get the price that truly reflects the market circumstances at the time.

ABSVD allows FSP to remove uncertainty when submitting its pricing to the market and reduces its exposure to trading risk.

Under options where there is no adjustment for WPD services, this will lead to longer imbalances for the BRP, the cost/benefit of which may be passed onto the flexibility service provider. This revenue stream will impact the bids that flexibility service provider / BSPs submit into tenders and markets for other Balancing Services, which may lead to inefficient allocation of these services, as FSPs in receipt of these ‘spill payments’ will be able to undercut BRPs that are not[25]. Inefficient allocation of Balancing Services ultimately leads to higher costs for consumers as a secondary outcome. However, given how small WPD volumes and associated imbalance charges are likely to be, this impact may not be significant.

6.2.2 Impact on independent aggregators (BSPs)

Independent aggregators are a non-traditional player that focus on aggregating disaggregated and demand side assets for balancing services and other revenue streams.

Aggregators may be BRPs, but may refer to parties that Balancing Service Providers (BSPs) only, e.g. through the use of a VLP. We focus on aggregators that are not BRPs in this section.

The key impact on aggregators that are not BRPs is that they will not be exposed to the imbalance volumes associated with the FSP – another BRP in the market will be. This may give independent aggregators a disadvantage over parties that are BRPs. However, arguably BRPs have this advantage over independent aggregators in the wholesale market already, created by the wider market arrangements.

[25] This was seen before the introduction of P354 which prevented spill payments to non-BM BSPs.

6.2.3 Impact on suppliers (BRPs)

Suppliers impacted will be the BRPs associated with the FSPs providing the service to WPD. Their imbalance position will be affected, or adjusted, depending on the option. The supplier's exact position will also depend on if there is an aggregator/BSP involved.

Under do nothing, or ABSVD with opt out, suppliers face the potential cost of longer imbalances than they had forecast (in other words they may receive 'spill' payments, or have less short volumes of imbalance). If BRPs have information about the activities, they could trade out that position in the wholesale market and avoid imbalance, however this would require more effort on the part of the supplier compared to a scenario where its volumes are automatically adjusted

Under ECVNA suppliers face a decision to accent the auto-balance function, or to trade this position themselves on the intra-day market, which arguably adds to the complexity of the suppliers' activities, but could lead to a better outcome for the suppliers compared to do nothing or ABSVD with opt out.

We set out further analysis of the impact on suppliers in section 7.

Figure 26 - Summary of market participant impacts

Assessment criteria	1. ECVNA approach	**2. ABSVD with opt out** a. ESO implementation b. DSO implementation	**3. ABSVD no opt out** a. ESO implementation b. DSO implementation	4. Do Nothing
Impact on flexibility service provider	FSPs do not need to engage in additional activities beyond providing the WPD service. **Overall: Neutral (0)**	Generators may have the option to be exposed to 'spill' payments for WPD services. **Overall: Slightly positive (1)**	Generators do not have the option to receive 'spill' payments for WPD services. **Overall: Neutral (0)**	Generators may be exposed to 'spill' payments for WPD services. **Overall: Slightly negative (-1)**
Impact on independent aggregators	Negative impact on third party aggregators that are not BRPs and cannot trade in the wholesale market. However this distortion is created by the wholesale market rules, rather than the DSO flexibility products so overall neutral **Overall: Neutral ()**	**Overall: Neutral (0)**	Aggregators that are not BRPs will be exposed to spill payments, but the BRPs of the FSP will. This may put them at a disadvantage. **Overall: Slightly negative (-1)**	Aggregators that are not BRPs will not be exposed to spill payments, but the BRPs of the FSP will. This may put them at a disadvantage. **Overall: Slightly negative (-1)**
Impact on suppliers	Greater requirement to in the ex-ante market (or can choose to auto-trade) However, this option gives suppliers the option to avoid unforeseen imbalances. The extent to which this is a benefit may depend on the level of sophistication of the supplier **Overall: Slightly negative (-1)**	**Overall: Neutral (0)**	If FSPs can opt out but suppliers are not informed this could lead to unexpected imbalances. **Overall: Slightly negative (-1)**	Will have longer imbalances for the volumes of dispatched volumes from FSPs. **Overall: Negative (-2)**

Source: Cornwall Insight

6.3 Impact on the DSO

The implementation option chosen may require greater input from WPD – e.g. if WPD is required to collect and aggregate data for submission to the central systems this would imply greater implementation and operational effort.

Under an option where the ESO implements an option through a change to the ABSVD methodology and dataflows, it is assumed that the DSO would be required to support in implementation.

6.4 Impact on the ESO

If the ESO is required to amend its ABSVD methodology document, and amend its internal process to submit additional DSO information through the existing processes, this will have rely on the ESO's input to implement the change.

Where there is an option for the DSO to submit its own dataflow to the BSC, there is not expected to be an impact on the ESO's activities or a requirement for the ESO to support implementation.

It is not assumed that improved supplier information and therefore trading behaviour to account for FSP volumes would have a positive impact on the ESO's ability to balance the system. Although there is a link between volumes traded in the ex-ante markets, in practice the ESO will balance the system on the basis of its own demand forecasts, rather than volumes traded by suppliers.

Figure 27: Summary of DSO/ESO impacts

Assessment criteria	ECVNA approach	**2. ABSVD no opt out** a. ESO implementation b. DSO implementation	**3. ABSVD with opt out** a. ESO implementation b. DSO implementation	Do Nothing
Impact on DSO	No additional activities for the DSO (in addition to NODEs activities). **Overall: Neutral (0)**	2a. Lower implementation time and cost. **Overall: slightly negative (-1)** 2b. Higher implementation time and cost **Overall: Negative (-2)**	2a. Lower implementation time and cost. **Overall: slightly negative (-1)**2b. Higher implementation time and cost. **Overall: Negative (-2)**	**Overall: Neutral (0)**
Impact on ESO	No impact compared to the status quo. **Overall: Neutral (0)**	2a. Higher implementation time and cost. **Overall: Negative (-2)** 2b. Lower implementation time and cost. **Overall: Neutral (0)**	2a. Higher implementation time and cost. **Overall: Negative (-2)** 2b. Lower implementation time and cost. **Overall: Neutral (0)**	**Overall: Neutral (0)**

Source: Cornwall Insight

6.5 Summary qualitative assessment of options

Figure 28: Summary assessment of options

Assessment criteria	1. ECVNA approach	2a. ABSVD no opt out ESO approach	2b. ABSVD no opt out DSO approach	3a. ABSVD with opt out ESO approach	3b. ABSVD with opt out DSO approach	4. Do Nothing
Interaction with WPD services	0	2	2	2	2	-1
Impact on consumers	-2	-2	-1	-2	-1	0
EU Alignment	-2	-2	0	-2	-2	0
Complexity and process	-2	-2	-2	-2	-2	0
Impact on liquidity	0	0	0	0	0	0
Impact on flexibility service provider (balancing service provider)	0	0	0	1	1	-1
Impact on independent aggregators (balancing service provider)	0	0	-1	-1	-1	-1
Impact on suppliers (balance responsible party)	-1	0	0	-1	-1	-2
Impact on DSO	0	-1	-2	-1	-2	0
Impact on ESO	0	-2	0	-2	0	0
Total	-7	-7	-4	-8	-6	-5

7 Quantitative assessment of costs and benefits

7.1 Introduction

In this section we provide an indication of costs and benefits to support the assessment of which returns the best value to the customer, the lowest overall system cost.

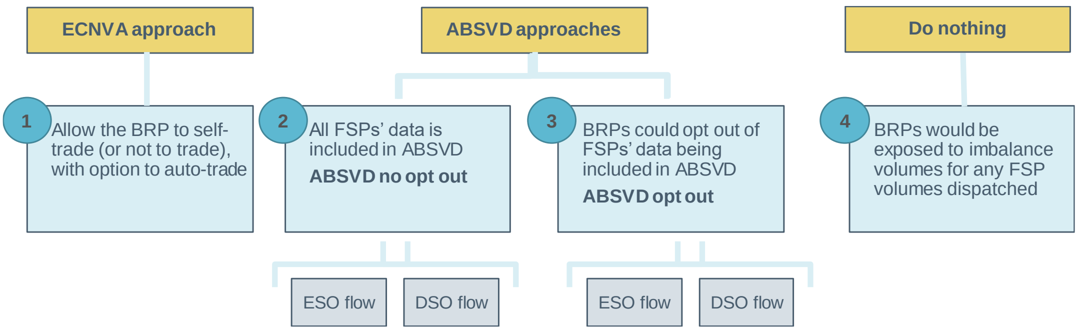
Costs and benefits assessed are based on:

- Implementation costs.
- Costs of operation.
- Any ongoing inefficiencies or efficiencies created by the arrangements.

We have based our assessments on quantitative data where possible. We have also use simplified examples to demonstrate the quantitative impacts on participants of the options in this paper.

Six options are assessed in this section – the four key options, with different implementation options (ESO or DSO) for the ABSVD approaches are set out in Figure 29 below.

Figure 29 - Overview of options



Source: Cornwall Insight

We have made a number of assumptions in this section:

- The cost to WPD of implementing the ECVNA approach would be low, as the required activities are carried out by NODES and/or covered by existing innovation funding.
- It may not always be possible to include all Dynamic volumes by the Submission Deadline, due to the risk of ECVN rejection

7.2 Implementation costs

A full impact assessment involving Elexon, ESO DSOs, and other impacted parties would be required to full assess the implementation costs of these options. However we have made a number of assumptions to support our analysis.

As set out in Section 3, we have assumed that ABSVD implementation via the ESO has a higher cost of implementation, compared to a similar outcome implemented via the DSO, or the ECVNA approach. Costs of implementing BSC Modification P354, which sought to make changes to ABSVD, were estimated at £300,000, which most of these coming from the ESO. Their costs included removing manual processes, and building new systems.

Implementation via the NODES project – the ECVNA approach – is assumed to have the lowest additional cost, as this is covered by the innovation funding.

Implementing the ABSVD approach via the DSO is expected to have DSO costs, but that these would be lower than the ESO. However, while this may be true for the WPD Infra-flex project, it may not be true if the market were to be rolled out to multiple DSOs. Therefore a fuller assessment of each of the DSOs would be required to carry out a full impact assessment.

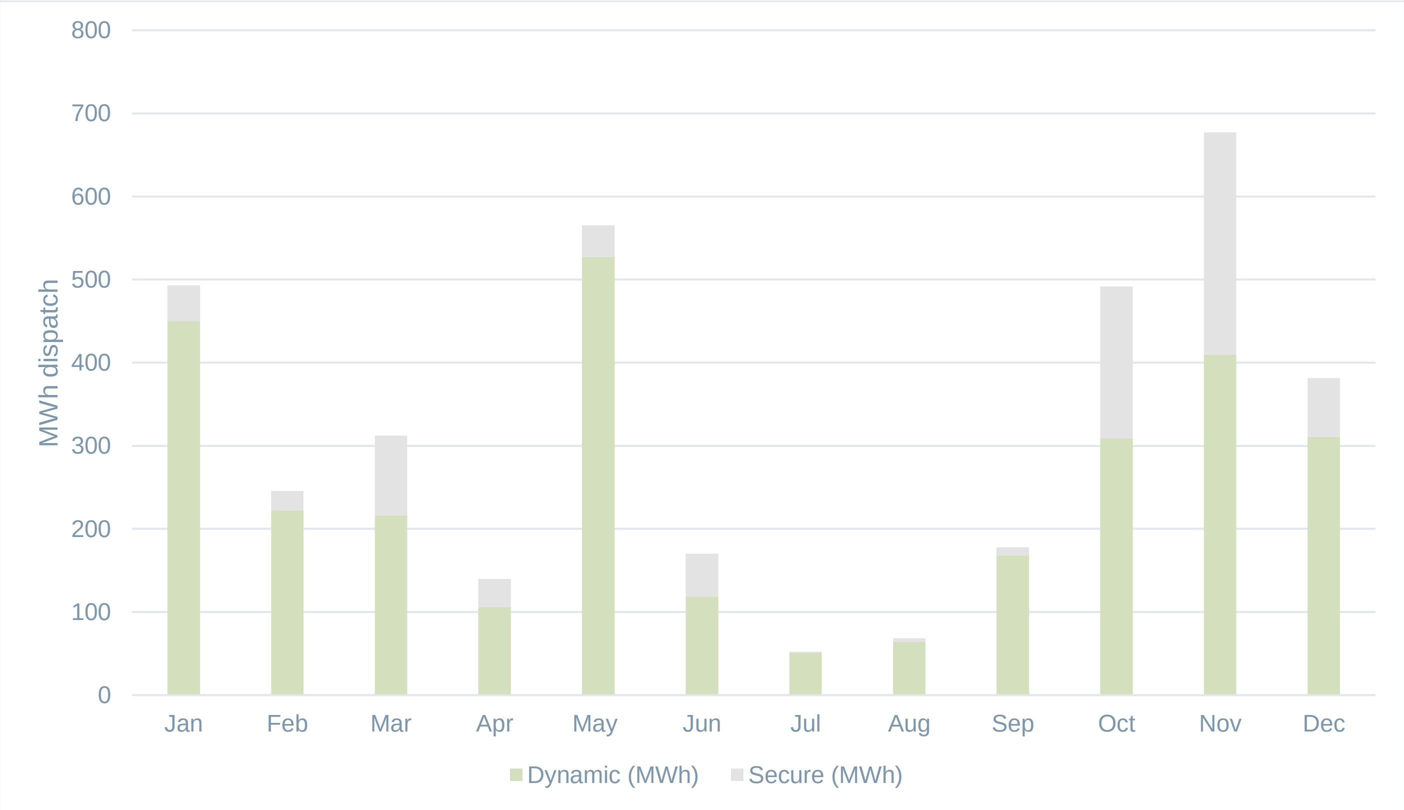
7.3 Interactions between DSO actions and the day ahead and intra-day markets

How WPD's actions interact with the day-ahead and intra-day markets will depend on the WPD Service, and the options set out in this paper.

Secure Service is procured week ahead and is in effect a forward trade between WPD and the FSP (noting that WPD cannot actually take a wholesale position itself, however NODES can take a market position as part of the project). The Dynamic products are dispatched 15 minutes ahead of delivery, which may or may not be ahead of the settlement period.

These timescales mean that it will be possible to trade Secure volumes, however these volumes are expected to be low for WPD products. However, other DSOs will have different requirements, and the proportions may different.

Figure 30 - WPD estimations of MWh dispatched, Dynamic and Secure products



However Dynamic volumes may not be able to be traded in time, as the volumes are not known until 15 minutes ahead of delivery of the DSO product. If volumes were known before the Contract Submission deadline, then these volumes could be traded, but not without risk of not finding appropriate counter-trades, or rejection of ECNV data. 1.02% of ECNVs were rejected in February 2020, and an average of 1.1% of ECVNs rejected for the preceding two years.

Therefore under an ECVNA approach, it would likely not be possible to trade all dynamic volumes ex-ante. On this basis, we consider it an inappropriate solution.

7.4 Understanding how often DSO actions would impact supplier energy imbalance position

Under scenarios where suppliers' positions are not adjusted for WPD services coming from within their portfolio, i.e. 'do nothing' or 'ABSVD with opt out' they will face long imbalances volumes for these volumes – this will mean they will have either a longer imbalance or a less short imbalance in the market, and they will face an imbalance charge or benefit associated with this.

We can estimate the cost of not adjusting positions on suppliers, by considering the cost or benefit of suppliers facing additional long imbalances.

Where a supplier has a long imbalance, they will receive the imbalance price for this volume (or if they have a short imbalance they will pay lower imbalance charges). However, this energy isn't 'free' – there was a cost to the supplier of procuring that energy in the wholesale markets which may have higher than the imbalance price.

Hence, to estimate the true cost/benefit of additional long imbalances in the market, we also need to consider the cost to the supplier of procuring that energy on the ex-ante markets. In this analysis, we reflect ex-ante prices in two ways by assuming suppliers are trading in the:

- Intra-day market – using the Market Index Price (MIP) a basket of different intra-day price; and
- Day-ahead market – using the day-ahead N2EX price

We use these to reflect the value that the supplier would have paid for the additional MW. The actual cost faced by a given supplier will depend on:

- Volumes of FSPs providing WPD services within their portfolio
- The precise timing of dispatch of WPD services, and specifically the imbalance price at that time
- The supplier's trading strategy

In carrying out this analysis we have assumed:

- WPD services are dispatched from 4pm to 6pm (Settlement Periods 33 to 36, this is line with assumptions made by Everoze on the MADE project)
- Utilisation volumes are as per monthly forecasts submitted by WPD for 2020
- 2019 imbalance and market price are an approximation for 2020 prices

Figure 31 – WPD Dynamic and Secure MW and MWh volumes, 2020

Month	Dynamic (MW)	Secure (MW)	Dynamic (MWh)	Secure (MWh)	Average Daily Dynamic (MWh)	Average Daily Secure (MWh)	Average SP Dynamic (MWh)	Average SP Secure (MWh)
January	160	19	450	43	20	2	5.11	0.49
February	127	10	222	23	11	1	2.78	0.29
March	97	38	216	96	10	4	2.46	1.09
April	54	10	106	34	5	2	1.26	0.40
May	73	11	527	38	25	2	6.28	0.45
June	40	9	118	52	5	2	1.35	0.59
July	28	2	51	1	2	0	0.56	0.01
August	28	10	64	5	3	0	0.76	0.06
September	37	7	168	10	8	0	1.91	0.11
October	104	21	309	183	14	8	3.51	2.08
November	173	27	409	268	19	13	4.87	3.19
December	159	20	311	71	14	3	3.53	0.80

We have estimated the imbalance benefit or cost for suppliers if these volumes were 'spilled' into the market across Settlement Periods 33 to 36, by calculating the difference between prices receive from the imbalance price and prices paid on the ex-ante markets, and applying these to the spilled volumes.

- For intra-day trading – The cost or benefit of receiving the imbalance price is the imbalance price less the MIP.
- For day-ahead trading – The cost or benefit of receiving the imbalance price is the imbalance price less N2EX day-ahead (DA) price

Where figures are positive, it was a benefit to the supplier; where figures are negative, it was a cost to the supplier.

The spilled volumes are as per WPDs assumptions for utilisation for Secure and Dynamic. It was assumed that assets despatch for two hours, so average volumes were calculated for these hours for each month and product (see Figure 31).

The imbalance benefit or charge was applied to these volumes across the year, to calculate a total impact on suppliers. This would have resulted in an overall **cost** to suppliers of

- £9,461 using 2019 MIP prices and 2020 forecast volumes
- £17,696.93 using 2019 DA prices and 2020 forecast volumes

The total charges varied depending on the month, with most charges associated with January, when Market Index Prices were consistency above system prices over Settlement Periods 33 to 36 (see Figure 32). There is significant variation of 'imbalance benefit' between particular half-hours;

- For example, suppliers could have 'earned' £185.14/MWh for having a long imbalance at 5pm on 1 March 2018 when the imbalance price was £500/MWh and the MIP was £314.86; however conversely would have lost £213.96/MWh for having a long imbalance at 4.30pm on 1 March 2018 when the imbalance price was £81.38/MWh and the MIP was £295.34/MWh.

However, on average, the average supplier would have been worse off from its imbalance position being longer across the 4pm to 6pm window in both 2018 and 2019.

Figure 32: Imbalance benefit in 2019 (£/MWh)

	Average of Imbalance charge - intraday (£/MWh)	Sum of Imbalance charge intraday (£)	Average of Imbalance charge - day-ahead (£/MWh)	Sum of Imbalance charge DA (£)
Jan	0.14	-6888.87	-1.01	-9521.23
Feb	-0.41	-1584.68	-1.58	-1973.06
Mar	-0.30	-632.26	-1.17	-171.74
Apr	-0.39	-255.69	-0.74	-406.88
May	-0.20	711.51	-1.93	1296.33
Jun	2.26	989.74	1.87	1308.70
Jul	-0.50	-42.70	-0.85	-5.48
Aug	-0.77	-192.10	-1.77	-197.00
Sep	-1.64	-939.92	-4.13	-1586.27
Oct	0.67	-628.37	-0.17	-102.11
Nov	0.71	55.77	-0.55	-4203.77
Dec	1.53	-20.50	-0.62	-2134.42
Total		-9,428.07		**-17,696.93**

Source: Cornwall Insight

In practice, the DA price may be the more appropriate figure (on the assumption that most suppliers trade most volumes at the DA stage or before), however this will depend in suppliers' trading strategies.

Where suppliers receive a benefit or cost they may pass these 'spill payments' or charges onto the FSP. Whether its an overall cost or benefit could put distort other parts of the market (e.g. balancing services, capacity market), and this could lead to inefficient dispatch in the market overall. However, this impact is likely to be low given the small charges.

Figure 33: Estimated supplier impact under do nothing

Data item	Comment	
WPD dispatch window	Weekdays	4pm to 6pm
Average Settlement Period volume dispatched	MW	3.66
Estimated supplier impact for 2019	£	-17,696.93

Source: Cornwall Insight

The impact of WPD actions is small across the year, and while the impact will vary depending on the half-hour, the greatest impact was £766. This would be spread across all of the suppliers within WPDs region that had FSPs within their portfolio.

The impact of this inaccuracy should be considered in the context of other data inaccuracies in the market and whether this distortion can be tolerated. For context, the Materiality Threshold for correcting a dispute under the BSC is £3,000 – no corrective action will be taken for disputes that have an impact under this level.

Under 'do nothing' it may also be possible to give suppliers information about the FSPs within their portfolios, which could them mitigate exposure to imbalance charges. However, the consideration of this is out of scope of this project.

7.5 Estimate for the impact of system wide DSO actions

It is possible to build on this analysis to give an estimate for the potential impact of all DSO actions data from ENA's Flexibility in GB website. This gives overall numbers for expected procurement volume for all DNOs.

Table 2 - DNO procurement volumes 2020[26]

	Sustain (MW)	Secure (MW)	Dynamic (MW)	Restore (MW)
ENWL	0	0	11	2
NPG	0	0	0	100
SPEN	125	125	125	125
SSEN	20	150	150	150
UKPN	20	150	0	0
WPD	0	47.52	286.05	333.57

[26] Source: https://www.energynetworks.org/electricity/futures/flexibility-in-great-britain.html

Making assumptions that these MW volumes will be dispatched in similar volumes, and at similar times as the WPD products, we can calculate illustrative figures for the total market impact of not adjusting DSO volumes.

Assuming 4% utilisation across Sustain, Secure and Dynamic volumes, this works out as an average of 35.04MW from the other DNOs in a given Settlement Period. Using these volumes, works out as a market-wide supplier impact of £150,655.24 across the year.

However, it should be noted that this is simple analysis that does not account for the fact that:

- Different DNOs may have different in any given month
- DNOs may have different MWh utilisation volumes
- DNOs may have different dispatch windows

Summary and conclusions

In this report we have set out:

- How imbalance settlement accounts for the difference between contracted and delivered electricity volumes in GB, and how Balance Responsible Parties (BRPs) have their positions adjusted for balancing services provided to the ESO by Balancing Service Providers (BSPs). This ensures each BRP is not impacted by the dispatch of services from BSPs within that BRP's portfolio:
    - **Energy Contract Volume Notifications (ECVNs)** are used to account for trading in the wholesale market. Each BRP must submit ECVNs before each Settlement Period commences, setting out that BRP contracted volumes.
    - **Applicable Balancing Service Volume Data (ABSVD)** are used to account for volumes dispatched by the ESO for balancing services. ABSVD is sent after the ESO dispatches BSPs, usually by 26 Working Days.
- Under current arrangements, no such adjustments are made to the position of BRPs for services dispatched by WPD. BRPs (i.e. suppliers in this instance) could be negatively affected by unforeseen 'long' imbalances when WPD services are dispatched, but the actual impact will depend on each supplier's trading strategy and portfolio.
    - However volumes and supplier exposure to trading charges are likely to be low (822MWh or £17,696 across all suppliers for WPD products).
    - In theory these unforeseen imbalances on supplier portfolios may create a cost for the ESO in resolving these, but in practice it is not assumed that DSO flexibility products should have a material impact on system balancing, and where there is a risk that it does, this should be a question for DSO and TSO to resolve as part of greater coordination more generally
- Both ABSVD and ECVNs could be used to adjust BRP positions for some volumes of WPD services, however:
    - The ECVN approach does not appear feasible for all Dynamic volumes, as these are not necessarily dispatched with enough time to allow a trade to be executed and an ECVN to be submitted
    - ECVN would be feasible for volumes of Secure utilisation, however these are expected to be relatively low for WPD volumes (other DSOs may have different flexibility requirements, and potentially greater Secure volumes)
    - Conversely, ABSVD can be updated days after dispatch, so the deadline which exists for ECVN is not an issue. Therefore ABSVD could be used for all volumes
    - ADSVD would put DSO and TSO products on a level playing field
- Interactions with the BSC and ESO respectively will impact implementation timescales and costs:
    - Solutions implemented via the NODES project only are assumed to have the quickest implementation and lowest cost (i.e. an ECVN approach).
    - Solutions implemented with DSO-BSC interaction are assumed to have slower implementation and higher costs (i.e. an ABSVD-style approach delivered by the DSO).
    - Solutions implemented via the ESO are assumed to have the slowest implementation and highest cost (i.e. an ABSVD approach delivered by the ESO).

Impact on consumers

The most important criteria to be considered is the impact on the end consumer. Specifically, which option is the best value for money, in the short term to facilitate volumes of WPD Flexibility and the innovation project, as well as overall efficiency of the wider market now and in the future.

There are a number of possible options for how to treat WPD flexibility volumes, and the relative costs and benefits of the options may change over time as the market evolves, and DSO demand for flexibility increases.

We have primarily considered the market as it is, and the likely dispatch of WPD Flexibility Services volumes based on live WPD tenders. Overall volumes are small, with most volumes coming from Secure products which are dispatched a week in advance. Other DSOs will have different requirements however, and these requirements may change over time.

The Infra-flex project is also a fixed duration project, so some solutions may be possible to implement within its timeframes. It is assumed that the ECVN approach would be the quickest to implement, as it would not require BSC or ESO support in implementation.

Recommendation on options

Based on our assessment two key options emerge depending on the time frame:

- In the short term – the do nothing approach appears to be more suitable, as it would be possible to implement within the infra-flex project, and the volumes of imbalances are small are likely within an acceptable 'tolerance level' in light of the cost of resolving them
- In the long term – an ABSVD approach with no opt out appears to be more suitable, on the assumption that DSO volumes increase, and treatment of these move towards a level playing field between DSO and ESO products.

Glossary

Name	Acronym	Description
Adjusted Load Following Capacity Obligation	ALFCO	Capacity Providers must deliver their "Adjusted Load Following Capacity Obligation" (ALFCO) during a Capacity Market Stress Event
Applicable Balancing Service Volume Data	ABSVD	used to account for volumes dispatched by the ESO for balancing services
Balancing and Settlement Code	BSC	A legal document which defines the rules and governance for the balancing mechanism and imbalance settlement processes of electricity in Great Britain
Balancing Mechanism	BM	The BM is one of the tools used by National Grid to balance supply and demand in real time
Balancing Mechanism Unit	BMU	The units used under the Balancing and Settlement Code (BSC) to account for all energy that flows on or off the Total System (the Transmission System and each Distribution System combined)
Balancing Responsible Party	BRP	A party who is responsible for the imbalance position of production and/or consumption assets
Balancing Service Provider	BSP	A provider of a balancing service to the ESO.
Balancing Services Adjustment Actions	BSAA	Actions included by National Grid in the imbalance price that were not taken in the BM, such as power exchange trades and non-BM STOR
Bid Offer Acceptance	BOA	Instruction issued by National Grid via EDL when accepting a Bid Offer submitted by a BSC Party
British Electricity Trading and Transmission Arrangements	BETTA	The electricity trading arrangements that have been in place across GB since 2005
Capacity Market	CM	The government's flagship energy security scheme
Capacity Provider	CP	A generator or demand side response provider that holds a Capacity Market Agreement
Capacity Volume Register	CVR	A document published to provide information on each CMU's performance in relation to its obligation following a Capacity Market Stress Event, which is used to support Volume Reallocation.
Constraint Managed Zone	CMZ	A geographic region served by an existing network where network requirements related to network security of supply are met through the use of flexible services, such as Demand Side Response, Energy Storage and Generation.
Credited Energy Volume	QCEiaj	The aggregate of the BM Unit Metered Volumes allocated to an Energy Account in a Settlement Period
Demand Control Actions	DCA	Actions taken by a network operator to increase or decrease demand to balance supply and demand
Distributed Energy Resources	DER	Generators connected to the distribution network
Distribution System Operator	DSO	A company that owns and operates a distribution system
Electricity Balancing Guidelines	EBGL	The rules for the integration of balancing markets in Europe, with the objectives of enhancing Europe's security of supply.

Electricity Forward Agreement	EFA	A contract calling for the delivery of and payment for electric power in a future period
Electricity Market Reform	EMR	A UK government policy to incentivise investment in secure, low-carbon electricity, improve the security of Great Britain's electricity supply, and improve affordability for consumers.
Electricity System Operator	ESO	The operator of the electricity system. In GB this is National Grid ESO
Electronic Dispatch Logging	EDL	A system used by BMUs to communicate real time information to National Grid ESO
EMR Settlement	EMRS	The provider of settlement services for the Capacity Market scheme
Enegry Contract Volume Notifications	ECVN	· used to account for trading in the wholesale market. Each BRP must submit ECVNs before each Settlement Period commences, setting out what its portfolio contracted for that half-hour
Energy Contract Volume Aggregation Agent	ECVAA	The organisation that BSC parties submit their contract positions to
Energy Contract Volume Notification Agent	ECVNA	An agreement between two Trading Parties and an ECVNA, which enables the notification agent to send notifications to the ECVAA on their behalf.
Fast Reserve	FR	A Balancing Service procured by National Grid ESO
Firm Frequency Response	FFR	A Balancing Service procured by National Grid ESO
Flexibility Service Provider	FSP	A provider of flexibility services in GB
Frequency Response Price Submission System	FRPS	The system used by generators to submit their prices to provide FFR services
Great Britain	GB	The collective name of England, Scotland and Wales
Kilowatt	kW	A unit of energy
Mandatory Service Agreement	MSA	An agreement between a BSP and National Grid ESO
Market Index price	MIP	a price based on a basket of ex-ante market prices
Megawatt	MW	A unit of energy
Megawatt Hour	MWh	A unit of power
Meter Point Administration Number	MPAN	A unique number assigned to an energy meter
Metered Volume Reallocation Notification Agent	MVRN A	The nominated BSC party responsible for submitting MVRNs for two BSC Parties
Metered Volume Reallocation Notifications	MVRN	A notification from the ECVAA that the energy flowing to or from a particular BM Unit is to be allocated to one or more different Party's Energy Accounts for the purposes of Energy Imbalance calculations
Metering System Identifier	MSID	A unique number assigned to an energy meter
National Electricity Transmission System	NETS	The collective name for the infrastructure that makes up the GB electricity transmission system

Net Imbalance Volume	NIV	The volume of the overall System energy imbalance
Network Innovation Allowance	NIA	A set amount of money that network operators are able to spend on innovation projects
New Electricity Trading Arrangements for England and Wales	NETA	The energy trading agreements previously governing England and Wales. These were replaced by BETTA in 2005
Obligatory Reactive Power Service	ORPS	The provision of varying reactive power output
Physical Notification	PN	The level of Import or Export (as the case may be) that a Party expects to Import or Export from a BM Unit in a Settlement Period , in the absence of any Balancing Mechanism Acceptances from the System Operator
Replacement Reserve	RR	A harmonised service across participating European TSOs for the provision of both an increase and decrease of active power. In GB this is procured by National Grid ESO
Replacement Reserve Instructions	RRI	The dispatch instructions for TERRE products
Replacement Reserve Schedule	RRS	The required level of balancing services procured through TERRE
Settlement Administration Agent	SAA	The organisation that calculates cashflows as part of the settlement process
Short Term Operating Reserve	STOR	A Balancing Service procured by National Grid ESO
Trading Operations Market Analysis System	TOMAS	
Trans-European Replacement Reserve Exchange	TERRE	The European implementation project for exchanging replacement reserves in line with the Electricity Balancing guideline
Transmission System Operator	TSO	An operator of an electricity transmission system
Virtual Lead Party	VLP	A party that only participates in energy settlement by offering balancing energy
Working Day	WD	Any week day (other than a Saturday) on which banks are open for domestic business in the City of London.