WPD INNOVATION
Transforming the electricity network

IntraFlex

NIA Major Project Closedown Report

October 2019 – November 2021

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

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Name	Role
David Penfold/ Gary Swandells	Author
Stuart Fowler	Reviewer
Yiango Mavrocostanti	Approver

Contact Details

Email

wpdinnovation@westernpower.co.uk

Postal

Innovation Team
Western Power Distribution
Pegasus Business Park
Herald Way
Castle Donington
Derbyshire DE74 2TU

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Western Power Distribution 2022

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1. Executive Summary

The IntraFlex Project is a continuation of our ongoing commitment to the development of effective flexibility services that enable smart grid methods to be employed in the support of efficient network management. Having already achieved the successful migration of previous innovation projects on flexibility services into Business as Usual (BaU), one of the key objectives is to broaden the burgeoning market and create increased opportunity for participation from Flexibility Service Providers (FSP's) through the establishment of new services.

Existing Distribution System Operator (DSO) flex services are typically procured many months ahead and while this is attractive to some providers, for many others this limits their ability to contract their capacity. IntraFlex has been developed in partnership with NODES[1] who created a trading platform that instead of adopting an auction type approach, operates on a continuous basis, matching bids and offers in real-time. This can in theory facilitate the ability to continue the trading of flexible capacity far closer to real time.

Close to real time operation can however present additional challenges, one of which was identified as impacting Balancing Responsible Parties (BRPs) such as energy suppliers, potentially affecting their wholesale imbalance position but leaving insufficient time to mitigate it. As such the original project scope included a proposal to include an active rebalancing link to the intraday market operated by Nord Pool as well as an information exchange with day-ahead markets. This would ensure that BRPs would remain informed of any actions that might negatively impact their trading assumptions and if desired automate the process of countering any imbalance created in the wholesale market.

Working in partnership with NODES and SGC (Smart Grid Consultancy) WPD expected to

- Develop a UK Market design for short-term flexibility market
- Create 'close to real time' products that have the potential to benefit the efficient management of the distribution network
- Procure flex capacity 'close to real time' via the NODES platform
- Carry out operational trials that demonstrate products that could limit supplier exposure to imbalance costs
- Establish the viability to operate new services alongside the existing BaU programmes

This report details the plan and execution of the project and provides detailed analysis of the outcomes. It also references next steps based on the outcomes of the project. We believe that the results of Intraflex to be compelling for the development of flexibility services such as Demand Turn Down and Up, in the UK and worldwide.

[1] NODES is an independent marketplace platform where Network Operators, producers and consumers of energy can trade decentralised flexibility and energy. Further details can be found on their website.

2. Project Background

It is acknowledged that to make flexibility services commercially attractive to participants, the ability to stack revenues from multiple sources is essential. Previous work in our SYNC, Entire and EFFS projects have looked to stack revenues against Electricity System Operator (ESO) services, however limited work has been done to link services into wholesale processes. The omission of these markets limits the potential for stacking revenue which could be a barrier to entry.

All network licensees have committed to the assessment of relevant reinforcement of significant value against flexibility options. With this commitment to flexibility, the volumes procured by Network Operators will increase with the consequential impact on and participation from Suppliers could increase. This project looked to investigate a solution to this issue and would be applicable to all network licensees.

As such the project looked to trial a short-term marketplace for the procurement of DNO flexibility. This trial investigated an active rebalancing link to the Nord Pool intraday market as well as an information exchange with day-ahead markets. The project also aimed to open up the access to rebalancing services so independent aggregators were able to participate alongside BRPs.

The project aim was to deliver a more cost reflective market structure along with added transparency to flexibility costs which would allow for more informed market investment decisions to be made, reducing the impact on the wider customer.

If the problem was solved, the risk associated with the provision of flexibility services would be reduced. In the long run we would expect to see increased liquidity within DNO DSR markets and a corresponding reduction in pricing.

Furthermore, this lack of link creates imbalance in the wider system but does not account for it. Whilst Balancing Mechanism (BM) providers of ancillary services see their positions adjusted following calls by the ESO, there is no such process for the DNO. With current volumes of DNO Demand Side Response (DSR) services limited, this imbalance is lost in the noise, however as volumes increase a process to account for them would allow for the whole system cost of the action to be reflective.

The project utilised a market platform developed by NODES which has been design as an integrated flexibility market and aimed at serving all levels of the grid both Distribution System Operator (DSO) and ESO.

2.1. Scale of Project

The trial was a market based trial engaging real Flexibility Service Providers (FSP's), aimed at larger providers of flexibility. Whilst this was primarily a technology and process trial, it initially focussed on areas where Constraint Managed Zone (CMZ) procurement was already underway. This was implemented to maximise any network benefit and facilitate any potential roll out to BaU. The trials were therefore based on real CMZs albeit the constraints were not real.

Potential providers were engaged within the first phase of the project (in WP2) to understand the relevance of the market design to them. Within this phase, the appetite for participation was gathered and initial recruitment undertaken.

2.2. Benefits to Customers

2.2.1. Customer Interaction / Impact

The project engaged with a wide range of suppliers, aggregators and providers of flexibility as part of WP2 to refine the market design.

It was expected that the project would target large flexibility providers through aggregators, both those with supply licences and those without, for the trial. Those with supply licence are in a position to gain direct benefits from the intraday market link. For independent aggregators without a supply licence the project expected to develop practical solutions for automated rebalancing with their suppliers. This expectation was tested through the stakeholder engagement in WP2.

2.2.2. Non-Financial

The project was aimed to deliver a more cost reflective market structure, added transparency to flexibility costs which should allow for more informed market investment decisions to be made, reducing the impact on the wider customer.

2.2.3. Financial

If the problem were solved, in the long run we would expect to see increased liquidity within DNO DSR markets and a corresponding reduction in pricing. At the time of undertaking of project our estimates for benefits were as follows.

It is anticipated that the value of DNO DSR could reach £12.1m/year by the end of ED1 (£3.38m/year within WPD). If the increased liquidity drove a 10% saving in this value the savings would be £340k/year across WPD or £1.21m/year across the UK.

Base cost = 12.1m/year
Method cost = 12.1*0.9= £10.9m/year
Financial benefits = £1.21m/year

The costs of roll out across the UK would be limited. This would simply require each DNO licencing the required platform.

3. Scope and Objectives

3.1. Scope

IntraFlex aimed to understand how to deliver a link between DNO procurement activity and Balance Responsible Party (BRP) imbalance positions.

As such the project was looking to trial a short-term marketplace for the procurement of DNO flexibility. This was to trial an active rebalancing link to the Nord Pool intraday market as well as an information exchange with day-ahead markets.

The active rebalancing aspect of the trial was to understand how to deliver a link between DNO procurement activity and Balance Responsible Party (BRP) imbalance positions.

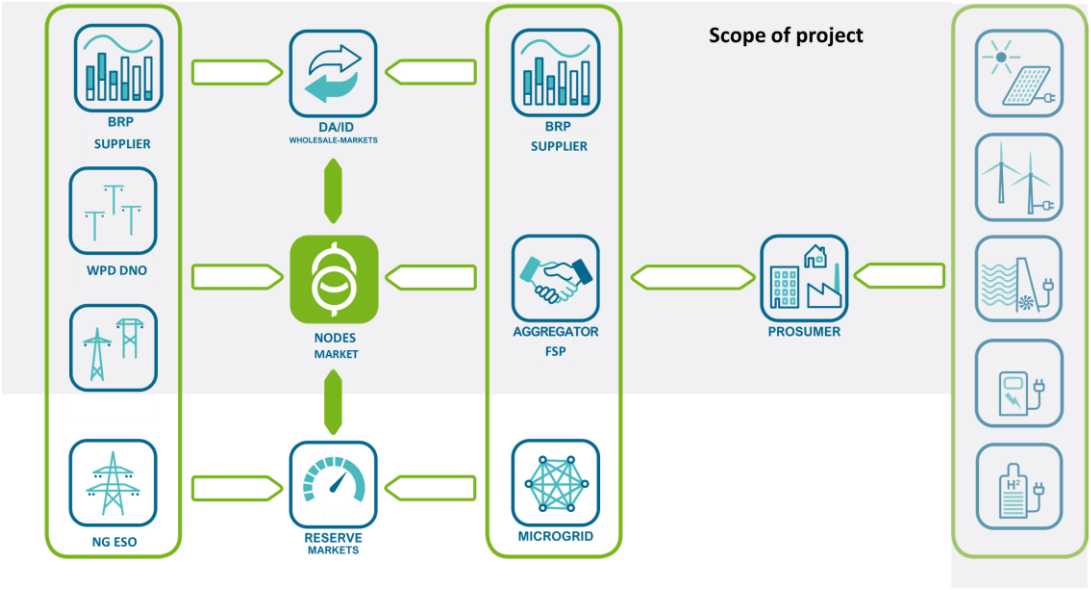

Figure 3-1: Scope of IntraFlex

The project was broken into five work packages based around two phases. The first of which was to test the NODES' ShortFlex service for DNO flexibility. The second, consisted of a more comprehensive trial with automated rebalancing of imbalance positions through the integration with the GB intraday market.

	Timeline												
Activity	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20
WP1 PM and Reporting													
WP2 Detailed Stakeholder Engagment and Market Design													
WP3 NODES Build													
WP4 WPD Build													
WP5 Trial													
	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21
WP1 PM and Reporting													
WP2 Detailed Stakeholder Engagment and Market Design													
WP3 NODES Build													
WP4 WPD Build													
WP5 Trial													

Figure 3-2: Project Timeline

Alongside each trial, significant stakeholder engagement was to be sought. This planned to bring participants onto the platform and allow them to be operational in the trial. This customer journey was split into several sub tasks allocated between SGC and NODES. Those which required on-the-ground presence such as recruitment, and customer

support were to be carried out by SGC, the more detailed requirements (on-boarding and platform technical support) were to be carried out by NODES.

Table 3-1: Status of project objectives

Objectives	Status
The objective of the project was to develop learning on:	✓
· The operability of short term flexibility markets	✓
· The value of increased information at the day ahead stage to suppliers	✓
· The value of an integrated link for rebalancing in the intra-day market	✓

4. Success Criteria

4.1. Potential for New Learning

The project expected to develop learning on the following topics:

- The operability of short-term flexibility markets
- The value of increased information at the day ahead stage to suppliers
- The value of an integrated link for rebalancing in the intra-day market

Detailed learning is described within Section 12, we believe that these learning objectives have been met.

Table 4-1: Status of project success criteria

Success Criteria	Status
· Development of a UK Market design for short-term flexibility market that reflects imbalance costs.	✓
· WPD access to ShortFlex products that have the potential to benefit the distribution network.	✓
· Procurement of ShortFlex via the NODES platform.	✓
· Demonstration of ShortFlex products that limit supplier exposure to imbalance costs.	✓
· Delivery of the project on time and on budget.	✓

The project met all its success criteria and moreover has provided some real insight into how a flexibility market could work for consumers. Some important next steps we believe have emerged and we have detailed such in Section 13 Planned Implementation.

5. Details of the Work Carried Out

The work carried out across the work packages of this project, including the live trials, is detailed below.

5.1. Work Package 1- Project Management and Reporting

This work package ran for the duration of the project and ensured the project ran smoothly and progressed adequately. This also tracked and managed risks to maximise the chance of successful delivery.

All regular reporting, weekly project meetings and logs were maintained in a timely manner as required.

5.2. Work Package 2: Detailed Stakeholder Engagement & Market Design

This work package key outputs included; completion of the final Market Design document and Technical Requirement Specification document. Also, the opening of the expressions of interest window for participants to register their flexible assets.

The go/no-go stage gate at the end of this work package considered the viability and potential value of the market design proposed and progress to the next phase was signed off.

5.2.1. Market Design Process

The initial Market Design assumptions were reviewed and further developed via the engagement of a wide group of industry stakeholders. This was to ensure that project teams understanding of the current processes for the handling of imbalance risk as well as the systems in place to mitigate them are correct.

This was accomplishment via the following steps:

1. Internal 2-day workshop with initial thoughts about the market being proposed reviewed by WPD, NODES & SGC with the following outputs:
    - 1st draft Market Design
    - Proposed Customer journey
    - Technical specification.
2. A review of the above documents with several market critical parties aimed at understanding current processes for the handling of imbalance risk: OFGEM, BEIS, Elexon and ESO.
3. Further review with wider groups of stakeholders via:
    - Webinars – 2 held hosted by NODES and SGC were attended by circa 76 people.
    - Workshop – Engagement with a wide group of stakeholders to ensure that market to be developed can produce value.

Following feedback from Elexon, an alternative route for the accounting of DSO services in the supply market was suggested: through the Applicable Balancing Services Volume Data (ABSVD) process. Cornwall Insight were engaged to review this suggestion. Their report on it can be found here: https://www.westernpower.co.uk/downloads-view-reciteme/460187

The resulting finalised Market Design following the detailed stakeholder feedback is summarised in detail in the Market Design report available on our website. https://www.westernpower.co.uk/downloads-view-reciteme/111475

During the stakeholder review it became clear that an information service, that will provide suppliers with information on the calls made to date by the DSO, would be very interesting.

Our initial intention was to make this information available until the day ahead energy market gate closure, but we saw value in extending the service up until NODES Gate Closure.

A further trial development was to provide an Auto-rebalancing service where the BRP could elect to have NODES automatically rebalance its position in the intraday timeframe.

However, in the case of negative pricing in the intraday market the cost of this action will be presented to the DSO at the time of purchase. In this scenario the DSO would pay the sell price which would be passed onto the aggregator and the rebalance price which would be passed into the intraday market.

We had limited initial feedback from stakeholders on the auto rebalancing proposal so upon agreement with the Steering Group we set a new deadline for the collation of feedback and the development of a tangible value case for it. During this extension we engaged in a more detailed engagement with the BRPs via an online survey and a few follow up interviews.

The survey was specifically targeted at licensed electricity suppliers and was designed to openly ask, if they as BRP's, would be interested in two trial elements of the project being;

- An information service detailing what flexibility has been procured by the DNO from the BRP's customers
- A rebalancing service that automatically flattened the BRP's position due to the procurement of flexibility by the DNO.

We had 4 respondents with half having a peak consumption of more than 1GW and half less than 500MW. All organisations were aware of imbalance costs and that they are important for their organisations but, unsurprisingly, they each had differing hurdle rates, for when the costs of imbalance become material enough for them to act, ranging from £10k - £m's.

On the 2 key questions about the Information service and Auto Rebalancing the feedback is very clear.

✓ **75%** of the respondents **WOULD** potentially sign up to the Information Service, as they see the information as useful

and

X **75%** of the respondents would **NOT** sign up to the Auto Rebalancing Service, as they see this as a step too far.

Therefore, as the survey very clearly highlighted limited value in the auto rebalancing service, following the appropriate change procedure, we removed it from the project scope. The general view was that such a service was too complex and risky whilst providing limited financial value. The information service was seen as a far more workable, and less risky option.

5.2.2. Payment Mechanics and Baselines

As the markets developed within this project are closer to real time, it was necessary to develop appropriate commercial terms to reflect this. Therefore, it was identified that new payment mechanics and baselining techniques needed to be developed. Again, the final Market Design document and Technical Requirement Specification document explain this in detail.

We attempted to align the payment mechanics with those already in use and therefore the general principals have been adopted as below with some unique to the IntraFlex service proposition.

- Utilisation only (No availability payment).
- 1-minute granularity for measurement of delivery.
- Grace factor enabling 100% payment for delivery at 95% or above.
- Ratchet reduction of 3% in payment for each percentage under 95%
- No payment for delivery below 63%
- No payment for over delivery
- Delivery capacity can alter for each half hour period in line with the bidding interval

As previously mentioned, a new baseline methodology had been developed in conjunction with the payment mechanics. The baseline methodology differed quite significantly from that currently used by Flexible Power with the most noticeable feature being that of a daily profile shape.

The Baseline methodology developed specifically for the trials were.

- Automation of suggested baseline values
- Profiled baseline varies across the day
- 48 half hour periods create the profile
- Average value from 5 previous weekday readings for each period
- Non-weekdays eliminated
- Values prepopulated for FSPs within the NODES platform
- FSP ability to overwrite the auto baseline if they had better intelligence to determine the likely 'actual' readings for each HH bid period
- Baseline locked when offer is placed but can be revised if not yet accepted
- FSP will adjust delivery at the shoulders of each HH period to maintain consistent delivery ≥95%

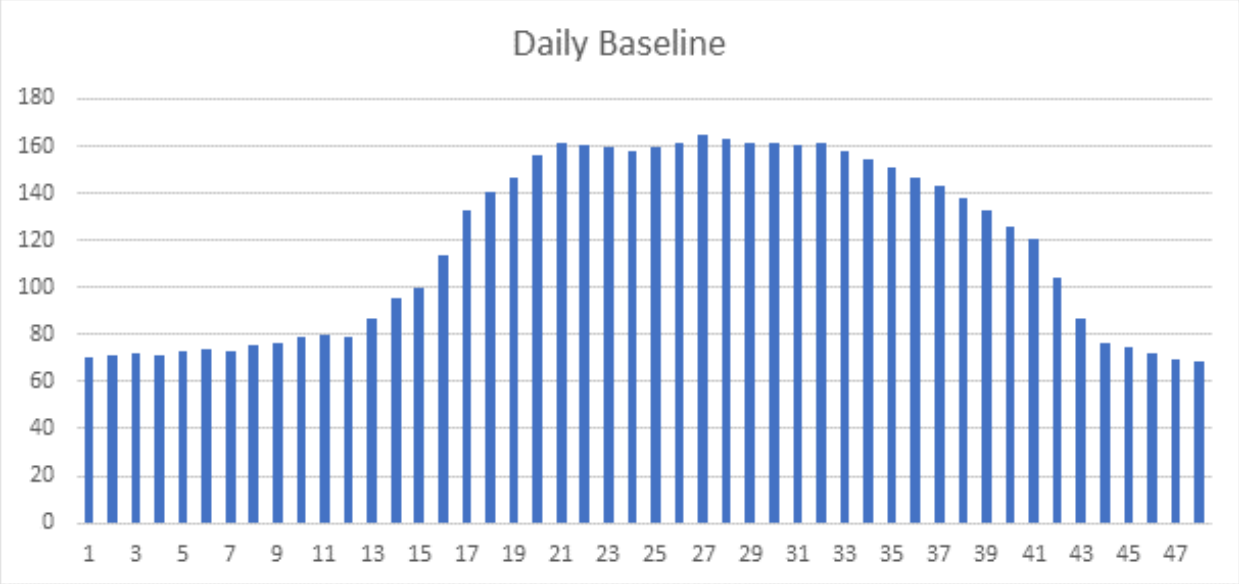

Figure 5-1: Example of profiled baseline created with IntraFlex methodology

5.2.3. Technical Systems Overview

To enable the new markets to function, several systems and interfaces were required which were intended to balance the requirement for simplicity whilst providing the required level of functionality. This involved significant coordination between NODES, Kiwi Power and the BaU Flexible Power team.

We balanced the requirements to reduce the trial development risk, whilst also looking to BaU roll-out. Development was split to align the two trial phases with more BaU work focussed for Phase 2 once Phase 1 learning was incorporated.

The primary systems are those owned and operated by NODES and these focus on the commercial relationship with the participant. For the trial, the metering systems (the project metering and baseline calculations) functions were provided through integration with existing WPD metering capability. This facilitated the timely deployment of the trial as well as the de-risking of the project rather than the mandated long-term solution.

It is expected that following the trial, as the market for flexibility services matures, this function may be taken on by an independent operator (NODES or another party). The provision of metering services is a key discussion within Ofgem's Future Insights paper on Flexibility Platforms in electricity markets.

NODES provided the commercial systems with participants able to interact via a Graphical User Interface (GUI) or Application Programming Interface (API). This built on their existing market platform and was supplemented with project specific development.

5.2.4. Expressions of Interest

The expressions of interest window opened at beginning of March 2020 and was due to close at the end of March 2020. Several potential participants requested extra time to respond, due to the COVID-19 situation within the UK, the expressions of interest window was therefore extended to the 8th of April 2020.

The following steps were taken to gather Expressions of Interest (EOI) as follows:

1. Awareness of the project was raised via; WPD LinkedIn & website, NODES LinkedIn & Website, SGC LinkedIn
2. Information that the project is looking for trial partners shared during the webinars and workshop.
3. EOI's invited asked for via;
    - WPD Innovation and Flexible Power Flex email distribution list,
    - WPD news article
    - LinkedIn push
    - Article in the Energyst
    - Targeted emails to attendees of the webinars and workshop
    - Announcements in the EnergyUK and ADE mailing lists
    - All EOI's collated and summarised into a spreadsheet ready for aggregating to WPD CMZ's
4. During the window extension targeted emails were sent out those attendees of the workshops and webinars that didn't respond.

The extension was implemented following feedback on the challenge of timescales given the COVID lockdown. We closed the extended expressions of interest window with 22 submissions providing over 700MW of response from 68 sites. These are summarised in the table below

Table 5-1: Overview of EoI responses

	MW		Sites	
	Total	Unique	Total	Unique
In Active Zone	103.5	82.1	17	14
Total	707.1	631.7	68	63

**the large domestic providers were omitted from this summary tables to help provide more visibility of responses*

We further refined the submissions and confirmed recruitment across the current Flexible Power zones, aggregating them by licence area for dispatch purposes and liquidity.

Table 5-2: Responses Split by Licence Area

		East Midlands	South West	West Midlands	South Wales	Total
In Active Zone	Unique MW	32.7	39.3	10.1	0.0	**82.1**
	Unique Sites	5	7	2	0	**14**
Total	Unique MW	115.9	95.4	256.9	163.5	**631.7**
	Unique Sites	14	11	24	11	**63**

**The large domestic providers were omitted from this summary tables to help provide more visibility of responses*

5.2.5. Stage Gate

At the end of work package 2 we had a stage gate for go/no go to work package 3 System Build. This was reviewed and approval was given to progress. A further stage gate was added after the phase 1 trial to assess the viability of going to the phase 2 trial and implementing automated rebalancing.

5.3. Work Package 3: NODES System & Process Build

To enable the new markets to function, a number of systems and interfaces were required. This involved significant coordination between NODES, Kiwi Power and the BaU Flexible Power team.

The primary system is owned and operated by NODES and focuses on the commercial relationship between the participants (FSP and DSO). This built on their existing market platform and was supplemented with project specific development.

For the trial the metering systems (the project metering and baseline calculations) functions are provided through integration with existing WPD metering capability. The development of the metering system is covered in section 5.4

5.3.1. Nodes Market Platform

The NODES market platform provides the commercial systems with participants able to interact via a Graphical User Interface (GUI) or Application Programming Interface (API).

The team created a guide to take FSPs through a step-by-step journey on how to use the platform
Trading in the Phase 1 Trials happened as follows:

- **Products** - Order volumes would be in MW, with a minimum lot size of 0.001 MW, Prices would be in £/MWh & Flexibility was traded in half hourly periods.
- **Order matching -** Matched continuously, ranked by price and time. All confirmed transactions are for triggered utilisation only.
- **Gate closure time -** Orders placed onto NODES were at delivery day – 3 days (T-3) so starting 72 hours ahead of the delivery period. With the market being open until 90 minutes before the delivery period.

As per Flexible Power:

- Where delivery is validated for 95% or more of the volume that was sold, the FSP still receives full payment.
- Where delivery is validated for less than 95% of the volume that was sold, payments are reduced by 3% for each percentage point that the validated deliveries differ from the sold volume.
- Where delivery is validated for higher than the volume that was sold there are no overpayments.

5.3.2. Project specific development work for Phase 1

During the Phase 1 extensive user testing prior to going live, several platform improvements were highlighted and actioned by NODES as follows:

Table 5-3: Phase 1 Developments

Platform Area	Development
Home Page - FSPs	

Map View:	Linked the map to zone names and make it more navigable. When you click on the map, assets now get filtered by the location selected.
Asset Entry	There was a need to identify an asset after they have been registered. This was actioned by creating a link to the asset being edited on the map.
	Ensured grid coordinates continue to be displayed after the asset is approved
	We made sure the reason for rejection of an asset by the DSO was displayed to the FSPs on their asset view.
Meter point Entry Field	This is the Unique ID so we made this a mandatory field.
Home Page - DSO	
Flex Market Page	Defaults for the drop down menus changed to be at top of the page. The following lists were changed to default to the last selection; • DSO • Grid Location. • Up/down regulation
	Drop down lists at bottom half of page were amended to add a tick box to display all orders that have been placed in all markets and display the DSO and Grid Location.
Order Entry:	"From time" field changed to display the market view so 5 days forward.

Several options for participant dispatch information were also provided. These built on functionality already developed by NODES. This included the options for FSPs to receive dispatch notification via SMS, email or through a URL call-back.

Finally, NODES developed internal processes to pick up baseline and meter values from the metering portal, using the APIs developed. The key linkage between the 2 systems was the Meterable Unit ID. This is a unique identifier, generated per asset in the metering portal and provided by the participant as part of asset registration. This allowed NODES to pull the right metering signals and baselines.

5.3.3. Project specific development work for Phase 2

During the Phase 1 trials and following feedback sessions the participants suggested several platform improvements. WPD and SGC also identified several platform features that would be needed to support the Phase 2 trial. These features were developed and delivered by NODES for Phase 2 as listed below.

Table 5-4: Phase 2 Developments

Platform Area	Development
Posting orders	Ability to post multiple orders at once
	An all or nothing order type
	Ability to edit an existing order
	Restriction to so that it is possible to place orders only in an orderbook that corresponds to a congestion zone where the flexibility service provide has assets
	Restriction so that orders can only be placed for periods where a baseline is available
Notifications	Notifications sent via the platform to users, when WPD posts/edits bids or publishes information required by the UCR
Settlement	Pricing on an hourly basis rather than half hourly
Filtering orders and trade	Ability to "jump" to a selected day when viewing market orders
	Ability to sort the order/trades by date, volume, price in ascending/descending order
	View that displays all orders in all zones
Market opening time	Setting that can be altered by WPD, enabling Phase 2 opening 7 days ahead
Statistics for WPD	Statistics (anonymous and aggregated) to enable WPD to assess the effectiveness of notifications

NODES also implemented several process improvements, in response to Phase 1 participant suggestions and WPD requirements for Phase 2. These included:

- Alignment of participant onboarding steps and terms and conditions (NODES Rulebook) with UCR requirements
- More frequent settlement reports
- Streamlined and standardised communication to platform users in the event of unplanned downtime
- Clarifications where detail was missing in operational guidance documentations, including on time zones and dispatch notifications

5.4. Work Package 4: WPD System & Process Build

This work package was in place to complete the development of the metering API, Baselining and Payment Mechanics ready for use by participants in conjunction with the NODES Market Platform.

The IntraFlex metering portal was used to facilitate verification and metering of sites and assets. This portal provided each of the enrolled assets with a unique identification code that was used to link it with the NODES market platform, to ensure the correct metering feed is available. It was based on the existing Flexible Power platform and adapted to accommodate the trial in the simplest manner possible.

5.4.1. Project Specific Development Work Phase 1

The IntraFlex portal built on the existing Flexible Power portal, adapting it for use within the project context. The work included the following developments.

Table 5-5: WPD Systems Development Work Phase 1

Platform Area	*Development*
Adapting the metering API	A key task was to adapt the Flexible Power API to accommodate the simpler requirements within IntraFlex. The new API was defined on the portal and was directed to a new URL. The data structure was also adapted to rationalise to a single metering database (as opposed to the 2 used in Flexible Power) and the addition of a 2hr cut off for the provision of data (adapted from the 15 mins used in Flexible Power). As per the Flexible Power API all timings are in UTC.
Baseline Calculation	The portal then used the metering to calculate the baselines as per the baseline methodology. Some detailed rules were applied in terms of the calculations and how they treated missing data. This worked in two stages, calculating the half hourly averages for each day and then the average across the last 5 days was taken. As long as data was provided for at least 1 minute in the HH then the process would return a value. These were rounded to the closest kW. No provisions were implemented for clock change as this was not necessary at this stage and bank holidays are treated as normal working days.
NODES Baseline API	An API was built so that NODES could pull the values from the metering portal. NODES developed a process to pull this at around 2AM every morning
NODES metering API	This allowed NODES to pull the required metering data for settlement. This was pulled when NODES undertook a settlement run.
Portal branding and Segregation	The portal was rebranded and hosted on a new domain to segregate it from the Flexible Power portal. Segregation between the back ends was limited to reduce costs.
Asset validation data	A simple asset visualisation and export tool was created to allow WPD to view the assets on the system. This allowed assets on the NODES marketplace to be approved.

5.4.2. Project Specific Development Work Phase 2

WPD development work in Phase 2 focussed less on the participant interface, and more on how WPD would interact with the marketplace. For this phase it included the building of an API to allow easier provision of multiple daily interactions to the NODES market platform.

In simple terms this API enabled the batch upload of multiple daily bids at differing volumes and values by utilising the ability to link cloud-based data to the NODES platform reducing the number of man hours needed to manage the trial.

Below is an example of the API user interface that shows the timeslots that Bids from WPD were to be placed by the API onto the market, the bid volume, and the bid price. The user interface also allowed “Market Messages” to be posted alongside the bids to inform the market participants that actions had been carried out on the market by WPD.

The user interface also allowed for multiple changes to the bid price to be published in batches rather than implementing individually. These batches could be a single day or multiple days with multiple timeslots, volumes and prices.

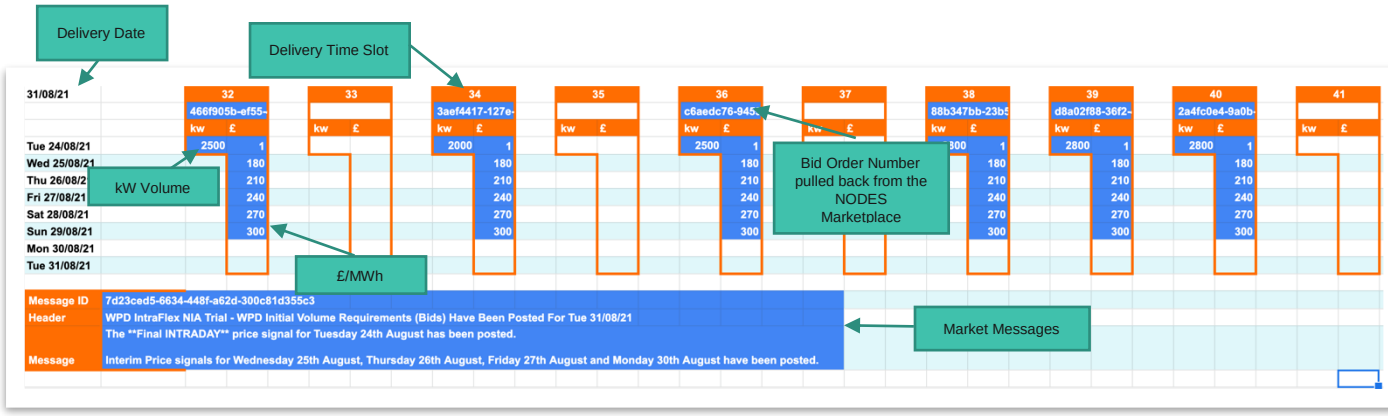

Figure 5-2: Batch upload API developed for phase 2 tests

5.5. Work Package 5: Trials

The first live trial phase of this work package was completed at the end of October 2020. Phase 1 established the technical robustness of the software and demonstrated the ability of FSPs to set up and use it. The Phase 2 tests, which completed at the end of August 2021, were aimed at determining the optimal usage patterns that encouraged trading of flexibility and grow the liquidity on offer. For this reason, the Phase 2 trials were attempting to encourage FSPs to make proactive offers on the platform as opposed to relying on them being able to respond to bids placed by WPD.

The following information, pertaining to what has been delivered, will be broken into two high level sections 1) Phase 1 tests and 2) Phase 2 tests. The overall outcomes of the market in action will be summarised in Section 6 with the following information pertaining to what was done.

5.5.1. Phase 1 Live Trials - Sub Tests

Test 0 Technical Proving; This initial ‘pre-trial’ test was intended to facilitate non-market responses to the system to ensure that everything was set up correctly and working as intended. This test was compulsory for all participating FSPs and required an individual test for each to be scheduled at a mutually convenient time.

This successfully ran for 2 weeks with some API & metering issues identified by FSP’s with the main learning being that we needed to be more prescriptive with the drop-dead date for completing this test with the FSPs.

Test 1 Basic Function and FSP Interaction; The first full test simply aimed to confirm that the FSPs who had enrolled are comfortable with the platform and the procedure to submit an offer, and that the assumptions around baselines etc. work as intended.

This test was live for 2 weeks with WPD publishing 7.3MW of ½ hourly flexibility requirements and successfully trading 4.9MWh of flexibility, 2.4MWh of flexibility was not taken up. It was seen that requirements over 2MWh cleared quickly.

Test 2 – Speed of response to order requirements; Based on the assumption that £300 MWh would be an acceptable incentive then this test was intended to see how quickly we secured responses or whether we ended up with some requirements expiring on the system unfulfilled.

These tests were published competitively and offers matched with WPD bids on a first come first served basis. All FSPs had equal opportunity to respond to WPD bids as a notification of the bid being published on NODES was issued via a group email dispatch.

It was desirable for us to see responses from multiple FSPs to ensure that the system is fit for purpose across the wider participation group rather than just one or two.

This test was live for 2 weeks with adjustment in the way in which pricing was defined. WPD published 23.15MWh of flexibility requirements and successfully traded 17.6MWh of flexibility, 5.5MWh of flexibility was not taken up.

There were 2 potential outcomes from the test:

- Outcome A – limited bids or no bids received. If this is the result, then we will commence to test 3.
- Outcome B – majority of capacity is fulfilled within 24 hrs of publication. If we find this happens, it would be reasonable to regard this as the limit of the learning for Test 2 and a successful result would enable advancing straight to test 4.

The outcome of this test was 'B' so the project progressed directly to test 4.

Test 4 – Profiled Capacity linked to pricing; By leading the market and publishing requirements WPD were looking to establish the principles through which FSP could respond to a meritocracy, linked to the network needs. The service pricing, instead of being linked to any time influence, showed different values on offer during each ½ hour directly correlating to the capacity needed.

During this test the volume posted at peak periods were initially placed at higher values and were then adjusted each time a partial offer was received. This in effect meant the price posted was adjusted down to reflect the reducing volume of the remaining capacity.

In theory, if price is a critical sensitivity, then this method should fill the requirements quicker with the highest prices secured by first bids. While we anticipated that this would ultimately create a service that helped fulfil a profiled delivery over a day, we would have liked to have seen if there were any specific patterns in bidder behaviour.

This test was live for 2 weeks with variable pricing, with times of more volume attracting higher prices. Higher volumes were uploaded at more variable times to understand the flexibility of assets.

WPD published 112.88MWh of flexibility requirements trading 22.49MWh of flexibility with 90.41MWh of flexibility not taken up.

Participants tended towards higher pricing (a greater number of higher priced bids were accepted than lower priced ones), other factors such as volume and timing seemed to be important. This would suggest that the reference price (£300/MWh) around which WPD placed bids during the trial at most times met or exceeded the minimum price required by the various technologies that took part.

5.5.2. Phase 2 Live Trials - Planning

The team developed a Phase 2 Trial Summary and Sub tests Operations document. Which was cascaded using webinars at various stages to initially check the overarching designs then a more detailed review of each specific sub test details.

5.5.3. Information Service Relaunch

We continued to seek feedback on the BRP Information Service. Feedback had included a suggestion that the BSC Code modification P375 could address some of the imbalance problem. (The modification enabled Virtual lead parties (VLPs) to register asset level meters with Elexon and use these for settlement.) We continued to discuss the impact of P375 on the need for the BRP Information service with IntraFlex participants during the latter part of March and it was determined that we should continue to offer the service via the NODES platform.

NODES reviewed the functioning of the Information Service and developed a sign-up process for participating BRPs. A basic version was made available on the platform but during both trials no BRPs were identified that would be impacted by FSPs participation in the trial.

5.5.4. Phase 2 Trial Summary

As previously discussed, Phase 1 of the IntraFlex trial created a flexibility market that operated close to real time. This provided a unique opportunity for the project to determine the veracity of a continuously clearing market where FSPs can place offers on the platform when it suited their own operational conditions, rather than in response to an arbitrary auction deadline. The week ahead model does not necessarily suit all FSPs as they may have other commercial services that they are engaged in or unsure about asset availability and baselines until closer to real time.

Therefore, the Phase 2 tests focussed on:

- Driving closer to a BaU behaviours with focus on peak demand delivery windows
  - ✓ Delivery windows were fixed each day of the week throughout the tests so the FSPs could get used to the bidding patterns.
- Delivering a longer duration trial with more value on the platform.
  - ✓ The Phase 2 tests were split across 6 sub tests lasting for 5 months with circa 303 MWh (£91k) available.
  - ✓ For comparison the Phase 1 tests were split across 4 sub tests which lasted for 2 ½ months with circa 133 MWh (£40k) available.
- Moving to confirm flexibility requirements at Intraday.
  - ✓ Tests 5 & 6 confirmed WPDs flexibility requirements by 10:00 the morning of delivery day (Intraday).
- Increasing liquidity and hence competition.
  - ✓ The Phase 2 tests saw an increase in FSPs to 7 with a number having large generating assets mixed with others having EV charge points and one with free standing batteries.
- Active bids from FSPs to create competition on price rather than just speed.
  - ✓ We were encouraged to not only see some FSP pre bidding but we also saw some competitive pre bidding towards the end of the Phase 2 tests.
- Platform and process improvements to make things simpler and easier to scale.
  - ✓ All the implemented initiatives greatly improved the interaction with the platform for both WPD and the FSPs
- Re engaging the BRP Information Service.
  - ✓ The information service was relaunched but did not acquire any FSP sign up. Feedback on why is currently being sought as part of the trials 1 to 1 feedback.

The overall structure of Phase 2 initially required FSPs to complete a commissioning test (Phase 2 Test Zero (P2T0)) and thereafter proceeding through 6 test phases. Each of the 6 phases included a variation on some key principles and different combinations to establish the most effective.

5.5.5. On-boarding

Prior to the tests themselves any new participants underwent the 'onboarding process' which is detailed separately in the Onboarding document, which is available to download from IntraFlex Phase 2 Onboarding.

Any flexibility service providers who took part in Phase 1 did not need to re-register or re-sign the Membership Agreement with the updated Rulebook being circulated. Providers were asked to confirm continued participation and participating assets via email to NODES.

5.5.6. Phase 2 Tests 1 to 6b Overview

The Phase 2 market operation tests were designed to help develop understanding and learning about the relative importance of various elements in the operation of a continuously clearing market. These started with a relatively simple example, with more features added as the trial developed through its sub tests.

The figure below highlights the basic bidding structure for Test 1.

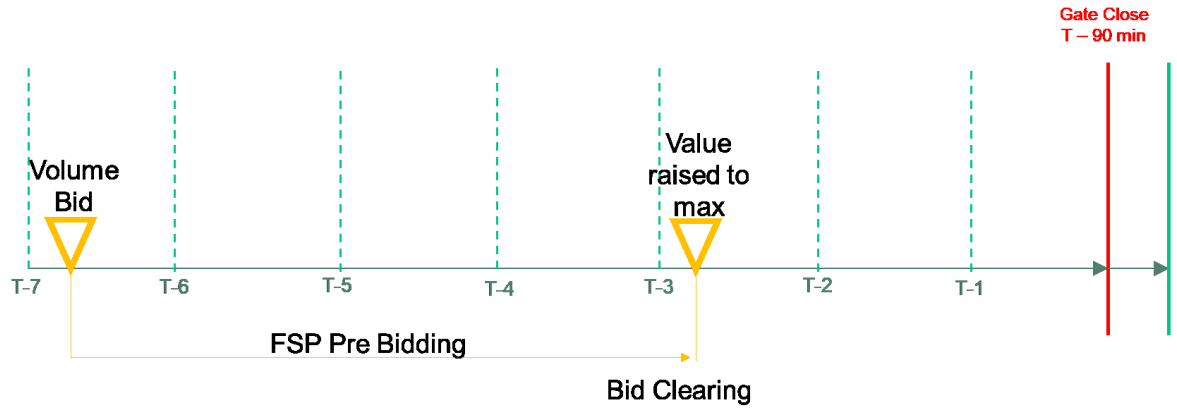

Figure 5-3: Basic Bidding Structure Test 1

By the time we progressed through to Test 6 we planned to introduce more advanced concepts such as variable pricing increments, intraday bids and how these interplay with weekends when the services are only expected to be required on weekdays.

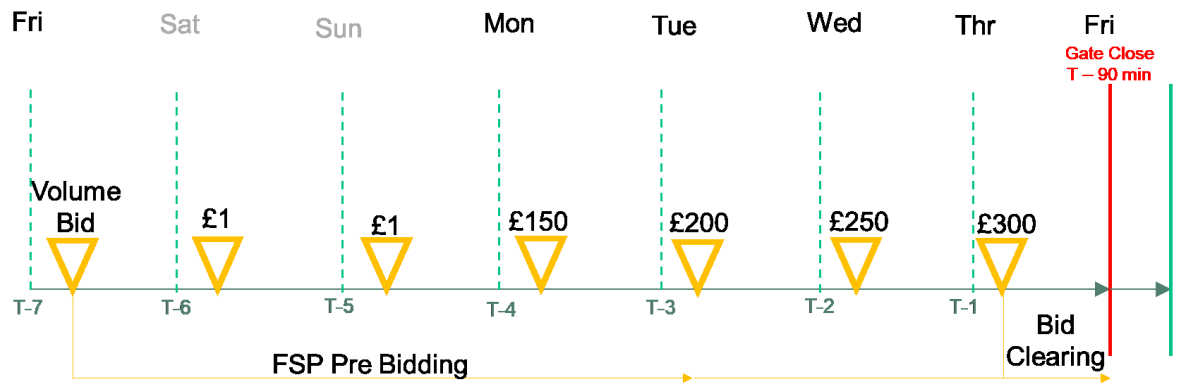

Figure 5-4: Basic Bidding Structure Test 6

The Table below describes the evolution of the bidding mechanisms as the trial develops.

Table 5-6: Evolution Of The Bidding Mechanisms

Test	Market Opens	Gate Close	Bid Alerts	Bid Time	Bid Increment	Scarcity Pricing	Max Value	Weekend Offers	Weekend Bids
1	7 days	90 mins	✓	10am	single	✗	T-3 days	✓	✗
2	7 days	90 mins	✓	10am	linear	✗	T-3 days	✓	✗
3	7 days	90 mins	✓	variable	variable	✗	T-3 days	✓	✗
4	7 days	90 mins	✓	10am	linear	✓	T-3 days	✓	✗
5	7 days	90 mins	✓	10am	linear	✗	Intraday	✓	✗
6a	7 days	90 mins	✓	10am	linear	✓	intraday	✓	✗
6b	7 days	90 mins	✓	variable	variable	✓	intraday	✓	✗

5.5.7. Phase 2 - Sub Tests Operational Information

As previously discussed, one of the key outputs from the Phase 2 trials planning phase was a “Trial Summary and Sub Tests Operations January 2021”(which can be found on our website) document and a “Bidding Strategy” document. A subset of the information within these documents had been cascaded to the FSP’s for understanding and is summarised below.

Throughout the sub tests the following principles were followed:

- A BID is placed by WPD and shows the volume of flexibility that is required for which ½ hour period.
- An OFFER is placed by the participants to show the time and volume of flexibility that they have available and the £value they would like to offer this at per MWh.
- T-x refers to the number of days before delivery (T-7 means 7 days before delivery, T-6 means 6 days before delivery and so on).
- All bids were to be posted at T-7 with a nominal £value but will show the volume required in the ½ hour period.
    - This shows participants where WPD will require flexibility as prompt for pre offers to be posted.
- Initial Market information bids placed **7** days ahead.
- Volume requirements communicated to participants via market messages on the platform.
- Positive confirmation of network assessment
- Participant’s pre offer their volumes with prices or respond to bids posted.
- WPD submits value of bids closer to real time (to be discussed later)
- Bids clear
- Remaining volume stays

To help clarify what each sub test meant for interaction with the NODES market platform, the table below was developed. In the table the columns refer to the days and dates for the trial in question. The rows refer to the actions

that WPD will take on the NODES market. Within each box, at the intersection of the column and rows, the text relates to the delivery day and test wk. # the action is being taken for.

For example,

The intersection of row **"Bids Zero Value (T-7)"** and the column **"Mon-26-Apr"** shows that the Bids posted on Monday 26th April will be for flexibility delivery on the Monday of test week 2.

The intersection of row **"Bids Max @£300 (T-3)"** and the column **"Fri-30-Apr"** shows that the updated Bids posted on the Friday 30th April will be the T-3 price adjustment for flexibility delivery on the Monday of test week 2.

There was to be no NODES Market interaction over the weekends therefore any bids that are timed to be adjusted on Saturday or Sunday were brought forward to the Friday. Therefore, as can be seen from the table, the T-3 BIDS for Tue and Wed of wk. 2 will be posted on the Friday and this pattern continued throughout the tests.

Greyed out boxes indicate no bids to be placed or adjusted.

It is shown in the table that on Monday 3rd May that T-7 bids will be posted for flexibility delivery on the Monday of test week 3 and T-3 bids prices will be adjusted for flexibility delivery on the Thursday of test week 2

Table 5-7: Example Test Bidding Timeline

PHASE 2 TEST 1	P2 T1 Week 1							P2 T1 Week 2						
	Sun-25-Apr	Mon-26-Apr	Tue-27-Apr	Wed-28-Apr	Thu-29-Apr	Fri-30-Apr	Sat-01-May	Sun-02-May	Mon-03-May	Tue-04-May	Wed-05-May	Thu-06-May	Fri-07-May	Sat-08-May
Bids £1 Value (T-7)		Mon wk. 2	Tue wk. 2	Wed wk. 2	Thur wk. 2	Fri wk. 2			Mon wk. 3	Tue wk. 3	Wed wk. 3	Thur wk. 3	Fri wk. 3	
Bids Max @£300 (T-3)						Mon wk. 2			Thur wk. 2	Fri wk. 2			Mon wk. 3	
						Tue wk. 2							Tue wk. 3	
						Wed wk. 2							Wed wk. 3	
Bid Delivery Day		Mon wk. 1	Tue wk. 1	Wed wk. 1	Thur wk. 1	Fri wk. 1			Mon wk. 2	Tue wk. 2	Wed wk. 2	Thur wk. 2	Fri wk. 2	

5.5.8. Phase 2 Tests 0-6b Design Details

5.5.8.1. Phase 2 Test 0 (P2T0) End to End System testing

This test was carried out for one asset per FSP in an orderbook, ZONE 0, which was dedicated to testing and included trade, dispatch and validation of delivery. The test trades were for a minimum of a half hour and maximum two hours at £300 per participant. This was implemented in this way to avoid any confusion with the live market place.

After delivery, NODES and WPD validated the delivery by comparing meter values to baselines and the FSP received confirmation that the test has been completed within a day by using the settlement information.

This successfully ran between the 7th April to the 15th April. We did allow 2 further FSPs to join the tests late facilitating them undertaking P2T0 on the 20th and 28th April. The method of enforcing a drop-dead date to complete the test 0 was seen to be successful and a marked improvement from the phase 1 trials.

5.5.8.2. Phase 2 Test 1 (P2-T1) Simple Bidding 3 weeks

This test was designed to get the FSPs back into the behaviours of placing offers to WPD bids with the following strategies:

- Retaining a predictable timing for all actions,
- System notifications (Market Messages) of any activity,
- Initial WPD bid placed at T – 7 days with volume required and a nominal value of £1 placed by 10:00 each weekday.
- FSP submit offers when they are ready with baseline and asset availability
- Max bid £value published at T - 3 days ahead by 10:00.
- The maximum bid value was fixed at £300/MWh
- Uncleared bids remain to T – 90mins
- No Weekend Bids

The following table shows the bidding pattern for this sub test.

Table 5-8: P2-T1 bidding pattern

PHASE 2 TEST 1	P2 T1 Week 1							P2 T1 Week 2							P2 T1 Week 3							P2 T1 Week 4						
	Sun 25 Apr	Mon-26-Apr	Tue-27-Apr	Wed-28-Apr	Thu-29-Apr	Fri-30-Apr	Sat-01-May	Sun-02-May	Mon-03-May	Tue-04-May	Wed-05-May	Thu-06-May	Fri-07-May	Sat-08-May	Sun 09 May	Mon-10-May	Tue-11-May	Wed-12-May	Thu-13-May	Fri-14-May	Sat-15-May	Sun-16-May	Mon-17-May	Tue-18-May	Wed-19-May	Thu-20-May	Fri-21-May	Sat-22-May
Bids Zero Value (T-7)		Mon wk 2	Tue wk 2	Wed wk 2	Thur wk 2	Fri wk 2			Mon wk 3	Tue wk 3	Wed wk 3	Thur wk 3	Fri wk 3			Mon wk 4	Tue wk 4	Wed wk 4	Thur wk 4	Fri wk 4			Mon P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1	
Bids Max @£300 (T-3)						Mon wk 2 Tue wk 2 Wed wk 2			Thur wk 2	Fri wk 2			Mon wk 3 Tue wk 3 Wed wk 3			Thur wk 3	Fri wk 3			Mon wk 4 Tue wk 4 Wed wk 4			P2 T1 Thur wk 4	P2 T1 Fri wk 4				
Bid Delivery Day		Mon wk 1	Tue wk 1	Wed wk 1	Thur wk 1	Fri wk 1			Mon wk 2	Tue wk 2	Wed wk 2	Thur wk 2	Fri wk 2			Mon wk 3	Tue wk 3	Wed wk 3	Thur wk 3	Fri wk 3			Mon wk 4	Tue wk 4	Wed wk 4	Thur wk 4	Fri wk 4	

This test lasted for 3 weeks and ran at an average of **87.5%** (133 MWh) of the volume posted being traded, with an average of **62%** (82.29MWh) of this being delivered. There was circa **38.2%** (51MWh) of the volume traded under delivered, 12.5% (19MWh) was not taken up and 44.9 MWh was over delivered.

This means during this test we needed to post onto the market **146%** of the flexibility volume needing to be procured.

The busiest times for FSP interaction on the market platform were between 10:00 – 11:00 (this is just after the new volumes and prices are posted) and 16:00 – 18:00 (assumed placing offers for next morning's price updates).

Test 1 Week 1	£	MWh	%
Traded	£5,588.70	37.26	83.4%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£2,947.91	21.33	57.3%
Sub Total	£2,947.91	21.33	47.7%
Under Delivered	£2,640.79	15.92	35.6%
Expired	£1,116.30	7.44	16.6%
Active	£0.00	0.00	0.0%
Sub Total	£3,757.09	23.37	52.3%
Total	£6,705.00	44.70	100%
Over Delivered		19.64	

Test 1 Week 2	£	MWh	%
Traded	£7,242.90	48.29	91.3%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£5,190.26	36.30	75.2%
Sub Total	£5,190.26	36.30	68.6%
Under Delivered	£2,052.64	11.98	22.6%
Expired	£694.20	4.63	8.7%
Active	£0.00	0.00	0.0%
Sub Total	£2,746.84	16.61	31.4%
Total	£7,937.10	52.91	100%
Over Delivered		16.25	

Test 1 Week 3	£	MWh	%
Traded	£7,155.15	47.70	87.4%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£3,130.82	24.65	51.7%
Sub Total	£3,130.82	24.65	45.1%
Under Delivered	£4,019.89	23.05	48.3%
Expired	£1,034.85	6.90	12.6%
Active	£0.00	0.00	0.0%
Sub Total	£5,054.74	29.95	54.9%
Total	£8,185.56	54.60	100%
Over Delivered		9.00	

Figure 5-5: P2-T1 Weekly volume trading summaries

5.5.8.3. Test 2 (P2-T2) Introducing Increments 3 weeks

This test was designed to get the FSPs used to a linear daily increase in bid values between T-7 and T-3 with the following strategies:

- Retain a predictable timing for all actions
- Initial bid at T – 7 days
- System notifications of any activity
- Fixed schedule for bid increments each day at set time

- Fixed increase in bid price increments.
- Max bid value reached by 3 days ahead
- No Weekend Bids

The following table shows the bidding pattern for this sub test.

Table 5-9: P2-T2 bidding pattern

PHASE 2 TEST 2	P2 T1 Week 4							P2 T2 Week 1							P2 T2 Week 2							P2 T2 Week 3						
	Sun 16 May	Mon-17-May	Tue-18-May	Wed-19-May	Thu-20-May	Fri-21-May	Sat-22-May	Sun-23-May	Mon-24-May	Tue-25-May	Wed-26-May	Thu-27-May	Fri-28-May	Sat-29-May	Sun 30 May	Mon-31-May	Tue-01-Jun	Wed-02-Jun	Thu-03-Jun	Fri-04-Jun	Sat-05-Jun	Sun-06-Jun	Mon-07-Jun	Tue-08-Jun	Wed-09-Jun	Thu-10-Jun	Fri-11-Jun	Sat-12-Jun
Bids Zero Value (T-7)		Mon P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1			Mon P2T2 wk 2	Tue P2T2 wk 2	Wed P2T2 wk 2	Thu P2T2 wk 2	Fri P2T2 wk 2			Mon P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3								
Bids Incremental @£75 (T-6)			Mon P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1			Mon P2T2 wk 2	Tue P2T2 wk 2	Wed P2T2 wk 2	Thu P2T2 wk 2	Fri P2T2 wk 2			Mon P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3								
Bids Incremental @£150 (T-5)				Mon P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1			Mon P2T2 wk 2	Tue P2T2 wk 2	Wed P2T2 wk 2	Thu P2T2 wk 2	Fri P2T2 wk 2			Mon P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3							
Bids Incremental @£225 (T-4)					Mon P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1			Mon P2T2 wk 2	Tue P2T2 wk 2	Wed P2T2 wk 2	Thu P2T2 wk 2	Fri P2T2 wk 2			Mon P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3						
Bids Max @£300 (T-3)		P2 T1 Thur wk 4	P2 T1 Fri wk 4			Mon P2T2 wk 1 Tue P2T2 wk 1 Wed P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1			Mon P2T2 wk 2 Tue P2T2 wk 2 Wed P2T2 wk 2	Tue P2T2 wk 2	Wed P2T2 wk 2	Thu P2T2 wk 2	Fri P2T2 wk 2			Mon P2T2 wk 3 Tue P2T2 wk 3 Wed P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3					
Bid Delivery Day		Mon P2T1 wk 4	Tue P2 T1 wk 4	Wed P2T1 wk 4	Thur P2T1 wk 4	Fri P2T1 wk 4			Mon P2T2 wk 1	Tue P2T2 wk 1	Wed P2T2 wk 1	Thu P2T2 wk 1	Fri P2T2 wk 1			Mon P2T2 wk 2	Tue P2T2 wk 2	Wed P2T2 wk 2	Thu P2T2 wk 2	Fri P2T2 wk 2			Mon P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3		

This test lasted for 3 weeks and ran at an average of **68.2%** (146 MWh) of the volume posted being traded, with an average of **86.9%** (127MWh) of this being delivered. There was circa **13%** (19MWh) of the volume traded under delivered, 32% (68MWh) was not taken up and 26 MWh was over delivered.

This means during this test that we needed to post onto the market **141%** of the flexibility volume needing to be procured.

The busiest times for FSP interaction on the market platform continued to be between 10:00 – 11:00 (this is just after the new volumes and prices were posted) and 16:00 – 18:00 (assumed placing offers for next morning's price updates).

Test 2 Week 1	£	MWh	%
Traded	£3,660.83	24.67	58.0%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£2,795.72	19.79	80.2%
Sub Total	£2,795.72	19.79	46.6%
Under Delivered	£904.60	4.88	19.8%
Expired	£2,674.65	17.83	42.0%
Active	£0.00	0.00	0.0%
Sub Total	£3,579.25	22.71	53.4%
Total	£6,374.97	42.50	100%
Over Delivered		7.18	

Test 2 Week 2	£	MWh	%
Traded	£8,785.65	58.57	82.5%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£6,399.25	50.24	85.8%
Sub Total	£6,399.25	50.24	70.8%
Under Delivered	£2,224.40	8.33	14.2%
Expired	£1,864.35	12.43	17.5%
Active	£0.00	0.00	0.0%
Sub Total	£4,088.75	20.76	29.2%
Total	£10,488.00	71.00	100%
Over Delivered		9.54	

Test 2 Week 3	£	MWh	%
Traded	£9,308.93	62.83	62.3%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£8,574.51	56.94	90.6%
Sub Total	£8,574.51	56.94	56.5%
Under Delivered	£755.15	5.97	9.5%
Expired	£5,683.05	37.89	37.6%
Active	£0.00	0.00	0.0%
Sub Total	£6,438.20	43.86	43.5%
Total	£15,012.72	100.80	100%
Over Delivered		9.64	

Figure 5-6: P2-T2 Weekly volume trading summaries

5.5.8.4. Test 3 (P2-T3) Variable increments at variable timing 3 weeks

This test was designed to get the FSPs used to a further reduction in the structure of the bidding process, by introducing variable bid increments and timings of bids being placed onto the market, thus encouraging FSPs to be more responsive to activity alerts from NODES system;

- Initial bid at T – 7 days
- System notifications of any activity

~~X Fixed schedule for bid increments each day at set time~~

~~X Fixed increase in bid value.~~

- Max bid value reached by 3 days ahead
- No Weekend Bids

The following table shows the bidding pattern for this sub test.

Table 5-10: P2-T3 bidding pattern

PHASE 2 TEST 3	P2 T2 Week 3							P2 T3 Week 1							P2 T3 Week 2							P2 T3Week 3						
	Sun 06 Jun	Mon-07-Jun	Tue-08-Jun	Wed-09-Jun	Thu-10-Jun	Fri-11-Jun	Sat-12-Jun	Sun-13-Jun	Mon-14-Jun	Tue-15-Jun	Wed-16-Jun	Thu-17-Jun	Fri-18-Jun	Sat-19-Jun	Sun 20 Jun	Mon-21-Jun	Tue-22-Jun	Wed-23-Jun	Thu-24-Jun	Fri-25-Jun	Sat-26-Jun	Sun-27-Jun	Mon-28-Jun	Tue-29-Jun	Wed-30-Jun	Thu-01-Jul	Fri-02-Jul	Sat-03-Jul
Bids Zero Value (T-7)		Mon P2T3 wk 1	Tue P2T3 wk 1	Wed P2T3 wk 1	Thu P2T3 wk 1	Fri P2T3 wk 1			Mon P2T3 wk 2	Tue P2T3 wk 2	Wed P2T3 wk 2	Thu P2T3 wk 2	Fri P2T3 wk 2			Mon P2T3 wk 3	Tue P2T3 wk 3	Wed P2T3 wk 3	Thu P2T3 wk 3	Fri P2T3 wk 3								
Bids Incremental random			Mon P2T3 wk 1	Tue P2T3 wk 1	Wed P2T3 wk 1	Thu P2T3 wk 1				Mon P2T3 wk 2	Tue P2T3 wk 2	Wed P2T3 wk 2	Thu P2T3 wk 2				Mon P2T3 wk 3	Tue P2T3 wk 3	Wed P2T3 wk 3	Thu P2T3 wk 3								
Bids Incremental random				Mon P2T3 wk 1	Tue P2T3 wk 1	Wed P2T3 wk 1					Mon P2T3 wk 2	Tue P2T3 wk 2	Wed P2T3 wk 2					Mon P2T3 wk 3	Tue P2T3 wk 3	Wed P2T3 wk 3								
Bids Incremental random					Mon P2T3 wk 1	Tue P2T3 wk 1			Fri P2T3 wk 1			Mon P2T3 wk 2	Tue P2T3 wk 2			Fri P2T3 wk 2			Mon P2T3 wk 3	Tue P2T3 wk 3			Fri P2T3 wk 3					
Bids Max @£300 (T-3)						Mon P2T3 wk 1 Tue P2T2 wk 1 Wed P2T2 wk 1			Thu P2T3 wk 1	Fri P2T3 wk 1			Mon P2T3 wk 2 Tue P2T3 wk 2 Wed P2T3 wk 2			Thu P2T3 wk 2	Fri P2T3 wk 2			Mon P2T3 wk 3 Tue P2T3 wk 3 Wed P2T3 wk 3			Thu P2T3 wk 3	Fri P2T3 wk 3				
Bid Delivery Day		Mon P2T2 wk 3	Tue P2T2 wk 3	Wed P2T2 wk 3	Thu P2T2 wk 3	Fri P2T2 wk 3			Mon P2T3 wk 1	Tue P2T3 wk 1	Wed P2T3 wk 1	Thu P2T3 wk 1	Fri P2T3 wk 1			Mon P2T3 wk 2	Tue P2T3 wk 2	Wed P2T3 wk 2	Thu P2T3 wk 2	Fri P2T3 wk 2			Mon P2T3 wk 3	Tue P2T3 wk 3	Wed P2T3 wk 3	Thu P2T3 wk 3	Fri P2T3 wk 3	

This test lasted for 3 weeks and ran at an average of **96%** (180 MWh) of the volume posted being traded, with an average of **81%** (147MWh) of this being delivered. There was circa **19%** (34MWh) of the traded volume under delivered, 4% (8MWh) was not taken up and 87 MWh was over delivered.

This means during this test that we needed to post onto the market **122%** of the flexibility volume needing to be procured.

During this test we started to see FSPs placing pre offers based upon the bidding pattern we had established in the previous tests.

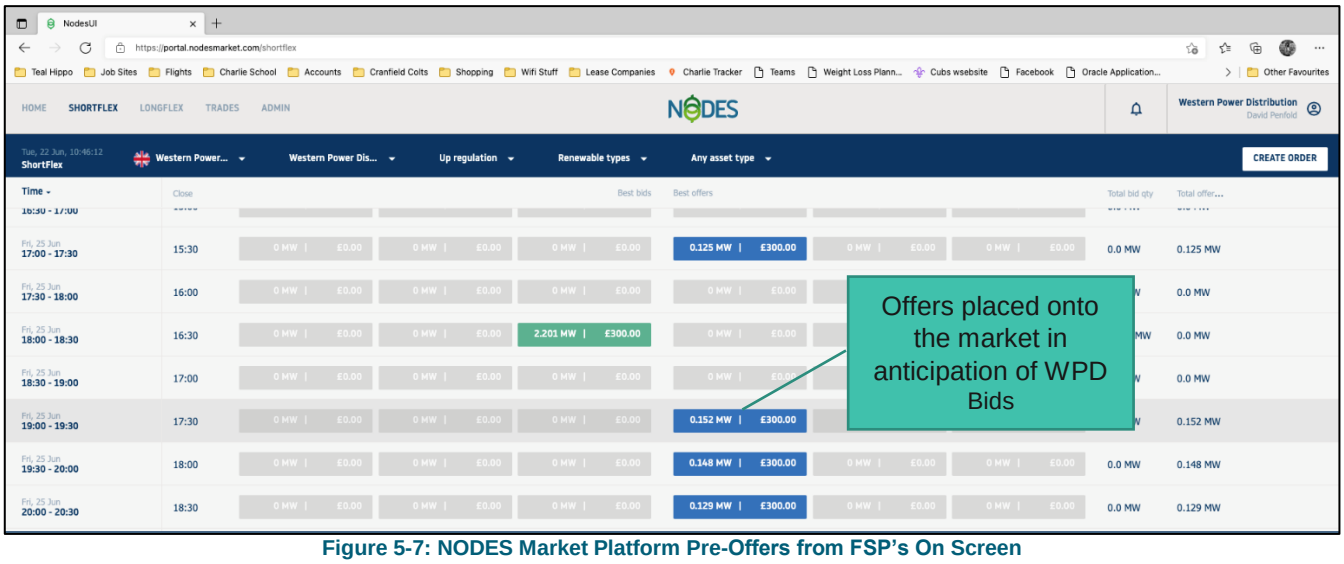

Figure 5-7: NODES Market Platform Pre-Offers from FSP's On Screen

The busiest times for FSP interaction on the market platform switched to be between 16:00 and 17:00 with between 10:00 – 11:00 now the second most popular. The number of interactions on the market platform remained at the same levels seen in the tests prior.

Test 3 Week 1	£	MWh	%
Traded	£10,701.58	71.59	94.1%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£8,138.21	46.35	64.7%
Sub Total	£8,138.21	46.35	60.9%
Under Delivered	£2,570.72	25.24	35.3%
Expired	£676.80	4.51	5.9%
Active	£0.00	0.00	0.0%
Sub Total	£3,247.52	29.75	39.1%
Total	£11,385.74	76.10	100%
Over Delivered		13.66	

Test 3 Week 2	£	MWh	%
Traded	£8,712.09	61.21	97.6%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£7,790.26	56.18	91.8%
Sub Total	£7,790.26	56.18	89.6%
Under Delivered	£940.39	5.02	8.2%
Expired	£223.95	1.49	2.4%
Active	£0.00	0.00	0.0%
Sub Total	£1,164.34	6.52	10.4%
Total	£8,954.60	62.70	100%
Over Delivered		39.78	

Test 3 Week 3	£	MWh	%
Traded	£6,897.89	47.52	95.8%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£6,192.38	44.19	93.0%
Sub Total	£6,192.38	44.19	89.1%
Under Delivered	£705.51	3.33	7.0%
Expired	£311.40	2.08	4.2%
Active	£0.00	0.00	0.0%
Sub Total	£1,016.91	5.41	10.9%
Total	£7,209.29	49.60	100%
Over Delivered		33.44	

Figure 5-8: P2-T3 Weekly Volume Trading Summaries

5.5.8.5. Test 4 (P2-T4) Scarcity Pricing model 3 week

This test was designed to get the FSPs used to a further reduction again in the structure of the bidding process encouraging FSPs to be more responsive to activity alerts from NODES system.

- Initial bid at T – 7 days
- System notification of bid activity
- Price increments relative to volume requirement
- Max bid value reached by 3 days ahead
- No Weekend Bids

The following table shows the bidding pattern for this sub test.

Table 5-11: P2-T4 bidding pattern

PHASE 2 TEST 4	P2 T3 Week 3							P2 T4 Week 1							P2 T4 Week 2							P2 T4 Week 3						
	Sun 27 Jun	Mon-28-Jun	Tue-29-Jun	Wed-30-Jun	Thu-01-Jul	Fri-02-Jul	Sat-03-Jul	Sun-04-Jul	Mon-05-Jul	Tue-06-Jul	Wed-07-Jul	Thu-08-Jul	Fri-09-Jul	Sat-10-Jul	Sun 11 Jul	Mon-12-Jul	Tue-13-Jul	Wed-14-Jul	Thu-15-Jul	Fri-16-Jul	Sat-17-Jul	Sun-18-Jul	Mon-19-Jul	Tue-20-Jul	Wed-21-Jul	Thu-22-Jul	Fri-23-Jul	Sat-24-Jul
Bids Zero Value (T-7)		Mon P2T4 wk 1	Tue P2T4 wk 1	Wed P2T4 wk 1	Thu P2T4 wk 1	Fri P2T4 wk 1			Mon P2T4 wk 2	Tue P2T4 wk 2	Wed P2T4 wk 2	Thu P2T4 wk 2	Fri P2T4 wk 2			Mon P2T4 wk 3	Tue P2T4 wk 3	Wed P2T4 wk 3	Thu P2T4 wk 3	Fri P2T4 wk 3								
Bids Incremental 1 (T-6)			Mon P2T4 wk 1	Tue P2T4 wk 1	Wed P2T4 wk 1	Thu P2T4 wk 1				Mon P2T4 wk 2	Tue P2T4 wk 2	Wed P2T4 wk 2	Thu P2T4 wk 2				Mon P2T4 wk 3	Tue P2T4 wk 3	Wed P2T4 wk 3	Thu P2T4 wk 3								
Bids Incremental 2 (T-5)				Mon P2T4 wk 1	Tue P2T4 wk 1						Mon P2T4 wk 2	Tue P2T4 wk 2						Mon P2T4 wk 3	Tue P2T4 wk 3									
Bids Incremental 3 (T-4)					Mon P2T4 wk 1				Fri P2T4 wk 1			Mon P2T4 wk 2				Fri P2T4 wk 2			Mon P2T4 wk 3				Fri P2T4 wk 3				
Bids Max according to scarcity model (T-3)						Mon P2T4 wk 1 Tue P2T4 wk 1 Wed P2T4 wk 1			Thu P2T4 wk 1	Fri P2T4 wk 1			Mon P2T4 wk 2 Tue P2T4 wk 2 Wed P2T4 wk 2			Thu P2T4 wk 2	Fri P2T4 wk 2			Mon P2T4 wk 3 Tue P2T4 wk 3 Wed P2T4 wk 3			Thu P2T4 wk 3	Fri P2T4 wk 3				
Bid Delivery Day		Mon P2T3 wk 3	Tue P2T3 wk 3	Wed P2T3 wk 3	Thu P2T3 wk 3	Fri P2T3 wk 3			Mon P2T4 wk 1	Tue P2T4 wk 1	Wed P2T4 wk 1	Thu P2T4 wk 1	Fri P2T4 wk 1			Mon P2T4 wk 2	Tue P2T4 wk 2	Wed P2T4 wk 2	Thu P2T4 wk 2	Fri P2T4 wk 2			Mon P2T4 wk 3	Tue P2T4 wk 3	Wed P2T4 wk 3	Thu P2T4 wk 3	Fri P2T4 wk 3	

This test lasted for 3 weeks and ran at an average of **75%** (88MWh) of the volume posted being traded, with an average of **83%** (73MWh) of this being delivered. There was circa **17%** (15MWh) of the traded volume under delivered, 25% (29MWh) was not taken up and 143 MWh was over delivered.

This means during this test that we needed to post onto the market **138%** of the flexibility volume needing to be procured.

During this test not only were FSPs placing pre offers based upon the bidding pattern, we had established in the previous tests, they were placing offers at the price they anticipated it would reach.

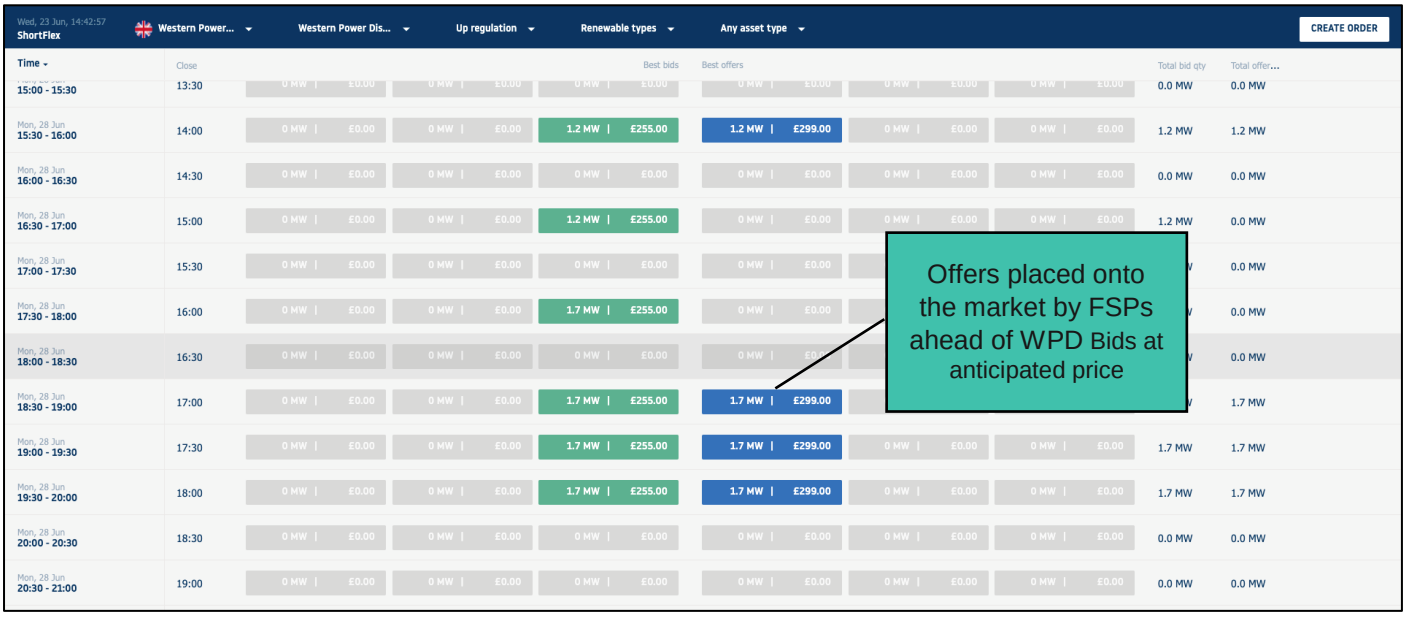

Figure 5-9: NODES Market Screen Showing Price Offers

The busiest times for FSP interaction on the market platform reverted back to being between 09:00 and 14:00 with another spike between 15:00 – 17:00. The number of interactions on the market platform remained at the same levels seen in the tests prior.

Test 4 Week 1	£	MWh	%
Traded	£6,062.90	38.40	81.7%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£4,700.98	31.39	81.7%
Sub Total	£4,700.98	31.39	66.8%
Under Delivered	£1,361.92	7.01	18.3%
Expired	£1,160.59	8.59	18.3%
Active	£0.00	0.00	0.0%
Sub Total	£2,522.52	15.61	33.2%
Total	£7,223.50	46.99	100%
Over Delivered		46.35	

Test 4 Week 2	£	MWh	%
Traded	£3,117.38	19.87	56.1%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£2,211.50	14.94	75.2%
Sub Total	£2,211.50	14.94	42.2%
Under Delivered	£905.88	4.93	24.8%
Expired	£2,255.42	15.53	43.9%
Active	£0.00	0.00	0.0%
Sub Total	£3,161.31	20.46	57.8%
Total	£5,372.81	35.40	100%
Over Delivered		31.77	

Test 4 Week 3	£	MWh	%
Traded	£4,764.10	29.71	85.12%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£4,046.36	26.39	88.84%
Sub Total	£4,046.36	26.39	75.6%
Under Delivered	£717.74	3.32	11.2%
Expired	£623.16	5.19	14.9%
Active	£0.00	0.00	0.0%
Sub Total	£1,340.90	8.51	24.4%
Total	£5,387.26	34.90	100%
Over Delivered		64.54	

Figure 5-10: P2-T4 Weekly volume trading summaries

5.5.8.6. Test 5 (P2-T5) Intraday with Predictable Increments 3 weeks

This was the first test delivering intraday confirmation of flexibility required with the maximum bid price only reached by 10:00 on the delivery day.

- Initial bid at T – 7 days
- System notification of bid activity
- Fixed schedule for bid increments each day at set time
- Fixed increase in bid value.

- **Max bid value only reached Intraday**
- Bids will be focussed on early afternoon and evening
- No Weekend Bids

The following table shows the bidding pattern for this sub test.

Table 5-12: P2-T5 bidding pattern

PHASE 2 TEST 5	P2 T4 Week 3							P2 T5 Week 1						
	Sun 18 Jul	Mon-19-Jul	Tue-20-Jul	Wed-21-Jul	Thu-22-Jul	Fri-23-Jul	Sat-24-Jul	Sun-25-Jul	Mon-26-Jul	Tue-27-Jul	Wed-28-Jul	Thu-29-Jul	Fri-30-Jul	Sat-31-Jul
Bids Zero Value (T-7)		Mon P2T5 wk 1	Tue P2T5 wk 1	Wed P2T5 wk 1	Thu P2T5 wk 1	Fri P2T5 wk 1			Mon P2T5 wk 2	Tue P2T5 wk 2	Wed P2T5 wk 2	Thu P2T5 wk 2	Fri P2T5 wk 2	
Incremental Bid 1 @£60/MWh			Mon P2T5 wk 1	Tue P2T5 wk 1	Wed P2T5 wk 1	Thu P2T5 wk 1			Fri P2T5 wk 1	Mon P2T5 wk 2	Tue P2T5 wk 2	Wed P2T5 wk 2	Thu P2T5 wk 2	
Incremental Bid 2 @£120/MWh				Mon P2T5 wk 1	Tue P2T5 wk 1	Wed P2T5 wk 1			Thu P2T5 wk 1	Fri P2T5 wk 1	Mon P2T5 wk 2	Tue P2T5 wk 2	Wed P2T5 wk 2	
Incremental Bid 3 @£180/MWh					Mon P2T5 wk 1	Tue P2T5 wk 1			Wed P2T5 wk 1	Thu P2T5 wk 1	Fri P2T5 wk 1	Mon P2T5 wk 2	Tue P2T5 wk 2	
Incremental Bid 4 @£240/MWh						Mon P2T5 wk 1			Tue P2T5 wk 1	Wed P2T5 wk 1	Thu P2T5 wk 1	Fri P2T5 wk 1	Mon P2T5 wk 2	
Final Max Bid at Intraday (Before 10:00) @£300MWh									Mon P2T5 wk 1	Tue P2T5 wk 1	Wed P2T5 wk 1	Thu P2T5 wk 1	Fri P2T5 wk 1	
Bid Delivery Day		Mon P2T4 wk 3	Tue P2T4 wk 3	Wed P2T4 wk 3	Thu P2T4 wk 3	Fri P2T4 wk 3			Mon P2T5 wk 1	Tue P2T5 wk 1	Wed P2T5 wk 1	Thu P2T5 wk 1	Fri P2T5 wk 1	

PHASE 2 TEST 5	P2 T5 Week 2							P2 T5 Week 3						
	Sun 01 Aug	Mon-02-Aug	Tue-03-Aug	Wed-04-Aug	Thu-05-Aug	Fri-06-Aug	Sat-07-Aug	Sun-08-Aug	Mon-09-Aug	Tue-10-Aug	Wed-11-Aug	Thu-12-Aug	Fri-13-Aug	Sat-14-Aug
Bids Zero Value (T-7)		Mon P2T5 wk 3	Tue P2T5 wk 3	Wed P2T5 wk 3	Thu P2T5 wk 3	Fri P2T5 wk 3								
Incremental Bid 1 @£60/MWh		Fri P2T5 wk 2	Mon P2T5 wk 3	Tue P2T5 wk 3	Wed P2T5 wk 3	Thu P2T5 wk 3			Fri P2T5 wk 3					
Incremental Bid 2 @£120/MWh		Thu P2T5 wk 2	Fri P2T5 wk 2	Mon P2T5 wk 3	Tue P2T5 wk 3	Wed P2T5 wk 3			Thu P2T5 wk 3	Fri P2T5 wk 3				
Incremental Bid 3 @£180/MWh		Wed P2T5 wk 2	Thu P2T5 wk 2	Fri P2T5 wk 2	Mon P2T5 wk 3	Tue P2T5 wk 3			Wed P2T5 wk 3	Thu P2T5 wk 3	Fri P2T5 wk 3			
Incremental Bid 4 @£240/MWh		Tue P2T5 wk 2	Wed P2T5 wk 2	Thu P2T5 wk 2	Fri P2T5 wk 2	Mon P2T5 wk 3			Tue P2T5 wk 3	Wed P2T5 wk 3	Thu P2T5 wk 3	Fri P2T5 wk 3		
Final Max Bid at Intraday (Before 10:00) @£300MWh		Mon P2T5 wk 2	Tue P2T5 wk 2	Wed P2T5 wk 2	Thu P2T5 wk 2	Fri P2T5 wk 2			Mon P2T5 wk 3	Tue P2T5 wk 3	Wed P2T5 wk 3	Thu P2T5 wk 3	Fri P2T5 wk 3	
Bid Delivery Day		Mon P2T5 wk 2	Tue P2T5 wk 2	Wed P2T5 wk 2	Thu P2T5 wk 2	Fri P2T5 wk 2			Mon P2T5 wk 3	Tue P2T5 wk 3	Wed P2T5 wk 3	Thu P2T5 wk 3	Fri P2T5 wk 3	

This test lasted for 3 weeks and ran at an average of **82%** (120MWh) of the volume posted being traded, with an average of **85%** (102MWh) of this being delivered. There was circa **15%** (18MWh) of the traded volume under delivered, 18% (26MWh) was not taken up and 132 MWh was over delivered.

This means during this test that we needed to post onto the market **130%** of the flexibility volume needing to be procured.

The busiest times for FSP interaction on the market platform continued between 09:00 and 14:00 with another smaller spike starting earlier than before of between 14:00 – 16:00. The number of interactions on the market platform remained at the same levels seen in the tests prior.

Test 5 Week 1	£	MWh	%
Traded	£7,273.44	51.82	86.74%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£6,533.03	47.93	92.49%
Sub Total	£6,533.03	47.93	80.2%
Under Delivered	£740.41	3.89	7.5%
Expired	£1,187.85	7.92	13.3%
Active	£0.00	0.00	0.0%
Sub Total	£1,928.26	11.81	19.8%
Total	£8,461.29	59.74	100%
Over Delivered		27.12	

Test 5 Week 2	£	MWh	%
Traded	£4,887.66	36.67	75.60%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£3,779.42	26.28	71.68%
Sub Total	£3,779.42	26.28	54.2%
Under Delivered	£1,108.24	10.39	28.3%
Expired	£1,775.10	11.83	24.4%
Active	£0.00	0.00	0.0%
Sub Total	£2,883.34	22.22	45.8%
Total	£6,662.76	48.50	100%
Over Delivered		54.46	

Test 5 Week 3	£	MWh	%
Traded	£4,427.70	31.86	83.63%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£4,116.53	28.22	88.58%
Sub Total	£4,116.53	28.22	74.1%
Under Delivered	£311.17	3.64	11.4%
Expired	£935.55	6.24	16.4%
Active	£0.00	0.00	0.0%
Sub Total	£1,246.72	9.88	25.9%
Total	£5,363.25	38.10	100%
Over Delivered		50.06	

Figure 5-11: P2-T5 Weekly volume trading summaries

At the end of this trial it was decided that we would slightly adjust Test 6 to enable FSPs to continue placing competitive pre offers.

5.5.8.7. Test 6 (P2-T6a) Intraday Bids 3 weeks

- Initial bid at T – 7 days

- System notification of bid activity
- Fixed schedule for bid increments each day at set time
- Fixed increase in bid value
- Max bid value only reached Intraday
- No Weekend Bids

Table 5-13: P2-T6 bidding pattern

PHASE 2 TEST 6a	P2 T5 Week 3							P2 T6a Week 1							P2 T6a Week 2							P2 T6a Week 3						
	Sun 08 Aug	Mon-09-Aug	Tue-10-Aug	Wed-11-Aug	Thu-12-Aug	Fri-13-Aug	Sat-14-Aug	Sun-15-Aug	Mon-16-Aug	Tue-17-Aug	Wed-18-Aug	Thu-19-Aug	Fri-20-Aug	Sat-21-Aug	Sun 22 Aug	Mon-23-Aug	Tue-24-Aug	Wed-25-Aug	Thu-26-Aug	Fri-27-Aug	Sat-28-Aug	Sun-29-Aug	Mon-30-Aug	Tue-31-Aug	Wed-01-Sep	Thu-02-Sep	Fri-03-Sep	Sat-04-Sep
Bids Zero Value (T-7)		Mon P2T6a wk 1	Tue P2T6a wk 1	Wed P2T6a wk 1	Thu P2T6a wk 1	Fri P2T6a wk 1			Mon P2T6a wk 2	Tue P2T6a wk 2	Wed P2T6a wk 2	Thu P2T6a wk 2	Fri P2T6a wk 2			Mon P2T6a wk 3	Tue P2T6a wk 3	Wed P2T6a wk 3	Thu P2T6a wk 3	Fri P2T6a wk 3								
Incremental Bid 1 @ £/MWh Set by scarcity model			Mon P2T6a wk 1	Tue P2T6a wk 1	Wed P2T6a wk 1	Thu P2T6a wk 1			Fri P2T6a wk 1	Mon P2T6a wk 2	Tue P2T6a wk 2	Wed P2T6a wk 2	Thu P2T6a wk 2			Fri P2T6a wk 2	Mon P2T6a wk 3	Tue P2T6a wk 3	Wed P2T6a wk 3	Thu P2T6a wk 3			Fri P2T6a wk 3					
Incremental Bid 2 @ £/MWh Set by scarcity model				Mon P2T6a wk 1	Tue P2T6a wk 1	Wed P2T6a wk 1			Thu P2T6a wk 1	Fri P2T6a wk 1	Mon P2T6a wk 2	Tue P2T6a wk 2	Wed P2T6a wk 2			Thu P2T6a wk 2	Fri P2T6a wk 2	Mon P2T6a wk 3	Tue P2T6a wk 3	Wed P2T6a wk 3			Thu P2T6a wk 3	Fri P2T6a wk 3				
Incremental Bid 3 @ £/MWh Set by scarcity model					Mon P2T6a wk 1	Tue P2T6a wk 1			Wed P2T6a wk 1	Thu P2T6a wk 1	Fri P2T6a wk 1	Mon P2T6a wk 2	Tue P2T6a wk 2			Wed P2T6a wk 2	Thu P2T6a wk 2	Fri P2T6a wk 2	Mon P2T6a wk 3	Tue P2T6a wk 3			Wed P2T6a wk 3	Thu P2T6a wk 3	Fri P2T6a wk 3			
Incremental Bid 4 @ £/MWh Set by scarcity model						Mon P2T6a wk 1			Tue P2T6a wk 1	Wed P2T6a wk 1	Thu P2T6a wk 1	Fri P2T6a wk 1	Mon P2T6a wk 2			Tue P2T6a wk 2	Wed P2T6a wk 2	Thu P2T6a wk 2	Fri P2T6a wk 2	Mon P2T6a wk 3			Tue P2T6a wk 3	Wed P2T6a wk 3	Thu P2T6a wk 3	Fri P2T6a wk 3		
Final Max Bid at Intraday (Before 10:00) @ £/MWh Set by scarcity model									Mon P2T6a wk 1	Tue P2T6a wk 1	Wed P2T6a wk 1	Thu P2T6a wk 1	Fri P2T6a wk 1			Mon P2T6a wk 2	Tue P2T6a wk 2	Wed P2T6a wk 2	Thu P2T6a wk 2	Fri P2T6a wk 2			Mon P2T6a wk 3	Tue P2T6a wk 3	Wed P2T6a wk 3	Thu P2T6a wk 3	Fri P2T6a wk 3	
Bid Delivery Day		Mon P2T5 wk 3	Tue P2T5 wk 3	Wed P2T5 wk 3	Thu P2T5 wk 3	Fri P2T5 wk 3			Mon P2T6a wk 1	Tue P2T6a wk 1	Wed P2T6a wk 1	Thu P2T6a wk 1	Fri P2T6a wk 1			Mon P2T6a wk 2	Tue P2T6a wk 2	Wed P2T6a wk 2	Thu P2T6a wk 2	Fri P2T6a wk 2			Mon P2T6a wk 3	Tue P2T6a wk 3	Wed P2T6a wk 3	Thu P2T6a wk 3	Fri P2T6a wk 3	

This test lasted for 3 weeks and ran at an average of **67%** (106MWh) of the volume posted being traded, with an average of **81%** (86 MWh) of this being delivered. There was circa **20%** (21MWh) of the traded volume under delivered, 32% (51MWh) was not taken up and 97 MWh was over delivered.

This means during this test that we needed to post onto the market **146%** of the flexibility volume needing to be procured.

During this test the behaviours of the FSPs and offers they were placing developed to the extent that we were seeing a live competitive intraday market. FSP's started placing competing offers in ahead of WPD final bid pricing.

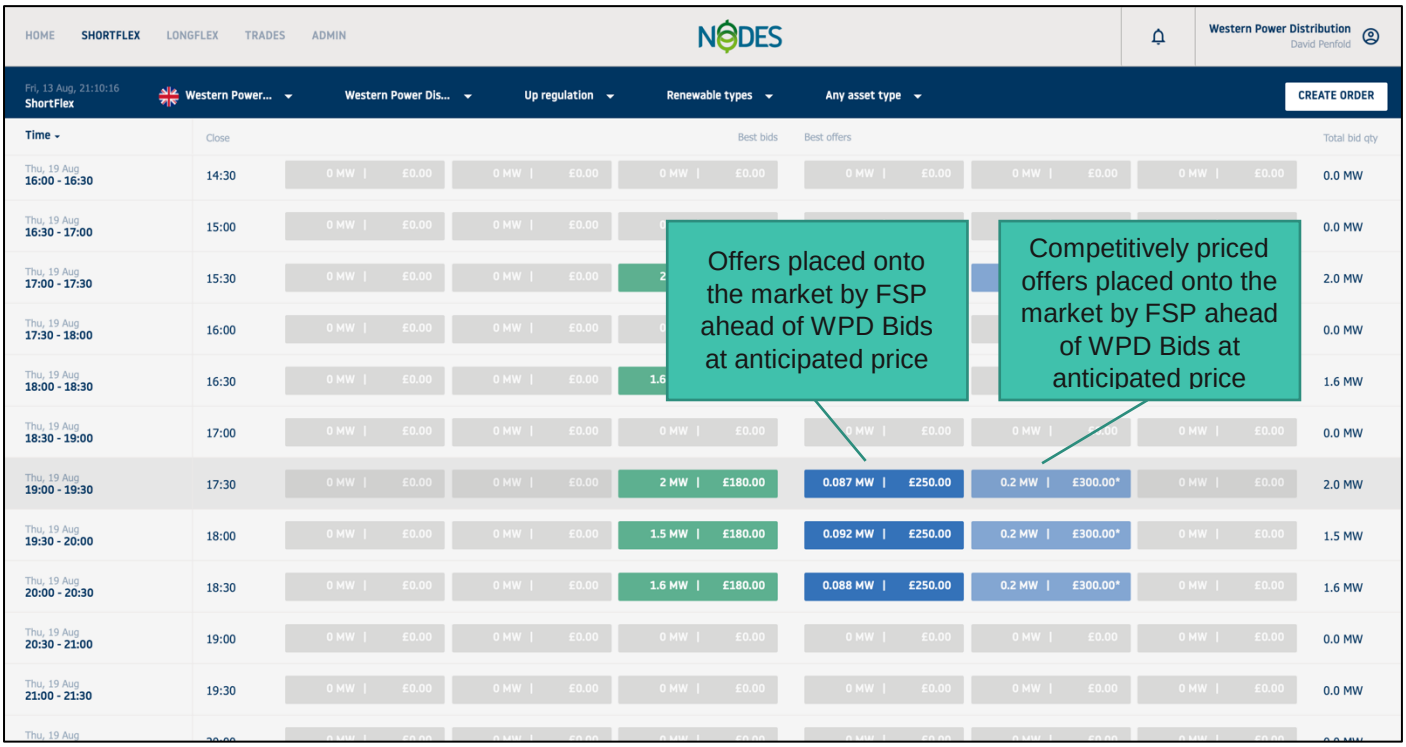

Figure 5-12: NODES market showing competitive offers placed by FSPs

The busiest times for FSP interaction on the market platform continued between 09:00 and 14:00 with another smaller spike starting earlier than before of between 13:00 – 15:00. There was a marked reduction in the number of interactions on the market platform which is believed to have been driven by summer holidays.

Test 6 Week 1	£	MWh	%
Traded	£3,945.66	28.07	64.10%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£2,986.41	20.43	72.77%
Sub Total	£2,986.41	20.43	46.6%
Under Delivered	£959.25	7.64	27.2%
Expired	£2,358.90	15.73	35.9%
Active	£0.00	0.00	0.0%
Sub Total	£3,318.15	23.37	53.4%
Total	£6,304.56	43.80	100%
Over Delivered		25.99	

Test 6 Week 2	£	MWh	%
Traded	£3,514.85	24.83	57.88%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£2,580.58	14.86	59.86%
Sub Total	£2,580.58	14.86	34.6%
Under Delivered	£934.27	9.97	40.1%
Expired	£2,710.35	18.07	42.1%
Active	£0.00	0.00	0.0%
Sub Total	£3,644.62	28.04	65.4%
Total	£6,225.20	42.90	100%
Over Delivered		33.01	

Test 6 Week 3	£	MWh	%
Traded	£7,897.32	53.19	75.08%
Outstanding Traded	£0.00	0.00	0.0%
Delivered	£5,429.10	50.63	95.19%
Sub Total	£5,429.10	50.63	71.5%
Under Delivered	£2,468.22	3.11	5.8%
Expired	£2,566.35	17.11	24.1%
Active	£0.00	0.00	0.0%
Sub Total	£5,034.57	20.22	28.5%
Total	£10,463.67	70.85	100%
Over Delivered		37.74	

Figure 5-13: P2-T6 Weekly volume trading summaries

In section 10 we will discuss the overall outcomes, performance and behaviours seen during the live trials.

6. Performance Compared to Original Aims, Objectives and Success Criteria

6.1. Performance Against Objectives

- **The operability of short-term flexibility markets** - **Complete:** This has been tested through both the Phase 1 and Phase 2 trials with participant engagement and feedback very positive, details of this are within section 9.4.
- **The value of increased information at the day ahead stage to suppliers** - **Complete:** Stakeholder feedback across both Phase 1 and Phase 2 clearly indicated that this could be a valuable service for suppliers. However, there was no take up of this service within either Phase 1 or Phase 2 trials. This is probably due to the disconnect between the party needing action (the FSP) and the beneficiary (the BRP) and the market size.
- **The value of an integrated link for rebalancing in the intra-day market - Complete:** During the ongoing review of the potential to develop this service, the feedback from the current participants and stakeholders, has very clearly informed the project team that this auto rebalancing service is of no interest at current market volumes. The costs and risk of such a system far outweigh any benefit.

6.2. Performance Against Success Criteria

- **Development of a UK Market design for short term flexibility market that reflects imbalance costs - Complete:** The development has been completed as part of work package 2 and is now being validated via the trials.
- **WPD access to ShortFlex products that have the potential to benefit the distribution network- Complete:** WPD access to ShortFlex products has been validated as part of the Phase 1 and Phase 2 trials with network benefits and learnings identified within this closedown report and ongoing dissemination events.
- **Procurement of ShortFlex via the NODES platform - Complete:** Shortflex has been procured as part of the Phase 1 trials and the Phase 2 trials.
- **Demonstration of ShortFlex products that limit supplier exposure to imbalance costs - Complete:** The provision of a BRP information service was relaunched and validated via the phase 2 trials.
- **Delivery of the project on time and on budget - Complete:** Both timescales and overall budget have been adhered to.

7. Required Modifications to the Planned Approach during the Course of the Project

7.1. COVID-19 Impact

As with business in general across all sectors the international COVID-19 pandemic that spread at the beginning of 2020 was entirely unpredicted within the scope of the trials and to that extent there were no prior mitigations that been considered to manage its impact. In the first instance, many of the meetings that were planned to develop the market design and manage the many complex aspect of this multifaceted project were previously assumed to be carried out through face-to-face meetings. This was not merely limited to interactions within the immediate project team and participants but also ongoing stakeholder updates, ESO interactions and overall governance through WPD to Ofgem. It was therefore necessary to significantly change the methods of working but in every other respect minimise the impact on the stated objectives that were set out at registration stage.

As the situation developed and it became increasingly apparent that the response to the pandemic would limit the ability to travel and carry out face to face meetings it was necessary to alter all the expected meetings to virtual gatherings, utilising a range of different software solution and web conferencing utilities. These included Microsoft Teams, Goto Meeting and Zoom. This did pose some initial challenges particularly to WPD representatives and the pre-existing IT policies that limited access to software with perceived vulnerabilities to cyber threats, but this was addressed quickly by the wider business with only limited delays being directly felt within the project team. SGC & NODES due to their smaller size had the ability to respond very quickly to implement new methods of working which were already in limited use to address the geographic factors that existed even before the commencement of the project. NODES is based in Norway and SGC largely work dynamically from customers sites in provision of professional services and consultancy. It could even be argued that to some degree the ability to carry out increased work remotely that there were some minor efficiencies that were achieved because of the alterations to the working methods.

As the 'work from home' arrangements became more enduring the disruption that was initially experienced had a lessening impact on the general activities of the project team. It is very difficult to quantify the impact of the pandemic on other parties who were involved in the project and more so on any who were unable to have greater involvement as a result. Anecdotal evidence was obtained to suggest that for several organisations that would have otherwise actively participated or register as a stakeholder required to prioritise their core business instead. In spite of this there were sufficient participants to validate the learning and demonstrate competitive bidding that would be expected from a liquid market.

7.2. Auto rebalancing - not progressed

- In relation to the value of developing an integrated link for rebalancing the imbalance created by DSO service procurement in the intra-day market, the feedback from the market participants and stakeholders has very clearly informed the project team that this auto rebalancing service is of no interest at current market volumes. This was therefore de-scoped from the project.

7.3. Change Requests

During the project we added 2 new stage gates to ensure the project trajectory was as the market stakeholders required and adjusted 1 KOM as follows;

1) Following the Phase 1 stakeholder engagement we added a new stage gate to WP2 Detailed Stakeholder Engagement and Market Design - Stage Gate 2: Review of intraday trial viability following additional stakeholder feedback (30/06/2020)
2) As part of WP4 WPD build the audit targeting work completion was delayed from March 2020 - Audit Targeting Tool developed (27/11/20).
3) As part of WP5 Trials we after the Phase 1 tests we added an additional stage gate to ensure the phase 2 tests were relevant - Stage Gate 3: Review of intraday trial viability following ShortFlex trial (16/10/2020).

8. Project Costs

The project budget was allocated as in the Table 8-1 below. COVID 19 played a part in the contractor budget being below expected due to reduced expenses and Project Management spend was less due to leveraging existing capabilities within the team.

Dissemination budget was not spent due to COVID 19 restrictions and the use of online tools.

Overall though the pleasing part of the project was that we were able through the trials to spend the budget for trials participation.

Table 8-1: Project Spend

Activity	Budget	Actual	Variance (£)	Variance (%)
WPD Project Management	£131,435	£80,055	-£51,380	-39%
Contractors	£585,244	£445,985	-£139,259	-24%
Payments to Users	£100,000	£98,782	-£1,218	-1%
Dissemination	£30,000	-	-	-100%
TOTAL	**£846,679**	£624,768	£221,911	-26%

9. Lessons Learnt for Future Projects

The 'lessons learned' is arguably the most important section of the innovation closedown report as it should document the journey from the start of the project where there was only an initial concept of what WPD and the project partners expected to achieve in terms of 'known unknowns'. As flexibility markets are a relatively new concept across the industry learning was collected across a wide range of topics and not just specifically around a single item of technology. To this end, the documented learning has been categorised under three key headings, with some of which requiring further extrapolation of the concepts into future investigation.

9.1. Technical

- **Metering captured via existing Flexible Power standards appears to maintain a low technical barrier to entry**

  Flexible Power had already been established within WPD as the primary mechanism through which to contract and manage flexibility services. Within these services there have been several technical standards developed as part of a previous innovation project with successful results. These have gone on to be adopted by several more DNOs and in doing so expanded the standards to a large part of the UK. On this basis it was agreed that to maintain simplicity and ease of access for participation within IntraFlex the metering would replicate that of Flexible Power. To avoid confusion or risk to the BaU systems a parallel metering portal hosted at a different URL (https:// intraflexmetering.co.uk) was set up to capture data via the API. Within the regular feedback meetings with the participants, it was very positively acknowledged particularly by those who already contract with Flexible Power in any of the participating DNO zones.

- **Most participants required multiple meetings to address their queries and ensure that they were correctly enrolling onto the system.**

  While praise was received for adopting common principles with Flexible Power it is also recognised that further work is required on the customer journey before they are ready to provide services. The combination of having to set up technically on two different web services, review and sign contracts and add sometimes large portfolios of assets that require to be approved required a great deal of support. More integrated technical systems and simplified customer interactions will vastly improve the process and further lower the barriers to participation.

- **Posting Market Messages does – at least to an extent - seem to drive interaction on the market portal so is key to gaining FSP usage.**

  During previous trials and both phases of IntraFlex, WPD has recognised that keeping participants continually informed generally improves the quality, quantity, and promptness of interactions. To this end project team ensured that there were alerts configured to advise FSPs of any changes to WPD's orders on the NODES platform. A market message was sent whenever WPD added new orders or edited the price of existing orders.

  When FSPs were asked whether they found the market messages useful, most FSPs responded that the messages acted as a general reminder of the need to log onto the NODES platform, even if the messages did not trigger the FSPs to log on to the platform immediately upon receiving the message.

  Analysis of market data showed that FSPs' activity on the platform did correlate with the market messages being sent out. While participant's identities were anonymised, we captured the web stats relating to the time, duration and pages visited whenever they occurred. There was a direct and easily observed correlation between the market messages being issued and the detection of visits. This trend continued even during the sub trials where the market update times were moved form a relatively fixed window to a variable schedule.

  There is a risk that with an enduring BaU service the methods used such as email could become ineffective due to overloading, so alternatives could be considered, or user definable alerts introduced.

- **Some FSP's are missing the market messages - potential for all signed up FSP's to be automatically registered to receive the messages and de register if not wanted**

  Further to the previous learning outcome, it was noted that some FSPs were not receiving market messages for a variety of possible reasons including email filters, etc. On the basis that a positive improvement in FSP responses to the market when they were notified of changes it is worth proposing that the default position would be to provide all updates and then allow FSPs to reduce these to fit their own circumstances by opting out.

9.2. Market Function /Structure / Governance

- **BRPs do not currently see DNO imbalance as having a material impact on business costs.**

  At the time of initiating the trial a significant objective was to present a solution to a potential issue that could result from unexpected changes occurring to a supplier's balanced portfolio. This could be seen as particularly detrimental to their core responsibilities due to the close to real-time context of the services that were being developed on the NODES platform. The IntraFlex project team therefore included stakeholder engagement as well as targeted interviews to assess the views of BRPs and establish what their view was of this potential risk. Without exception, the feedback acknowledged the observation that had been made in terms of the general mechanics of the process, but it was deemed that the actual value of the negative position that may occur was insignificant to the overall cost of their businesses. It would be something that they would monitor as the services grow but it would have to be by many multiples before it would be something that was deemed to be detrimental enough to merit any remedial action.

- **Upward Regulation flexibility is unlikely to negatively impact BRPs in the short to medium term**

  In general, the imbalance position that is most negative for a BRP is when they have failed to procure enough electricity to meet the demand of its customers over a half hour period. In such circumstances the shortfall is covered by the actions of the ESO who carries ultimate responsibility to maintain system balancing. Costs are then charged back in line with the balancing and settlements code. The nature of upward regulation is that BRPs will see their position increase in length rather than shorten. In the majority of cases this will not result in penalties but provide a small increase in earnings unless the whole system is long. This will remain under review as with code changes the imbalance penalties have increased that should encourage more BRPs to take a longer position which could reverse the overall situation by penalising over supply, but it is very unlikely that this will see rates charged back by ESO being as high. This will also need to be reassessed with the future introduction of downward regulation which is intended to manage generation rather than demand constraints.

- **BRPs could address the issue of imbalance risk from activity within ancillary services markets through changes to their contracts that make them increasingly punitive or the addition direct exclusion clauses**.

  One of the primary issues the project team had to investigate was the views of BRPs in recognition that flex market activities were not specifically excluded in supplier contracts, thus allowing customers to participate without seeking specific permissions.

  However, customers or BRPs do not own their trading position, at worst they will have thresholds which they are expected to remain within, in terms of deviation from and expected usage profile. Occasional events outside of the thresholds will not normally trigger and penalty as they are often measured over longer periods, such as a month. If flexibility programmes resulted in tangible impacts to their profitability, they would be well within their rights to modify future contracts to sharpen penalties, take a share of the benefit or even prevent altogether. IntraFlex has therefore identified this a potential risk to the growth of the industry and wished to offer more pragmatic alternatives that would be conducive to both sides.

- **BRPs do not currently support proposals for external entities such as the market operator automatically rebalancing their positions**

The risk associated with imbalance is regarded to be low as outlined in the prior documented learning outcomes. On more detailed analysis with the BRPs, it is apparent that they expect that if they are also the party taking action to offer Flexibility to the DSO, then they would be aware of the proposed action and could also determine the holistic impact. If the outcome was to be that further action was necessary to manage their imbalance position, they see that they would be best positioned to resolve it themselves. This potentially reduces the overall risk of imbalance to their customers who participate directly in ancillary services or utilise the services of a third-party aggregator. As the market matures it is reasonable to expect that BRPs will reposition their services to embrace flexibility as an additional earning opportunity that they would fulfil themselves and discourage their customers from paying a third-party.

- **BRPs do see benefit in an information system that helps them act on imbalance created.**

  Further to the above learning points where BRPs stated that they would not wish an automatic action to be taken on their behalf, they do see real potential value on receiving timely alerts from an information service. This is largely down to the same reasons given previously regarding the impact of upward regulation already being potentially beneficial on occasions when the system is short. In most instances a BRP would elect not to take any action where their position is lengthened in these circumstances. If they were to be alerted as to when any third-party action is being taken that might impact their imbalance, they could use this information to assess whether it was to their benefit or detriment and only act where it is seen to be of material significance.

- **FSPs who are not themselves BRPs have so far not expressed that they see the benefit to sharing information with the BRP via the information service. Potentially, ongoing industry development, including the BSC Mod P375, could at least partially address the issue, in cases where the FSP has signed up to the BSC (Balancing Settlement Code) as a VLP (Virtual Lead Party).**

  In addition to the BRP signing up to receive information about traded volumes that impact their balance, the FSP also must agree that this information should be shared with the BRP. There is no obvious directive incentive from which the FSPs would benefit as a result. We can speculate that, in fact, the information sharing may lead a BRP to conclude that the actions of the FSP are detrimental to a point where they wish to sharpen penalties, take a share of the benefit, or even prevent altogether.

  For context, P375 proposes to make the settlement of the Balancing Mechanism (BM) more accurate by using metering equipment 'behind the Meter'. Settlement of Balancing Services currently utilises data from a boundary meter at the point of connection to the distribution network. This is where a site is connected to the Distribution Network. This can be problematic as it measures electricity flows for the site. In reality the balancing service is provided by specific asset or assets within the site, which can result in the delivered volumes used in settlement being masked by other independent activity behind the boundary meter. This can result in penalties for the Virtual Lead Party (VLP), incorrect adjustments to the Supplier's imbalance position and loss of potential revenue for the end customer. P375 proposes to use asset specific metering" for balancing services to address this.

- **The penalties being applied when flexibility requirements are either under or over delivered need to be strengthened.**

  Penalties is a very interesting and potentially sensitive topic as while it is fully recognised that these will almost certainly be necessary, there will likely be differing views on when the most appropriate time would be to introduce them. Particularly within a trial where we are making every effort to attract participants and lower any barriers to entry, any punitive measures are likely to be interpreted as a disincentive. It is also necessary to separate the conditions around under delivery vs over as these have different consequences that impact different parties.

  Over delivery was assumed to be of greatest concern to BRPs as the greater the volume of delivery, the more that it is likely to affect their market imbalance. Even within the 'auto rebalance' proposals, they would only seek to rebalance the procured volume so over delivery still carries potential to distort their position. However, based upon the feedback and learning that has already been documented, it is apparent that BRPs are at present not concerned about the limited impact that 'upward regulation' services have. These can in fact be helpful in circumstances where the BRP is holding a 'short position.' The result is a general view that no

further action should be taken, other than maintain observations to determine if other factors such as increasing volume or downward regulation increase the risk to BRP imbalance.

Under delivery is not an issue for the BRPs, and the negatively affected party is most likely to be the DNO/DSO who is purchasing the Flexibility Services. As the operation of efficient networks becomes more reliant on commercial services it is vital that they offer similar levels of reliability to avoid supply outages or premature deterioration of network assets due to overloading. To date this has been achieved through financial incentives. Where an FSP under delivers, the FSP's revenue for flexibility that has been sold is decreased gradually down to zero. Under no circumstances does WPD or NODES charge a penalty where an FSP would be charged for failure to provide services, over and above the revenues of flexibility that has been sold.

As part of the ongoing development of the market we would expect to introduce secondary trading that would be aimed FSP transferring their contractual requirement to another FSP in the event they were no longer able or willing to provide the service directly. In the absence of any penalties there is little to motivate an FSP to engage in secondary trading to ensure that they deliver their flexibility as transacted. Furthermore, under delivery could result in penalties to the DNO as part of their regulatory conditions in the event that supplies are interrupted or assets damaged as a result of significant under delivery.

Going forward we will therefore need to consider how incentives can be formed to incentivise delivery, including secondary trading, whilst still not discouraging FSP participation in the market.

- **Over/under deliveries: Dialogue with the FSPs around over/under deliveries can help improve delivery percentages.**

  Dialogue with the FSPs revealed that some over/under deliveries were caused by FSPs not fully utilising platform features, such as the ability to upload baselines calculated by the FSP itself and the ability to receive dispatch notifications. This shows that dialogue with FSPs who over or under delver can play a key role in lessening over or under deliveries (but clearly does not replace financial incentives).

- **Due to the nature of the trial the lack of liquidity could be restricting competitive offers from the participating FSPs.**

  A key objective of the trial was to demonstrate the viability of the platform and market design to create a suitable environment for competition in securing Flexibility contracts. To achieve this, there is a prerequisite that you have sufficient sellers and buyers to make competition a reality. As DNOs are regulated monopolies there will in most cases (in the absence of secondary trading or the ESO purchasing flex in the same order books as the DSO) be a limited number of buyers, but sellers are also restricted by the necessity that their assets are located downstream of a constraint.

  To maximise the chances of establishing competition within a brand-new service, the areas in which assets could be located were opened to all current and prior constraint zones. These would normally each be treated as a separate market, but for the trial were combined to create a single trading environment. This was proven to be a successful decision as during phase 2 of the trial we observed a range of competitive behaviours reflected in price and time of offer as was hoped but not necessarily expected at time of design.

9.3. Operational Behaviours

- **The onboarding process benefitted greatly from working closely with the participants and having defined and regularly communicated deadlines for participants to act by.**

  FSPs needed to complete a number of contractual and technical steps in order to participate in the project. The project aimed to keep these to a minimum, but certain steps - like technical build required to submit meter readings and review of contractual terms - could not be avoided. It was also that case that the was some overlap with the market design activities as the timeline for the project was condensed into two relatively short operational phases.

The project team decided it would attempt to maintain a close relationship with the prospective FSPs to deliver close support to limit the risk of churn, particularly as FSPs were also having to contend with Covid related disruption and in many cases reduced staff numbers internally. SGC & NODES ran several group sessions to keep FSPs informed of the processes and any stage gates as well as direct one to one support calls. In addition to the general updates and information sessions it was necessary to complete the following to achieve onboarding.

- Asset identification and location inclusive within CMZs
- Asset approval
- Rule book / contract completion
- Metering portal / API set up
- Administration details for settlement and payments
- Test Zero commissioning completion

For Phase 2 of the project, NODES added a pre-qualification form that FSPs had to submit prior to go live. This was added for WPD's compliance with the Utility Contract Regulations (UCR). There was some concern that this form would form an additional barrier to participation, but FSP feedback indicated that it was not.

- **Bids are being accepted at a lower volume than expected when considering known system sizes. This may be influenced by there being no penalty for over delivery.**

The operational results revealed a high proportion of offers from FSPs that were fulfilled by assets notably larger than the capacity they were being remunerated for in the bid. For example, a 2MW asset would regularly act upon bids that were around the 1MW requirement. This is generally because of three factors. Firstly, the assessment by the FSP is done based on value per asset rather than per MW which combined achieves a minimum marginal operating threshold that makes it worthwhile starting up the asset. Secondly, that there is sufficient duration to keep the asset operating once it had been started, so they would typically react to offers that were concurrent over multiple HH periods. Finally, it was necessary to operate the asset at exactly the requirement and therefore they could take advantage of other value streams such as the sale of the electricity at the full output of the asset. If there was a limitation on only providing the capacity reflected in the bid then it is unlikely we would experience as high levels of offers in response.

- **We should be clear, at the outset of such trials as well as BaU about the quantum of volumes we would be looking to trade thus avoiding signed up participants being unable to offer flexibility due to size of the asset.**

WPD and its partner SGC have maintained a policy throughout previous trials and within the burgeoning BaU Flexibility Procurements that it is better to share the specifics of network needs, as this heightens the likelihood of acquiring what is needed. This is not always the case in other markets, where some of the drivers behind competitive behaviour stems from the unknown metrics. Unfortunately, this strategy can sometimes have a negative unintended consequence and over time discourage participants. Particularly during this stage of market development where WPD are keen to achieve increased liquidity it remains important that the information on offer is as transparent as possible. During the trial there were some assets onboarded that could provide capacity that was several multiples of the average or even maximum bids that were placed. If it is known in advance what the average or maximum capacities are likely to be they should be clearly communicated from as soon as they are known.

- **Bilateral calls were a more useful method to obtain participant feedback than questionnaires.**

During the first Phase of the trial participants were requested to complete a questionnaire after each trial phase but in spite of multiple prompts and requests, the response level was less than 50%.There could be several factors that may have led to this, including staff shortages due to Covid-19 or simply insufficient incentives to prioritise it from those responsible for trials responsibilities at each FSP.

During the second Phase of the trial the project team resolved to schedule short bilateral feedback calls with participants, rather than sending out surveys. The bilateral calls proved to be a more effective way of obtaining feedback.

- **Participants typically appointed one person internally to manage the trial, so when on holiday, absent or too busy there was a direct impact on the trial response levels**

  As with the previous learning outcome regarding feedback this observation is related more with the trial conditions and how these can potentially be improved in future projects. Due to the specialised nature of the interactions and trading type activity that was required to manage the operations at each FSP, the responsibility was typically allocated to a single individual. This did impact the continuity of the trial and clearly identifiable changes in behaviour when the key individuals were unable to fulfil their activities for whatever reason, there were even occasions where attempts had been made to temporarily delegate duties but still resulted in errors or missed opportunities to places offers. From feedback and FSP discussions it is anticipated that the likelihood of this would diminish in a BaU environment.

- **Stakeholders were very positive in relation to the price discovery and moving closer to real-time, creating a level playing field for less predictable baselines and capacities e.g. EV's and domestic sites.**

  An area of particular interest during stakeholder and FSP feedback sessions related to the phase 2 market design as this was intended to encourage competitive behaviour and one of the major areas where the learning outcomes have been focused. Creating the competition between FSPs with very different asset types is not without challenges particularly when trying to create a level playing field when operating parameters are so different. Conventional generating assets will often be able to provide a baseline at the week ahead stage as well as confidently nominate the capacity they can offer. Demand turn down from an aggregated group such as EV technology might only be able to achieve a similar within the final 24hr period ahead of delivery. Based upon these dynamics it would not have been surprising to discover that there was a split of opinions on the market design where conventional generators were concerned about an erosion of their competitive advantage. The reality was that when feedback was received it was acknowledged even from conventional asset owners that the new market dynamics were likely to improve reliability and increased opportunities to participate would support overall growth in the application of flexibility. While this might reduce the rates being paid through increased competition, a larger market was recognised to be of greater benefit in the long run.

- **Moving to a 7-day market has increased the opportunity for FSP involvement and simplified the bidding process as volumes will now be posted 7 days ahead of requirement**

  One of the adjustments to the market design for phase 2 was the extension of the market from a 5 to a 7-day rolling view. This brought with it a few advantages to FSPs in simplifying their analysis of the requirements as well as more time to consider their appropriate responses. With the initial bids from WPD not having a tangible value to match an offer against for at least the first 3 days after posting of volumes it created a fairer process where everyone has an equal opportunity to see the requirements up to 7 days ahead before bids incrementally increase towards the maximum bid pricing closer to real time.

- **Ongoing developing Industry protocols look like they may negate the requirement for a separate Information Service as scoped in this project.**

  After the IntraFlex Project was registered and the trial had commenced there were announcements from National Grid regarding alterations to Applicable Balancing Services Volume Data (ABSVD) that was intended to fulfil a very similar function as the proposed IntraFlex information service to BRPs. As a result, the project team adjusted the project scope to include and independent assessment of the proposed ABSVD principles and benchmark it against the IntraFlex proposal. The results of the analysis by Cornwall Energy concluded that there would be significant duplication based on the knowledge available at that time and therefore it added further support to the view that the auto-rebalancing and information services should be de-scoped from the wider trial. The report found that with the risk of duplication and no specific requirement to rebalance a BRPs position this would not constitute a good use of customer's money through the innovation fund.

- **ESO Dynamic Containment pricing @ Circa £400/MWh could be a price barrier to DSO Flexibility trading**

  National Grid utilise a suite of 'Ancillary Services' that assist them with the operation of the electricity system. Some of these are intended to support the Transmission Network while others are largely for balancing and managing critical events for the systems as a whole. The ESO services are normally non-geographic so there is a potential for FSPs to have the option to provide services to any of these requirements, but this can lead to conflicts between contracts. WPD have endeavoured to avoid the creation of conflicts in the design of its Flexibility Services throughout the innovation projects it has undertaken, but nevertheless some still exist.

  Dynamic Containment (DC) is a fast-acting post-fault service required by the ESO to contain system 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). If an asset was providing services to WPD it is very likely that it would be unable to offer DC concurrently. It would therefore be likely that an FSP would opt to provide services to the party that was in a position to offer the greatest value. During the feedback sessions it was suggested that DC was worth up to 30% more per MWh which could impact the ability for a DNO to access capacity within a specific geography due to the higher value on offer, despite the ESO being able to acquire from elsewhere with the same net impact.

- **The tests outturn so far is pointing towards needing to post 135% of the volume required to account for under delivery and volume not being taken up**

  During the trial the project team monitored the volume delivered vs the orders placed. In many events the FSPs over delivered as they were utilising assets that were larger than the requirement. In terms of this observation and the learning outcome, the delivery was capped at 100% and therefore the events that experienced over delivery have not been utilised to reduce the statistical analysis of under delivery. The over procurement of 35% above the requested volumes was calculated at the mid-point of the trial and increased to just over 40% by the end. The observation has also been simplified for the purposes establishing what an appropriate budget would be to manage a constraint and over procure capacity to mitigate risk. It would not necessarily overcome any situations in real time where a participant fails to deliver, which is more likely to require penalties to incentivise.

- **Pre-Publishing the final price the WPD requirement posted when we reach T-3 is causing the FSP behaviour of waiting for the WPD requirement to reach this final price.**

  A potentially controversial decision in the market design was the decision to share with FSP in advance what the maximum price being offered would ultimately be. In the earlier sub trials this appeared to provide the resulting behaviour that FSPs would wait until the final increase increment and then act promptly to secure at that price. This was not unexpected and, in some respects, helped assure the project team that the mechanisms in the market design were operating as intended. In later sub trials when the final increment was delayed to day-ahead and intraday it was observed that FSPs started to place offers at T-3 days at lower prices to ensure that they secured their order for their favoured delivery periods. Other FSPs who then offered closer to real time may not find any capacity remaining for their preferred periods but had their offers matched at a higher value rate.

- **The EV asset FSPs (<0.5MW) seemed to be able to place offers a week at a time with the larger asset (>1MW) owners being able to place offers intraday**

  This shows that EV assets are capable of offering some volume days ahead of delivery, even if the volume can be maximised closer to real time when the FSP can make a more accurate forecast of the full volume of flexibility that can be made available.

- **The larger asset (>1MW) FSP's seem to be content to take any residual volume after the smaller asset FSP's (<0.5MW) have taken what they require**.

  According to feedback, most participants logged onto the platform approximately once per day and accepted WPD's bids that were on the platform at that moment in time, when WPD's price was sufficiently high. We

therefore believe that this was driven by the times of day that different participants chose to interact with the platform.

- **The larger FSP asset owners seem to be comfortable trading at below the £300 MWh value.**

  As with previous learning outcomes, it is noted that FSPs will tend to assess the value of a bid wholistically in relation to the size of their asset. If the asset is larger than the volume required, they will still run the full capacity of the asset and de-rate the payment appropriately. On this basis if the combination of multiple value streams achieves their trigger price they will trade, even if that falls below the maximum bid value they know will be achieved if left in the market. However, they then run the risk of securing the order and having their asset idle, so prefer to opt for the reduced but adequate margin.

- **The EV FSP asset owners seem to be comfortable trading lower than the value of the large asset owners.**

  Although the new FSPs who aggregate multiple loads such as EVs are much smaller and have a more complex task to analyse their opportunities in some respects that have an advantage over conventional generators. EVs provide their flexibility service by delaying or slowing the charging cycles of the vehicles and as such they are simply reshaping a profile, which has a very low cost of operation once the technical capability has been established. Conventional generators such as gas and diesel engines have a high fuel cost, plus maintenance associated with the frequency with which they start and stop the assets and total operating hours. The necessity to achieve a minimum trigger price and maintain it over periods to ensure that they don't over work the assets will typically mean they need to secure a higher value order.

- **Pre-offering: The trial nature of the market, with limited value on screen, limits the resources FSPs can dedicate to participation, with more active participation like pre-offering being more resource intensive. A move to BaU -assuming this means more volumes on screen- could encourage more active participation, such as pre-offering.**

  The nature of placing 'pre-offers' is speculative as these will not result in orders unless the bid prices from the buyer remain on the market long enough that they increment up to a matchable value. Also, by placing a pre-offer it could be perceived that the FSP is 'showing their hand' and inviting any competitor FSP to undercut their offer and win the order. The combination of the time necessary to place multiple pre-offers coupled with the uncertainty meant it was prohibitive for the FSPs to dedicate resources to this style of trading. In the event that the market was deeper and wider it would be more conducive to an FSP investing time and resources in market activity.

- **Market timings: A close to real time market may be beneficial particularly for EV chargers, as the ability to predict what flexibility they can make available is closer to Realtime.**

  Participant feedback was that the ideal market timings for EV chargers would be that they get a notification of what the volume requirements are at a day ahead stage and after that they submit orders until GTC.

- **Meter data: It would be useful to be able to provide metering data retrospectively, e.g in case of technical failure but where metering data is still recorded.**

  Meter data that is collected via the portal and pushed to NODES does not require to be in real time. The purpose of the data is primarily to fulfil the commercial activities such as setting baseline values, measuring performance, and settling payments to FSPs. These can all feasibly be done with data provided 'after the fact', but protracted delays could impact the ability to process in a timely manner. Going forward it would make sense to take a pragmatic view when setting service requirements and the extent to which the metering portal and NODES should allow data to be provided retrospectively.

- **Some questions require input from qualified experts outside of the project team.**

During set up, questions arose related to the treatment and application of VAT as WPD are paying the VAT to customers via a NODES who are not UK VAT registered. This required input from qualified experts outside of the project team.

- **Flexibility procured via the platform is out turning at a lower cost than anticipated at £288/MWh**

  One of the ultimate learnings from the IntraFlex project as well as being the basis of the operational objectives was to identify whether we could develop a market in which we could achieve competition, even with relatively low liquidity due to infancy, geographic restrictions to participation and an unexpected pandemic. In spite of all the hurdles that the project team encountered, the final results were both positive and compelling with the average rate for flexibility reflecting a 4% reduction from the typical price within Flexible Power and price cap for the trial.

9.4. FSP feedback:

We sought feedback from FSPs during and after Phase 1 and Phase 2.

9.4.1. Phase 1

During Phase 1 we sought feedback from FSPs using surveys sent at the end of the various tests and via a roundtable discussion at the end of the phase. We also recorded feedback received on an ad hoc basis.

The feedback we obtained centred around technical platform features. This included the need for:

- a minimum volume order type.
- restrictions to prevent operational errors, including measures to prevent FSPs from placing orders in order books where they do not have assets and from placing orders for periods where they have not uploaded a baseline.
- clarity around time zones displayed.
- changes to the way orders and trades are displayed using filters.
- emails from the platform rather than manual emails at the start of each test.
- standardisation around sign conventions, and energy and power units for submitting meter values and baselines between the metering system and NODES.
- a roundtable with all participants to share learning and feedback.

As a result of the Phase 1 feedback, the new features listed in the section on “Project specific development work for Phase 2” were developed. We also ran the roundtable discussion that was suggested.

9.4.2. Phase 2

During Phase 2 feedback was obtained via bilateral calls with each FSP, held in the middle of the phase and at the end of the phase. We also recorded feedback received on an ad hoc basis. Key messages included the following:

- All participants said the trial generally went well. In particular:
  - The platform was easy to use and the barrier to market entry was low.
  - A near to real time market with a short product duration enables flexibility like EV chargers to maximise the flexibility they can make available.
    - The ability to predict what flexibility can be made available from EVs is at day ahead stage.
    - For EVs it is difficult to commit to providing a certain amount of flexibility over a longer period, such as a day or multiple hours. Granular products like 30 minutes allows EV-aggregators to provide flexibility with more certainty. It therefore releases flexibility that they could not make available otherwise.
  - We listened to feedback and developed new features.
  - All participants would be interested in continued participation in a follow up project.

- The FSPs pointed out that a more active approach to participation – offering pro-actively and/or responding to other FSPs' activity – is more resource intensive than a routine where the FSP logs onto the platform at a certain time each day and responds to WPD's bids. We were told that a more pro-active and responsive behaviour would be more likely to develop if there were larger volumes (more value) on the market and the market was not a time limited pilot.

- When asked about potential future developments the FSPs expressed that:
  - Building a future link to the ESO market would be useful as it would enable participation with assets outside of the WPD's congestion zones.
  - It would be good to involve additional DNOs in the market.
  - A link to WPD's existing Flexible Power platform would be welcome.
  - That secondary trading would be interesting, but that the present limited liquidity would be a limiting factor to its usefulness.

- FSPs explained why they over or under delivered. We found that under deliveries mainly related to operational issues and over deliveries to asset size.

- We also received some feedback on metering data and baselines, including that there is a need to enable FSPs to provide metering data retroactively in case of technical failures and that excluding traded period from the default baseline calculation would be useful for FSPs who do not have the resources to calculate their own baseline.

10. The Outcomes of the Project

10.1. Phase 1 Live Trials – Trading Outcomes

During the phase 1 live trials we had 8 FSP's registered to take part with 2 unfortunately needing to withdraw before the trials commenced. 6 FSP's were therefore active at various times across the phase 1 live trials successfully placing offers to WPD bids on the NODES market platform.

We completed 224 trades procuring circa 51MWh with offers from 3MW down to 10kW and traded at prices £360 down to £240/MWh.

Reviewing the number and volumes of bids posted by WPD that were fulfilled in Phase 1 it can be seen that overall (Table 10-1 below);

- 20% of the bids posted were fulfilled which equated to 33% of the volume.
- There was greater take up of the bid volume bid bands
    - 10kW→49 kW,
    - 50kW→99kW,
    - 750kW→999 kW
    - above 2MW getting the most take up.
- There was average take up of the bid volume bands
    - 500kW→749kW
    - 1MW→2MW
- There was little interest in the following bid volume bands despite WPD posting over 110 bids
    - 100kW→249kW
    - 250kW→499kW

Phase 1 Tests Bidding Outcomes										
Bid Size Band (kW)	No. of Bids Posted	%	Min Bid (kW)	Max Bid (kW)	Total Volume (kW)	No. of Complete Volume Fulfilled Bids	%	Total Volume Fulfilled (kW)	%	No. of Partial Volume Offers
<10	5	▼ 2%	2	7	25	1	▼ 20%	4	▼ 16%	25
10 - 49	14	▼ 5%	10	49	454	11	▲ 79%	387	▲ 85%	111
50 - 99	19	▼ 7%	50	94	1,609	3	▼ 16%	538	▬ 33%	18
100 -249	57	▲ 21%	100	231	8,675	1	▼ 2%	200	▼ 2%	10
250 - 499	54	▲ 19%	250	480	19,879	7	▼ 13%	2,650	▼ 13%	-
500 - 749	45	▲ 16%	500	740	25,249	11	▼ 24%	5,950	▼ 24%	-
750 - 999	32	▬ 12%	750	975	27,187	10	▲ 31%	8,200	▲ 30%	-
1,000 - 1,499	33	▬ 12%	1,000	1,474	38,971	8	▼ 24%	9,993	▼ 26%	-
1,500 - 1,999	13	▼ 5%	1,500	1,810	21,196	4	▬ 31%	6,400	▬ 30%	-
>= 2,000	5	▼ 2%	2,000	4,000	13,000	4	▲ 80%	11,000	▲ 85%	-
Totals	277				156,245	60	22%	45,322	29%	164
								Total Number of Market Offers		224

Table 10-1: Phase 1 Bidding Outcomes

These results reflect the types of assets that were most active. This included larger assets that would not be economic to dispatch for bids below a certain threshold and EV chargers that were able to partially match both small and large volumes, but only fully match smaller volumes.

On reviewing the delivery windows, of the bids posted by WPD that were fulfilled in Phase 1, it can be seen that there were specific times of day when we achieved good fulfilment.

During phase 1 all delivery windows between 08:30 and 20:30 were signposted with circa 50% not receiving any take up.

We believe the FSP's appetite for certain time periods were driven by revenue streams from other markets that may have been achieved by dispatching the relevant asset at certain times. In addition, for assets like EV chargers, the time of day when flexibility can be offered is driven by driver behaviour, with evening times being times when flexibility can be offered.

Time	Average % Bid Filled
9:00 am	50%
9:30 am	25%
10:30 am	40%
11:30 am	50%
1:00 pm	31%
2:00 pm	20%
5:00 pm	21%
5:30 pm	46%
6:00 pm	34%
7:30 pm	40%
8:30 pm	44%

Time	Average % Bid Filled
8:30 am	0%
10:00 am	0%
11:00 am	0%
12:00 pm	0%
12:30 pm	0%
1:30 pm	0%
2:30 pm	0%
3:00 pm	0%
3:30 pm	0%
4:00 pm	17%
4:30 pm	9%
6:30 pm	17%
7:00 pm	0%
8:00 pm	0%

Table 10-2: Delivery Window Uptake

Test Summary Phase 1	£	MWh	%
Traded	£12,670	58	35%
Delivered	£9,767	51	86%
Sub Total	**£9,767**	**51**	**30%**
Under Delivered	£2,903	8	14%
Expired	£8,986	109	65%
Sub Total	**£11,889**	**117**	**70%**
Total	**£21,656**	**167**	**100%**
Over Delivered		75	

Table 10-3: Phase 1 Summary

10.2. Phase 2 Live Trials – Trading Outcomes

The phase 2 tests ran for 18 weeks with an average of 80% (772 MWh) of the volume posted being traded and with an average of 80% (618MWh) of this being delivered. There was circa 20% (158MWh) of the traded volume under delivered, 20% (194MWh) was not taken up and 529 MWh was over delivered.

In phase 2 we completed 1,198 trades with offers from 5.1MWh down to 7kWh and we traded at prices of £360 per MWh down to £60 per MWh via the NODES marketplace.

This means during the phase 2 tests on average we needed to post on the market 136% of the flexibility volume that needed to be procured.

During the phase 2 tests we also had access to Webstats enabling us to ascertain the timings of the FSPs interaction with market.

As can be seen from Table10-4 below across the phase 2 trials we had 1,305 platform interactions with the busiest times for FSP interaction being between 10:00 – 11:00 (this is just after the new volumes and prices are posted) and 15:00 – 18:00 (assumed placing offers for next morning's price updates).

Time Of Day	FSP Market Interaction
00:00	12
01:00	5
02:00	5
03:00	0
04:00	1
05:00	3
06:00	2
07:00	30
08:00	28
09:00	47
10:00	214
11:00	159
12:00	105
13:00	77
14:00	101
15:00	109
16:00	109
17:00	105
18:00	58
19:00	45
20:00	28
21:00	23
22:00	15
23:00	24
Total	**1,305**

Table 10-4: FSP Market Place Interaction

During the phase 2 live trials we had 7 FSP's registered and actively taking part at various times across the live trials successfully placing offers to WPD bids on the NODES market platform. Reviewing the number and volumes of bids posted by WPD that were fulfilled in Phase 2 it can be seen that overall.

- 987 MWh of volume requirements were posted with 772 MWh (80%) being traded.
- Of this 618 MWh was successfully delivered which is equivalent to 64% of the volume posted.
- There was an above average take up of the bid size bands
    - 1.5 MWh → 3.99 MWh,
    - Then above 4.5MWh
- There was below average take up of the bid volume bands
    - Less than 1 MWh
    - 1MWh → 1.49 MWh
    - 4 MWh → 4.49 MWh

Bid Size Band (MWh)	Volume Placed	Volume Fulfilled	Volume Expired	% Traded
<1 MWh	10.6	4.57	6.03	43.1%
1.0 --> 1.49 MWh	234.6	167.39	67.21	71.4%
1.5 --> 1.99 MWh	216.0	167.63	48.37	77.6%
2.0 --> 2.49 MWh	212.4	187.05	25.35	88.1%
2.5 --> 2.99 MWh	136.8	120.57	16.24	88.1%
3.0 --> 3.49 MWh	63.8	47.14	16.66	73.9%
3.5 --> 3.99 MWh	32.9	28.83	4.07	87.6%
4.0 --> 4.49 MWh	8.2	0.24	7.96	2.9%
4.5 --> 4.99 MWh	31.6	31.60	0.00	100.0%
>= 5 MWh	40.3	40.25	0.00	100.0%
Totals	987.1	795.27	191.88	

Table 10-5: Volume placed by banding size

Like Phase 1, this reflects the types of assets that took part in the trial. This included several assets that would not be economic to dispatch for bids below a certain threshold.

On reviewing the delivery windows, of the bids posted by WPD that were fulfilled in Phase 2, there were specific times of day when we achieved good fulfilment much higher than we achieved in Phase 1.

As can be seen from table 10-6 below during phase 2 all delivery windows were between 15:00 - 20:30 and were signposted at 7 days before the delivery window. We have seen circa 72% of the WPD bids placed being completely fulfilled with 28% being partially filled.

This may have reflected the fact that there were additional larger assets that took part during Phase 2 compared to Phase 1. WPD also increased the volumes that were on the screen, making participation more attractive. We also believe that participants who took part in both Phase 1 and Phase 2 learnt how to use the system and developed routines that enables them to offer regularly into the market.

There is a clear delivery window that attracted less interest being the 15:30 – 16:00 window. One FSP suggested that a reason for this may be that wholesale electricity prices tend to be lower during that time period.

Delivery Window	Bids Placed	Bids Totally Filled	Part Filled	% Filled
15:00	1	1	0	100%
15:30	54	24	30	44%
16:00	18	11	7	61%
16:30	35	20	15	57%
17:00	55	48	7	87%
17:30	35	29	6	83%
18:00	36	30	6	83%
18:30	35	27	8	77%
19:00	90	67	23	74%
19:30	88	62	26	70%
20:00	55	41	14	75%
20:30	19	14	5	74%
Totals	**521**	**374**	**147**	

Table 10-6: Delivery windows bid counts

Test Summary Phase 2	£	MWh	%
Traded	£113,697	772	80%
Delivered	£89,278	618	80%
Sub Total	**£89,278**	**618**	**64%**
Under Delivered	£24,339	157	20%
Expired	£28,780	194	20%
Sub Total	**£53,120**	**352**	**36%**
Total	**£142,397**	**969**	**100%**
Over Delivered		529	

Table 10-7: Phase 2 Summary

10.3. Overall Live Trials Trading Outcomes

Combined across the 2 phases, we placed 1.137GWh onto the market, completed 1,422 trades, and procured a total of 831MWh. Offers sized from 5.1MWh down to 7kWh, which traded at prices from £360/MWh down to £60/MWh.

The result of this procurement was the delivery of 669MWh by FSPs of flexibility at an average price of £296/MWh. There was 165MWh of procured flexibility under delivered and 303 MWh not bid for meaning a total of 468MWh of the 831MWh flexibility required wasn't achieved.

Therefore, this means that to achieve the flexibility volumes required the DSO would need to put onto the market **141%** of the actual requirement.

During the project, savings of up to **4%** emerged on the cost of flexibility as seen in the Phase 2 trials.

These trials are the first time in the UK that a marketplace has facilitated this kind of market behaviour among Flexibility Service Providers (FSPs).

Test Summary Phase 1 & 2	£	MWh	%
Traded	£126,367	831	73%
Delivered	£99,045	668	80%
Sub Total	**£99,045**	**668**	**59%**
Under Delivered	£27,243	165	20%
Expired	£37,766	303	27%
Sub Total	**£65,009**	**468**	**41%**
Total	**£164,053**	**1,137**	**100%**
Over Delivered		604	

Table 10-8: Phase 1 & 2 Summary

10.3.1. Flexibility procurement price sensitivity

During the trials we have seen lower prices accepted for flexibility where bids were confirmed at intraday verses the T-3 days. As can be seen in the table 10-9 below there was a correlation between the lower out turn price and moving to intraday final bid pricing.

WHERE GREATER THAN 1 % of MWh FILLED BY £/MWh AND TEST																					
TEST	£/MWh																				Grand Total
	£120	£225	£240	£270	£275	£280	£292	£297	£300	£304	£309	£311	£312	£320	£327	£331	£332	£336	£359	£360	
1 (T-3)									100.00%												100%
2 (T-3)		2.60%							97.32%												100%
3 (T-3)				5.58%	3.71%	5.75%			84.22%												100%
4 (T-3)	1.02%		13.57%	8.30%		1.37%	4.09%	1.30%	2.67%	1.02%	1.32%	1.02%	1.36%	3.03%	1.14%	2.23%	2.27%	1.59%	1.36%	47.02%	100%
5 Intraday	0.03%		33.84%						66.04%												100%
6 Intraday			1.02%	31.69%					66.69%												100%
Grand Total	0.12%	0.48%	7.75%	6.35%	0.83%	1.44%	0.45%	0.14%	74.63%	0.11%	0.15%	0.11%	0.15%	0.34%	0.13%	0.25%	0.25%	0.18%	0.15%	5.22%	100%

Table 10-9: Bid Price sensitivity

10.3.2. Delivery Windows

It was also identified that 2 delivery windows clearly had lower availability of flexibility, 15:30 and 16:30. This was potentially driven by value that could be gained elsewhere.

MWh FILLED BY DELIVERY WINDOW AND TEST (RAG Table)														
TEST	TIME											Grand Total	Filled MWh	% Filled
	15:30 Filled	16:00 Filled	16:30 Filled	17:00 Filled	17:30 Filled	18:00 Filled	18:30 Filled	19:00 Filled	19:30 Filled	20:00 Filled	20:30 Filled			
1 (T-3)	6	5	6	20	7	11	8	30	21	16	4	147	133	90%
2 (T-3)	8	5	4	23	6	13	2	32	25	22	6	214	146	68%
3 (T-3)	15	4	10	23	13	13	13	37	30	16	4	185	177	96%
4 (T-3)	4	1	4	10	8	8	9	19	14	9	3	117	88	75%
5 Intraday	9	6	4	24	9	15	9	28	20	14	4	169	143	85%
6 Intraday	9	3	4	14	7	7	8	20	17	12	3	148	104	70%
Grand Total	50	24	31	115	51	69	50	166	127	87	23	981	792	
MWh	83	30	49	123	62	76	67	200	162	100	29			
%	60%	81%	62%	93%	82%	90%	75%	83%	78%	87%	82%		81%	

Table 10-10: Delivery Windows

10.3.3. Participation by Asset Type

As can be seen from table 10-11 below it is also clear that the type of asset drives the strike price the FSP is willing to commit to.

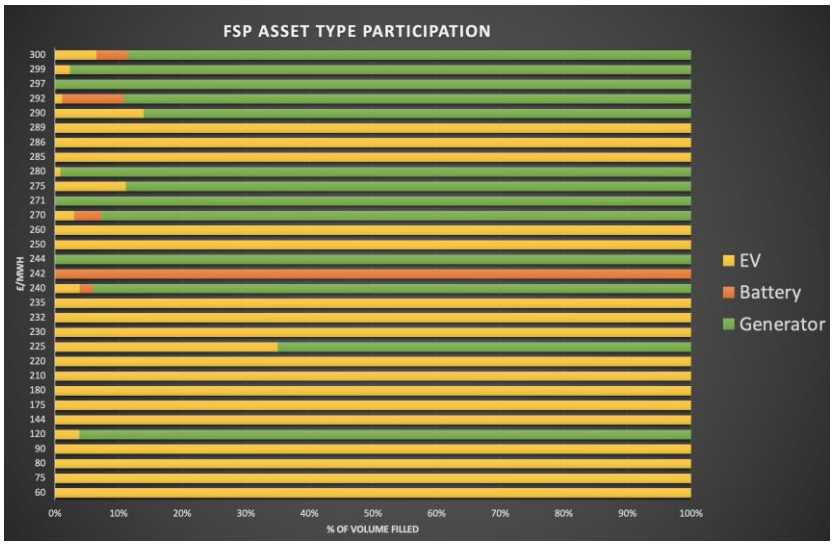

Table 10-11: Asset Type by Price

10.3.4. FSP behaviours:

- Some bids (requirements) placed by WPD were matched by offers (from Participants) within 10 minutes of submission; others matched within 2 hours of real time.
- Participant behaviour varied over the trial with different levels of engagement. Some of this was to do with the limited nature of the trial.
- We also believe that annual leave and unprecedented disruption due to Covid-19 during the tests had an impact on the ability for participants to place offers.
- The participants with large generating assets appear to post offers in batches as soon as they can following the publishing of the Market Information email. This shows that the market information email served a reminder.
- The smaller generating asset participants with small batteries and/or EV's are posting offers much closer to real time than the larger generating asset owners and are not necessarily reacting to the market emails. Reasons for this were provided as part of FSP feedback received (below).
- FSPs started to place pre offers onto the market ahead of WPD placing requirements onto the market based on the bidding pattern that was used in phase 2.
- FSPs during the latter sub tests started posting competitive price and volume offers in anticipation of the WPD requirements being posted.

11. Data Access Details

Anonymised data will be available to share in accordance with WPD's data sharing policy www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx

12. Foreground IPR

IPR	Category	Owner	Progress
NODES Platform	Background	NODES	Developed before the project
NODES Intraday link	Foreground	NODES	No longer being developed
NODES day ahead information	Foreground	NODES	First version has been developed
Flexible Power documentation and Processes	Background	WPD	Developed before the project
Audit Targeting	Relevant Foreground	WPD	Still to be developed
UCR review	Relevant Foreground	WPD	In development
Link to FP dispatch	Relevant Foreground	WPD	Developed
UK Market design	Relevant Foreground	All partners	First version developed and published. To be revised following trials
NODES Market design	Background	NODES	Developed before the project
UK Market design technical adaption white paper.	Relevant Foreground	All partners	Still to be developed

13. Planned Implementation

The results of the IntraFlex trials have been compelling. They provide some real insight for the business as to how we may effectively procure flexibility in the future. It is our intention that we will carry out a potential extended trial to follow on from IntraFlex to measure the appetite for additional products and services and then this will then form part of a roadmap, similar to what has been undertaken under Future Flex to inform a business as usual rollout of the learnings where appropriate.

We are also keen to explore how more collaboration with the supply chain could further improve participation or at least give additional insights into how best to accelerate participation. This is evidenced by our NIC proposal, EQUINOX for 2021.

Glossary

Abbreviation	Term
ABSVD	Applicable Balancing Services Volume Data - The data representing volume of Active Energy associated with Applicable Balancing Services.
API	Application Programming Interface - API is the acronym for Application Programming Interface, which is a software intermediary that allows two applications to talk to each other. Each time you use an app like Facebook, send an instant message, or check the weather on your phone, you're using an API.
BaU	Business as Usual
BEIS	Department for Business, Energy, and Industrial Strategy
BM	Balancing Mechanism - The balancing mechanism is used to balance supply and demand in each half hour trading period of every day.
BRP	Balance Responsible Party – Are financially responsible for maintaining the balance between supply and demand of energy within their portfolio.
BSP	Balancing Service Provider - Balancing Service Providers (BSPs) are remunerated for balancing services provided to the System Operator (SO). The balancing energy costs are allocated to the Balance Responsible Parties (BRPs) in the form of imbalance costs.
CMZ	Constraint Managed Zone - This is 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 stand-by generation.
COVID-19	2019 Novel Coronavirus
DNO	Distribution Network Operator - Any Electricity Distributor in whose Electricity Distribution Licence the requirements of Section B of the standard conditions of that licence have effect (whether in whole or in part).
DA/ID	Day Ahead/ Intra Day
DSO	Distribution System Operator - Are the operating managers of energy distribution networks, operating at low, medium and high voltage levels (LV, MV). Transmission grids transport large quantities of high (and extreme high) voltage (HV, EHV) electricity across vast distances, often from large power plants to the outskirts of large cities or industrial zones, where it is transformed into lower voltages distributed to all end-users through the distribution network. Over-head and underground cables leading to your home or business are operated by DSOs.
DSR	Demand Side Response- Is the modification of consumer demand for energy through various methods such as financial incentives and behavioural change through education.
EOI	Expressions of Interest
ESO	Electricity System Operator - is an entity entrusted with transporting electrical power on a national or regional level, using fixed infrastructure.
FSP	Flexibility Service Provider
GUI	Graphical User Interface - is a form of user interface that allows users to interact with electronic devices through graphical icons and audio indicator such as primary notation, instead of text-based user interfaces, typed command labels or text navigation.

Abbreviation	Term
IPR	Intellectual Property Rights - All industrial and intellectual property rights including patents, utility models, rights in inventions, registered designs, rights in design, trademarks, copyrights and neighbouring rights, database rights, moral rights, trade secrets and rights in confidential information and know-how (all whether registered or unregistered and including any renewals and extensions thereof) and all rights or forms of protection having equivalent or similar effect to any of these which may subsist anywhere in the world and the right to apply for registrations of any of the foregoing.
ISP	Imbalance Settlement Period
kW	Kilowatts
LongFlex	Long Term Flexibility (before day ahead timeframe)
MW	A megawatt (MW) is a unit of electric capacity or electric load. A MW is equal to 1,000 kilowatts (kW).
MWh	A megawatt hour (MWh) is equal to 1,000 Kilowatt hours (kWh). It is equal to 1,000 kilowatts of electricity used continuously for one hour.
NIA	Network Innovation Allowance
OFGEM	Office of Gas and Electricity Markets
SAT	Site Acceptance Test - is a useful tool to determine the functionality of the equipment at the user site before its installation
ShortFlex	Short Term Flexibility (on a day ahead or intra-day timeframe)
UCR	Utilities Contracts Regulations
WP#	Work Package

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Registered in England and Wales
Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB

wpdinnovation@westernpower.co.uk
www.westernpower.co.uk/innovation

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