WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

Project Entire

CLOSEDOWN REPORT

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Contents

Glossary

Abbreviation	Term
API	Application Programing Interface
ASC	Agreed Supply Capacity
BaU	Business as Usual
BSP	Bulk Supply Point
CMZ	Constraint Management Zone
CRM	Customer Relationship Management
DD	Delivery Delta
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSO	Distribution System Operator
DSR	Demand Side Response
EFFS	Electricity Flexibility and Forecasting System
EoI	Expression of Interest
ER	Engineering Recommendation
ER	Engineering Recommendation
ESO	Electricity System Operator
FALCON	Flexible Approaches for Low Carbon Optimised Networks
GSP	Grid Supply Point
NMS	Network Management System
RTU	Remote Terminal Unit
STOR	Short Term Operating Reserve
SYNC	Solar Yield Network Constraints
UAT	User Acceptance Testing
WPD	Western Power Distribution

Executive Summary

Project Entire aimed to demonstrate the commercial viability of flexibility services for both the Distribution Network Operator (DNO) and the service provider. Building on learning from the FALCON[1] and SYNC[2] projects, the project looked to develop DNO services that could sit alongside existing Electricity System Operator (ESO) services such as a flexible Short Term Operating Reserve (STOR) contract. This allowed participants to stack revenue, easing access to the service. Whilst the project originally included the offering of a managed, stacked services to customers, this element was removed from the project as part of a review with Ofgem and the project focussed instead on the development of market complementary services, allowing stacking and asset management to remain the focus of the competitive market.

As such the project developed three services to reduce demand on the network offered across a geographic area running alongside the M1-M40 corridor in the East Midlands.
In addition significant work was carried out to develop the systems and processes required to deliver the services. These focussed on the development of the core customer and operational portal, but also include a number of ancillary processes.
This was carried out under the newly created Flexible Power brand which created a clear route for market engagement.

Following extensive engagement and recruitment activity over 120MW of capacity responded across 69 sites. However, of these over 60MW (from 12 sites) were not compliant with our minimum standard (in zone and credible for delivery). Whilst there was high initial interest, good feedback and a good number of contract signatures (seven), very few sites (three) made it to the operational trial. Follow up indicated that this was due in part to the workload created by other market changes as well as a general fatigue associated with DNO Demand Side Response (DSR) trials. Despite the design focussing on reducing the burden to potential customers, the potential time bound nature of potential returns limited participation. Other key learning included the value of improved market information, and the level of support needed to aid market participation.

Due to the trial fatigue hawse have committed to the roll out of the services developed as part of the trial into business as usual (BaU) and will look to assess all relevant reinforcement of significant value against flexibility options. To date there have already been two BaU procurement processes taken forward and developed on the learning from the Entire project. Learning form the project is also being shared bilaterally with

[1] The Flexible Approaches for Low Carbon Optimised Networks (FALCON) project ran from 2011 to 2015 in Milton Keynes and investigated a range on techniques to mitigate issues in 11kV networks. Full details can be found at: https://www.westernpower.co.uk/projects/falcon
[2] The Solar Yield Network Constraint (SYNC) project ran from 2015 to 2017 and investigated a number of DSR techniques for the management of generation peaks. Full details can be found at: https://www.westernpower.co.uk/projects/sync

other DNOs. The processes have also fed into the Open Networks project[3], informing the development of standard DNO flexibility services and processes.

The project delivered on its key objectives on time and under budget and has brought the understanding of DNO led flexibility forward significantly.

A series of four learning reports accompany this closedown report and detail specific areas of work: the service design, the systems built, the participant recruitment and the operational trial results.

[3] The ENA's Open Networks project aims to help deliver changes to energy networks in response to decarbonisation. More details can be found at: http://www.energynetworks.org/electricity/futures/open-networks-project/

1 Project Background

Building on previous DNO flexibility trials, project Entire looked to further develop the commercial proposition for DNO led flexibility services with the aim to make them commercially and technically viable for both the DNO and the flexibility provider.
Trials such as FALCON had shown the technical viability of DSR to manage DNO networks; however it was also shown that the commercial mechanisms for accessing such services needed further development. In particular the ability of customers to stack revenue streams, garnering value from multiple flexibility buyers, was not easily available. Exclusive contracts tied participants to specific services, pushing up prices in those services as well as reducing the liquidity available to other buyers.

The SYNC project looked to address this issue by aligning DNO requirements with an ESO service, Demand Turn Up. This showed the value of coordination, however expanding this beyond the relatively new service and into more established services such as STOR would have been challenging.

Project Entire aimed to look at an alternative approach, with the DNO leading the customer engagement and owning the customer relationship.
With a focus on simplicity and ease of use, the aim was to expand the available pool of flexibility by building a product that was complementary to those offered by the ESO. This would allow the DNO service to cover the opportunity cost of participants rather than the total asset cost.

2 Scope and Objectives

DNOs have been running limited scope trials in order to assess the potential of DSR as an enhancement to existing network operations. These have to date not addressed the issue of customer participation in multiple DSR schemes and the need for a service provider that can aggregate and optimise capacity to meet the requirements of multiple schemes (ESO, DNO and Supplier) and maximise value to asset owners. If this is not addressed it is unlikely that DNOs will be in a position to recruit participants for the exclusive purpose of constraint management due to higher, or more frequent, income stream from non-DNO sources.

Prior DSR trials have so far been limited in their scope with only small sample groups being engaged to offer quite limited functionality specifically for distribution constraint management. As the name **'Entire'** suggests, we extended the previously limited scope to fully develop and test the skills, relationships and systems necessary for a DNO to provide a comprehensive, commercially effective DSR capability. We will be doing this in areas within our network that were due a significant capital upgrade but where the certainty of immediate need is absent. The project looked to also demonstrate how DSR can be used to defer capital investment which can sometimes take up to 10 years.

In order to achieve this, the **'Entire'** project scope included;

- Recruit team / place contracts with partners;
- Develop connection policies / DSR contracts / technology and systems to facilitate services;
- Comprehensive knowledge of all legacy embedded generation and its impact on network and updating of asset records;
- Stakeholder engagement and interaction including recruitment of DSR programme participants;
- Interaction with external DSR programmes to optimise commercial attractiveness of DNO DSR. Establishing direct relationships with the largest demand customers to understand their usage, flexibility and possible changes. This will be combined with advice around ASC (Approved Supply Capacity) and DSR to reduce their costs and introduce new revenue opportunities;
- Identifying the skills gaps and organisational structure issues that are required to be addressed to operate a commercial DSR programme and ongoing migration to a Distribution System Operator (DSO);
- Measuring direct impact of Low Voltage (LV) connected DSR on 33kV and 132kV infrastructure and establishing financial 'use case';
- Determination of data required for customer recruitment. This will include an assessment of the benefits (and any confidentiality barriers) from market availability of this data; and
- Assessment of varying DSR offerings for constraint management.

Objective	Status
The trial will identify and address many of the key challenges a DNO is presented with as they develop DSR and other commercial service capabilities within what is a traditional engineering and asset management organization. In doing so WPD will create a roadmap for WPD's other regions as well as other DNOs to assist development of a commercial service capability and deliver increased value to their customers. In order to start this transition, it is necessary to ensure that the data held regarding customers with generation or sufficient volumes of flexibility to affect the network operation, is accurate and comprehensive. It is therefore our intention to carry out a deep audit of customer assets within the trial zones and ensure that they are compliant with the current standards, while taking advantage of this interaction to engage with them to educate and where appropriate recruit for demand side management activity. By carrying out this project we will ensure that the underlying assumptions regarding our networks are correct and that we have increased visibility of dynamic users that will effect operational decisions as we migrate to local system operation.	✓

3 Success Criteria

Success Criteria	Status
NETWORK: Identify, audit and update all generation connected to the 11kV network within the trial zone(s). This should enable the return of any unused export capacity to network planners. Identify all connected generation above 150kW and identify where these may affect dynamic network operation. We will also interact with other WPD initiatives to advise where increased telemetry may be required to monitor active locations in the network and update future forecasting models.	✓
SYSTEMS: Identify, develop and demonstrate new policies, processes and systems that are required in order for WPD to operate standalone DSR services. (Monitor, control, meter and settle) across all UK Distribution Networks.	✓
OPERATIONAL: Identify new skills and roles that currently don't exist within the DNO organisational structure and either train existing staff to address gap or create appropriate job specifications for future recruitment.	✓
COMMERCIAL: Develop an economic business model for combined internal and external DSR service provision that demonstrates enhanced value to customers. This will integrate savings with additional opportunities that could generate new incremental revenues from third party DSR schemes and cost avoidance. Broadening the scope of what a DNO can do with DSR we would expect to achieve improved efficiencies for overall GB system operation.	Partially Completed
MARKET: Agree a new set of conditions that allow and incentivise DNOs to operate DSR services that not only address internal constraint issues but incentivise the efficient use of these new capabilities to support overall GB System operation requirements. This will enable the use of customer assets and WPD's own stand by generation to participate in external DSR schemes, including ESO balancing services.	Partially Completed
KNOWLEDGE: Document and share all key learning that is achieved in order that the results should be replicable	✓

4 Details of Work Carried Out

For reporting purposes the work carried out has been split into four key topics.

- Service Design;
- Project Systems;
- Participant Recruitment; and
- Operational Trial.

A brief overview of each area has been provided in this report, with full details available in dedicated learning reports for each area of work.

4.1 Service Design

The initial piece of work was to design the services to be procured as part of the project.

4.1.1 Network Use Cases

The service design was initiated by studying a number of use cases to understand how services might be utilised.
These fell into three broad categories:

1. **Pre-fault Intervention**

Most 132kV and primary networks are built to n-1 redundancy allowing them to provide the security of supply required as part of Engineering Recommendation (ER) P2/6[4]. A typical example would be a Bulk Supply Point (BSP) fed by two 132/33kV transformers. Traditional design would ensure that the total site loading does not exceed the rating of a single transformer preventing any assets from being overloaded if a transformer faults and allowing supplies to be maintained.

Where the loading on the site could potentially exceed the rating of the single transformer, flexibility services could be used to reduce loading back below the rating to ensure n-1 compliance. In such mode of operation actions are taken ahead of any event to ensure network integrity.

2. **Post-fault Intervention**

As the loading on a network group increases, the requirements in ER P2/6 increase to also cover second circuit outages. As such, during an outage on one asset (but not a fault), there are requirements on the DNO to restore load following a subsequent fault. For a class D network (with a group demand between 60MW and 300MW) this would be the smaller of group demand minus 100MW or a third of group demand within three hours.
Under such a scenario, supplies are lost to the group; hence pre-fault intervention is not appropriate. A flexibility service could provide value following the fault as part of a restoration plan. For example generation could be used to reduce the loading on an

[4] ER P2/6 is the current distribution network planning standard. This governs the minimum security of supply required for different networks of different sizes.

interconnector and maintain supplies to a wider group of customers whilst the circuit under outage is returned to service.

3. Restoration

The final use case identified was that of value beyond the minimum security standards identified in ER P2/6 such as the mitigation of Interruption Incentive Scheme (IIS) liabilities. Whilst the minimum security standard might be to secure load under an outage followed by a fault, there is still a risk of lost load under a double fault. Flexibility services could help the management of such a network during restoration. In such a scenario, the value per MW is linked directly to the avoided customer minute lost liability which in turn is linked to the average kW/Customer on the network. This is a high value, but very low likelihood event.

The translation of the network use cases into commercial services aimed to deliver products that were beneficial to both DNO and participant. Throughout the process, various trade-offs were made. These generally erred towards simplicity and ease of participation, maintaining low barriers to entry to help develop these new markets.

4.1.2 Weekly Process

The starting point for the service design was to adjust the advanced-notice services developed as part of the FALCON project and adapt them to fit within the existing marketplace. The design focused primarily on accommodating an existing flexible STOR contract offered by the ESO. This service has a flexible participation option offered on a weekly acceptance and rejection process. Participants submit their pre-agreed capacity for acceptance by midnight on Thursday evening with the ESO National Grid accepting or rejecting requirements by 12.00 on the Friday. A similar weekly process was developed as shown in Figure 1 with participants declaring capacity by Wednesday at midnight with the DNO accepting or rejecting capacity by 12.00 on the Thursday. This advanced warning would give participants certainty over revenue and allow them to participate in multiple markets.

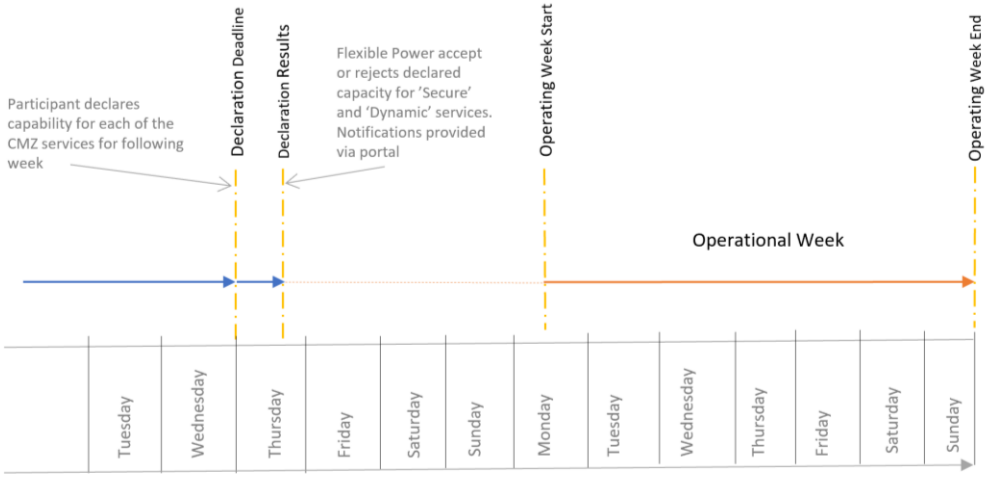

Figure 1: Declarations and Operational Timescale

4.1.3 Three Services

Within the weekly process, three services were designed to align with the three use cases identified. These were called Secure, Dynamic and Restore.

The **Secure** service was based on the pre-fault intervention and the week-ahead commitment to requirements trialled in the FALCON project. As such the DNO would indicate at the week-ahead stage exactly when the participant is required to run. This aimed to give both participant and the DNO maximum notice to maximise possible reliability. Payments were split between an advanced "arming" payment and a utilisation payment.

The **Dynamic** service acknowledged that for certain post-fault interventions week-ahead notification of the specific running requirements were not appropriate. However the times of heightened risk (outages) could be identified. As such an advanced "availability" fee was proposed to ensure flexibility is available, with actual utilisation triggered by a real time signal.

The Secure and Dynamic were designed as the main services, with every zone having either a Secure or a Dynamic service.

In addition all zones had a **Restore** service. As this is to mitigate general risk on the network, there is no period of heightened requirement and hence no advanced fee was made. However as utilisation would offset customer minutes lost, a premium utilisation price could be offered.

These services are summarised in **Error! Reference source not found.**.

	Secure	Dynamic	Restore
Original Use case	Pre-fault intervention	Post-fault intervention	Post-fault network restoration
Advanced payment	Yes, an arming payment for the declared run time £75-118/MW/h	Yes, an availability fee for the duration of potential requirement £5/MW/h	No
Utilisation payment	£150/MWh	£300/MWh	£600/MWh
Dispatch Notice	Week Ahead, on acceptance of availability	15 minutes ahead of requirement.	15 minutes ahead of requirement.

Table 1: Flexible Power Services Summary

4.1.4 Pricing Philosophy

Within the trial a fixed pricing policy was utilised. This was designed around the pricing seen to be acceptable to the market as part of the FALCON project, providing higher per unit value than the competing services, but remaining within a realistic value range for the DNO. The fixed price was intended to simplify the process for new participants. With no previous market information, initial pricing would have been very challenging for participants. Fixed pricing simplified the process and reduced a barrier to entry. This removed some of the cost, but also the risk of participation. This strategy was considered appropriate for the formation of flexibility markets within specific geographic areas. It was acknowledged that other options would be required in the long term once a liquid market had been established.

4.1.5 Payment Methodology

A detailed payment mechanism was designed to incentivise reliable delivery of service. Previous trials had utilised linear relationships between utilisation payments and delivery. However this does not incentivise the accurate declaration of capacity by participants. As such a new mechanism was developed which included a small grace factor for delivery (5%) followed by a 3% reduction in payment for every 1% of under delivery below the grace factor (in addition to a linear reduction for non-delivery within the grace factor). This is shown in Figure 2.

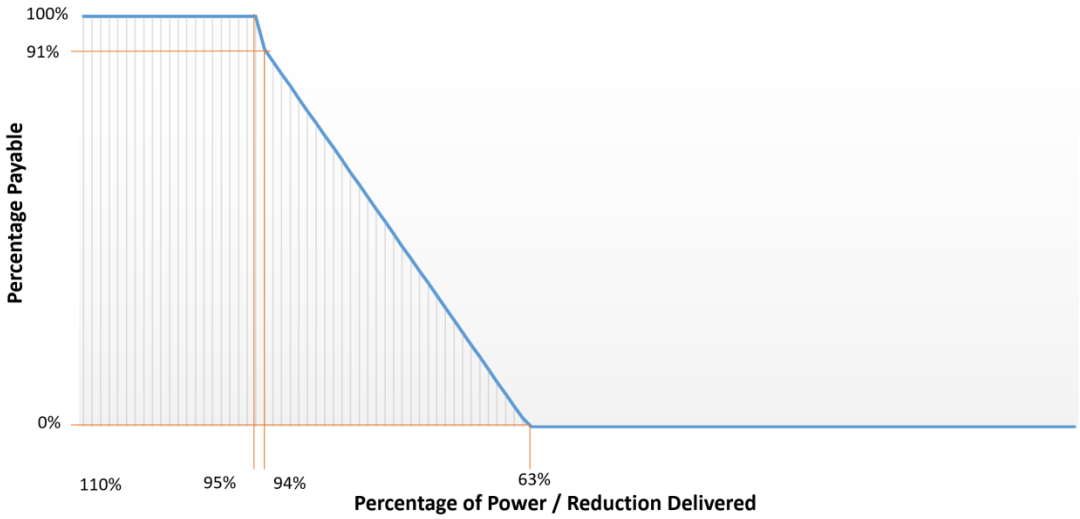

Figure 2: Secure and Dynamic Utilisation Payments

In addition to the utilisation reduction there is also a monthly reconciliation to claw back availability/arming payments for under delivery. This looked at the average proportion of energy delivered (per event, capped at 100%) and was used as a multiplier for total availability and arming payments.

A less punitive payment mechanism was developed for the utilisation only Restore service with a linear relationship between utilisation payment and delivery between 80 and 110% and a 2% ratchet below 80%.

In each of these mechanisms, delivery must be assessed against a baseline. For the trial a simple baseline was developed as the average of output between 3-8PM for the first

three weeks of the previous month. This represented a reasonable option to balance simplicity and establishing a methodology that would be inclusive for all site types

4.1.6 Billing

The service and payment cycles were based on a calendar month and therefore we operated 12 billing cycles within a year. After the end of each event a performance report was created and provided to the participant via the web portal. This allowed the participant to review their results. At the end of the month these event reports were then compiled along with the availability / arming payments and reconciliations for any shortfall of delivery. Once the statement was created and provided to the participant there was a further 14 days during which they could raise a query. If a query is raised, then the earnings statement would be placed on hold until any concerns were been resolved.

If however no query was raised within the 14 day window it was then assumed to be correct and the portal will generate a 'self-billing' invoice that can be downloaded for financial records, the portal automatically sent a duplicate to the Accounts Payable department for processing. This would then be paid directly into the bank account provided within 30 days. This process is shown in Figure 3.

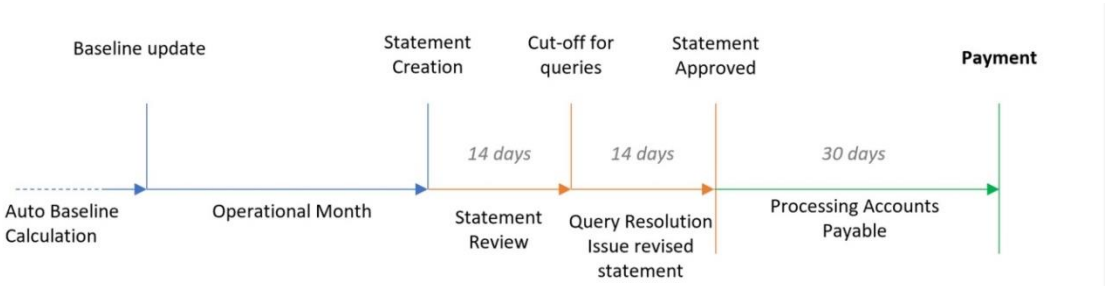

Figure 3: Settlement and Billing Timeline

4.2 Project Systems

A large part of the project focussed on the development of systems to help facilitate the operation of flexibility services. These were broadly split into two new systems (delivered within the Kiwi Power Collar system) and integrations into the wider DNO systems. These are highlighted in

Figure 4.

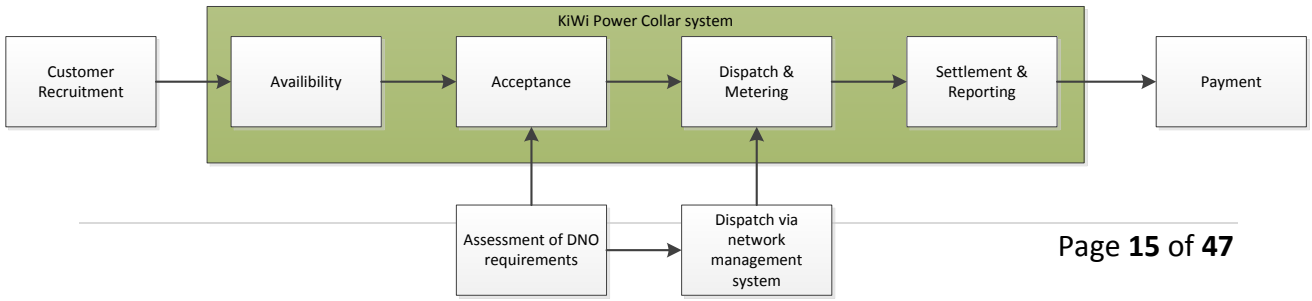

Figure 4: Systems Required

4.2.1 New Systems

Once the functional requirements for the new systems were established, delivery was put to competitive tender and won by Kiwi Power who developed the required functionality with their Collar system. It covered the following functions.

Availability

The Availability functionality facilitated the submission of participant availability on a weekly basis. This was carried out via a web based portal which accommodated a calendar. Participants also specified their key operating parameters including, available MW and maximum and minimum run times as shown in Figure 5.

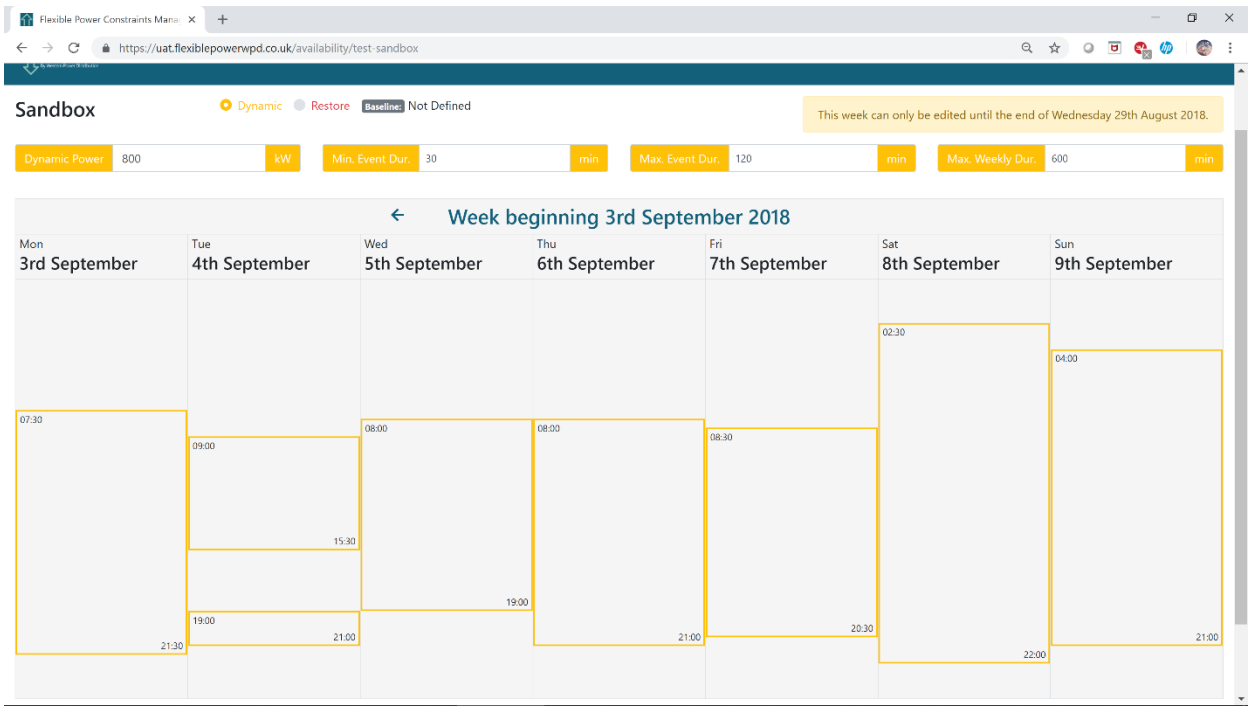

Figure 5: Availability Portal

Acceptance

The Acceptance calendar also allowed operators to accept the capacity made available by participants within the portal as shown in Figure 6.

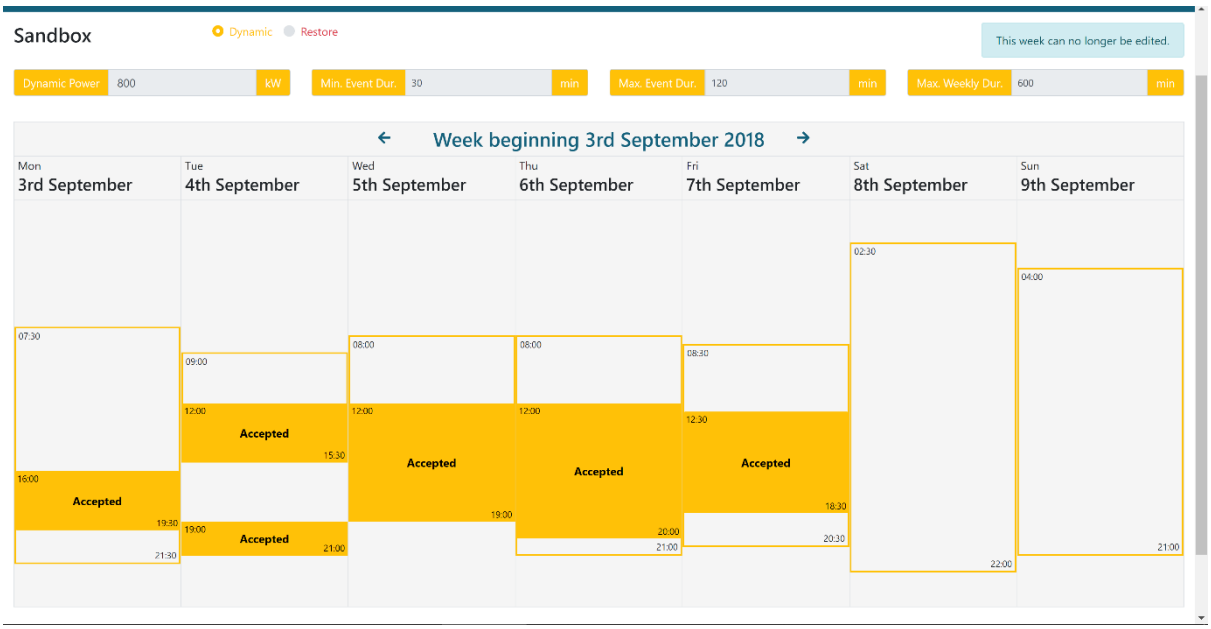

Figure 6: Acceptance Portal

Dispatch and Metering

Dispatch and Metering was carried out via a simple Application Programming Interface (API), which enabled participants to submit minute by minute usage data as well as receive start and stop signals for dispatch. The information was fed into a monitoring view to allow the DNO operator to see the response received.

Settlement and Reporting

The Settlement and Reporting processes allowed the system to log the metered output for each zone and assess both the baseline and the actual performance of participants. Performance was then highlighted in both an operational view (based on kW and kWh) in a performance report and also in a monetary perspective in an earning statement. Examples of these reports are shown in Figure 7. Finally invoices were produced to facilitate the payment process.

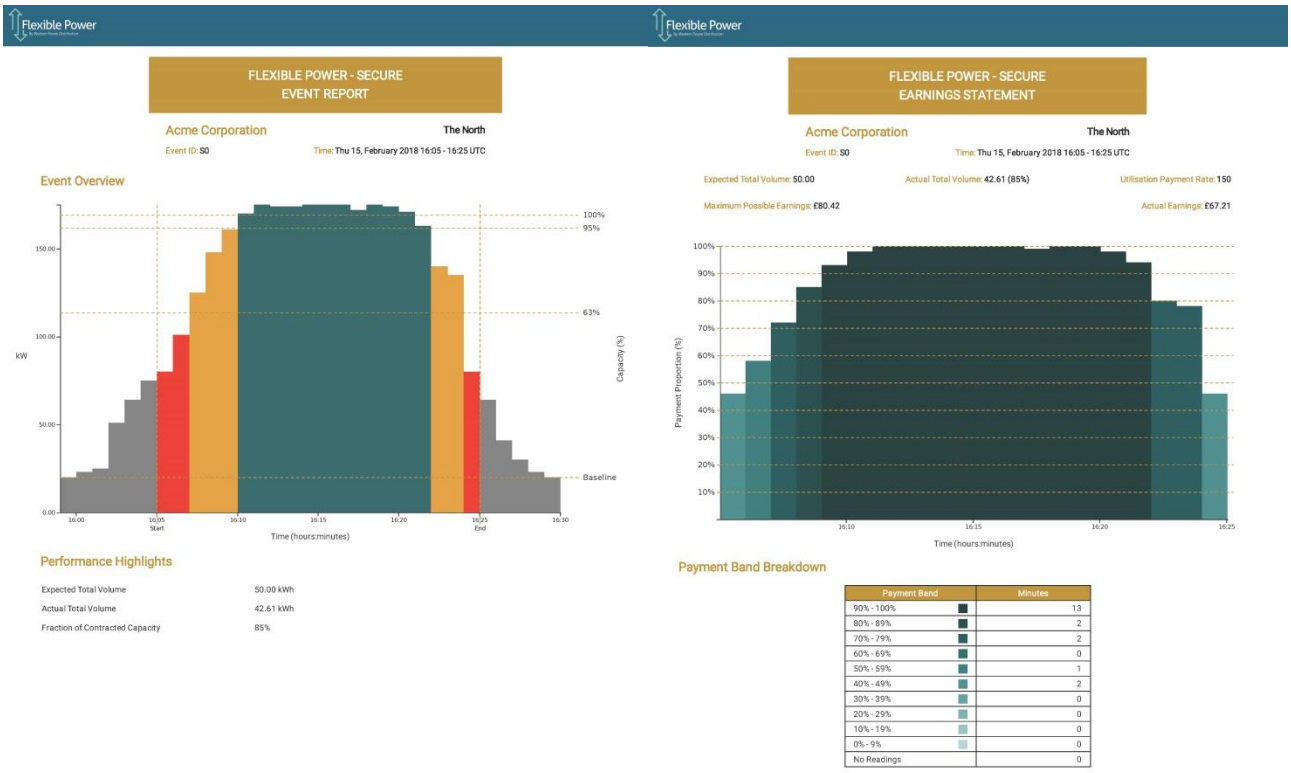

Figure 7: Sample Performance Report (left) and Earning Statement (right)

4.3 Additional Integrations

Further systems and integrations were also required to facilitate the services. These include the development of:

- A website ;
- A customer relationship management tool ;
- Operations Support tools ;
- Links to the Network Management System[5];
- Contract management tools; and
- Processes for the payment of participants.

4.4 Participant Recruitment

4.4.1 Flexible Power

As part of the project a separate brand was created to front the customer engagement for flexibility. This was done to clearly segregate the service procurement activities from the more traditional business communications around connections and network

[5] The Network Management System is the live tool used to manage and operate the distribution network. This is the tool used by control engineers to switch on the network.

operation. This would also allow other DNOs to share the branding of service requirement if desired.

Figure 8: Flexible Power Logo

This branding was used on all communications and a separate website was created (www.flexiblepower.co.uk).

4.4.2 Location

The trial took place in the East Midlands as shown in Figure 9. The wider area was split into 14 zones based on differing constraints. The area was chosen due to the high expected load growth.

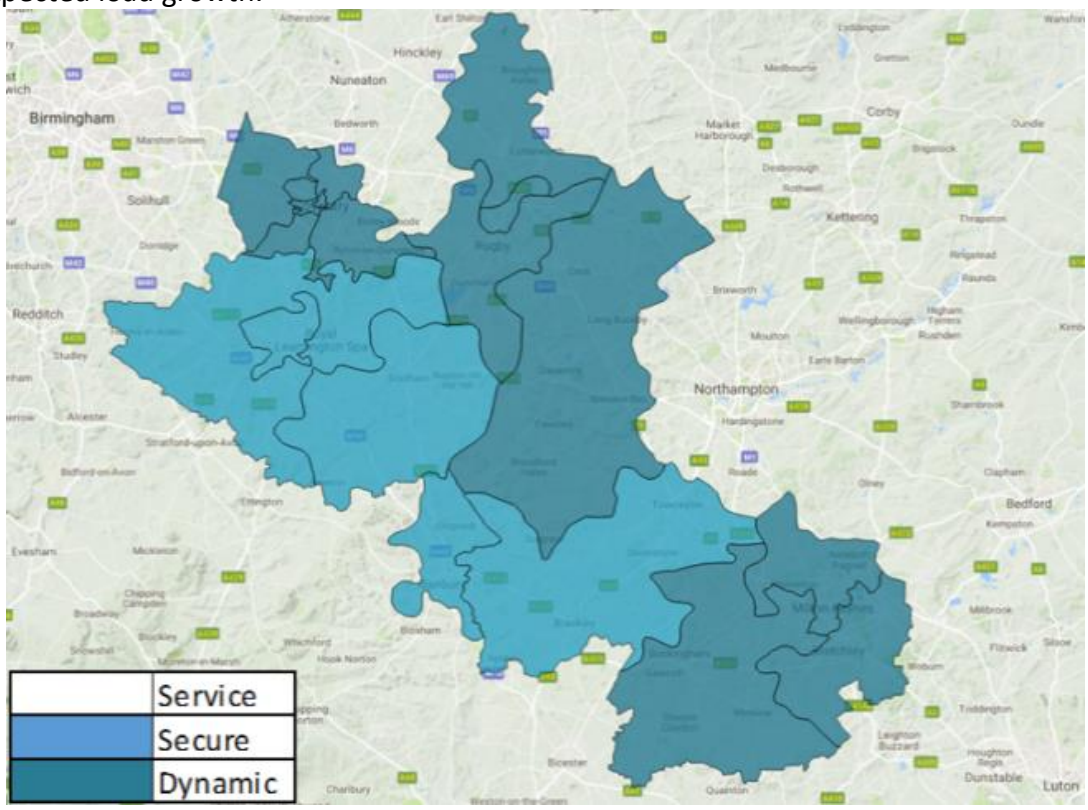

Figure 9: Trial Location

4.4.3 Recruitment Process

Participant recruitment was split into four phases. The whole process was designed to be as simple as possible to limit the cost of participation.

The process was framed with continuous customer engagement to try and widen the pool of participants. Initial engagement focussed on building relationships with potential participants and highlighting the service requirements. This involved proactively engaging with all the aggregators in the UK as well as speaking at conferences, utilising mailing lists, and promoting heavily on the website.

Expression of Interest
The Expression of Interest (EoI) element of the process was designed to develop an understanding of the high level viability of a zone. By collecting limited information from potential participants it allowed judgments to be made on the total potential volume in a target area with minimal effort from participants. The EoI permitted zones with very limited potential capacity could be filtered out limiting the follow up resource required for all parties.

Preparation
Procurement consisted of collecting more detailed information on the sites, getting contracts signed and building the communication interface.

Finalise and Test
The final stage consisted of commissioning and testing the interfaces as well as getting final billing details for the participant.

Operate
The recruitment process aimed to deliver as many participants to the operational stage as possible. Operational activities were broadly split into three areas:
weekly availability declarations and acceptance, dispatch, settlement and billing. These were carried out primarily via the customer portal and the API.

4.4.4 Recruitment Results

The services offered attracted lots of interest with many positive conversations with potential participants as highlighted by the high volume of responses to the EoI phase (as shown in **Error! Reference source not found.**).

	Total	Compliant	Potential	Non-compliant	Out of zone
Sites	69	34	23	4	8
MW	121.47	41.46	17.95	41.0	21.06

Table 2: Expression of Interest Results

However the gap between interest and tangible ability to provide services proved large. The EoI stage showed a large volume of MWs interested but not in the correct target areas, or even from providers who could not provide the technical service required.

Progression through the procurement phase was also very challenging with a significant drop off between interest and commitment. In total six contracts were signed with three sites and 2.299 MW is active to date. The drop off between contracts signed and sites active highlights the challenge involved with bringing volume live. Participant feedback highlighted a variety of reasons:

- Busy marketplace. There are currently a number of significant changes happening within the UK market for flexibility services. These included changes to schemes such as the reduction of embedded benefits, wider access to the Balancing Mechanism or the mergers and acquisitions of several firms. This

limited the available resource that could be devoted to DNO services;

- Trial fatigue. There have been a number of DSR trials by DNOs within the UK, with limited roll out to BaU. Such experience has created a reticence for participation, as participants saw limited scope for the return of the time investment necessary to operate within the innovation trials; and
- Limited Value. A minority of potential participants highlighted that at the current scale, participation did not present enough value to warrant interest.

4.5 Operational Trials

The operational trials were limited by the level of participation with only three sites available for the Secure service. Only one site was available for the Restore service. However in total 44 events were logged with interesting learning coming from them. Due to the limited sample size, caution should be taken when interpreting the results. Calls were made to try and replicate potential system needs whilst also testing participant and system performance.

In general data reliability was good with over 97% reliability over the whole trial. Within events this reliability was even better. In addition participant availability declarations were also high, although the uniformity varied by provider.

An example of typical response is shown in figures 10 and 11.

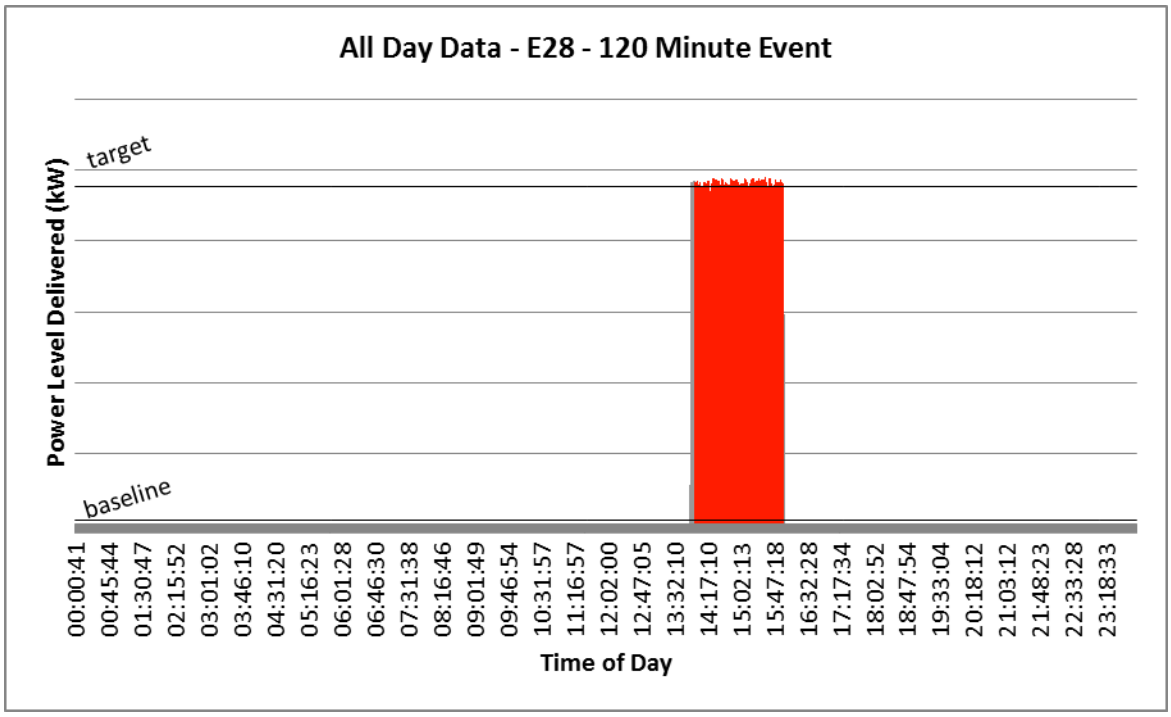

Figure 10: Example Response All Day Data

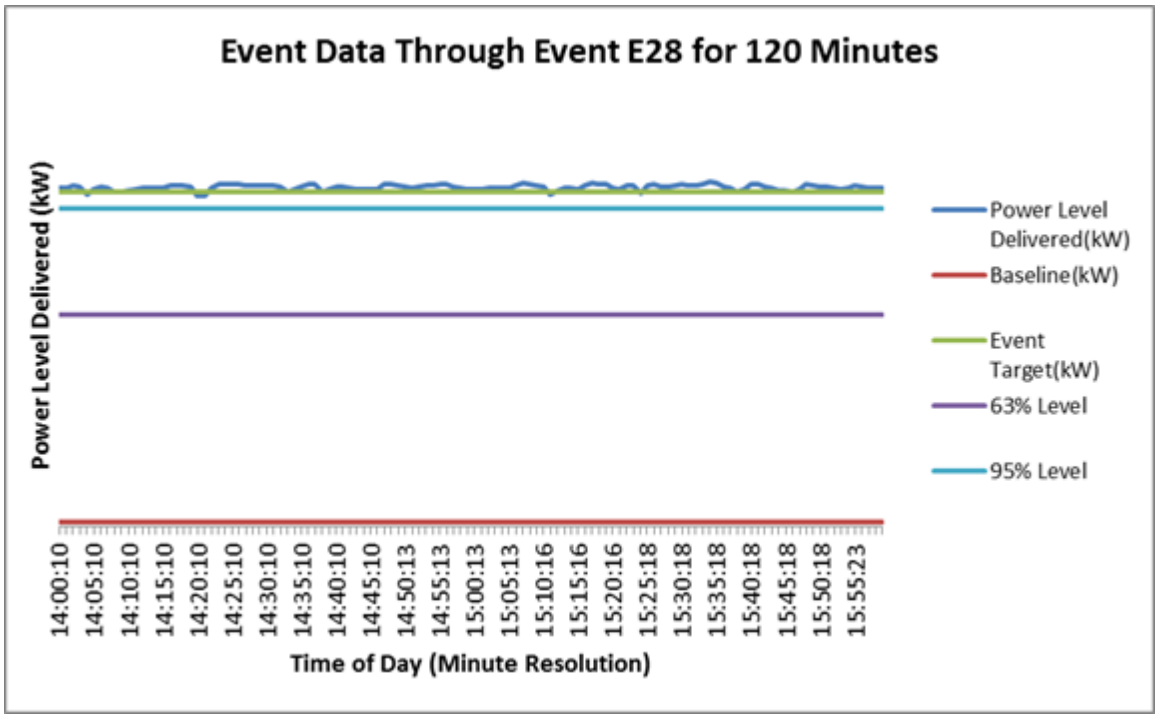

Figure 11: Example Response Event Data

General event performance was good, however the quantification depended on the metrics used. These ranged from counting events with continuous output above certain thresholds (figure 12) to more nuanced minute by minute assessments (figure 13).

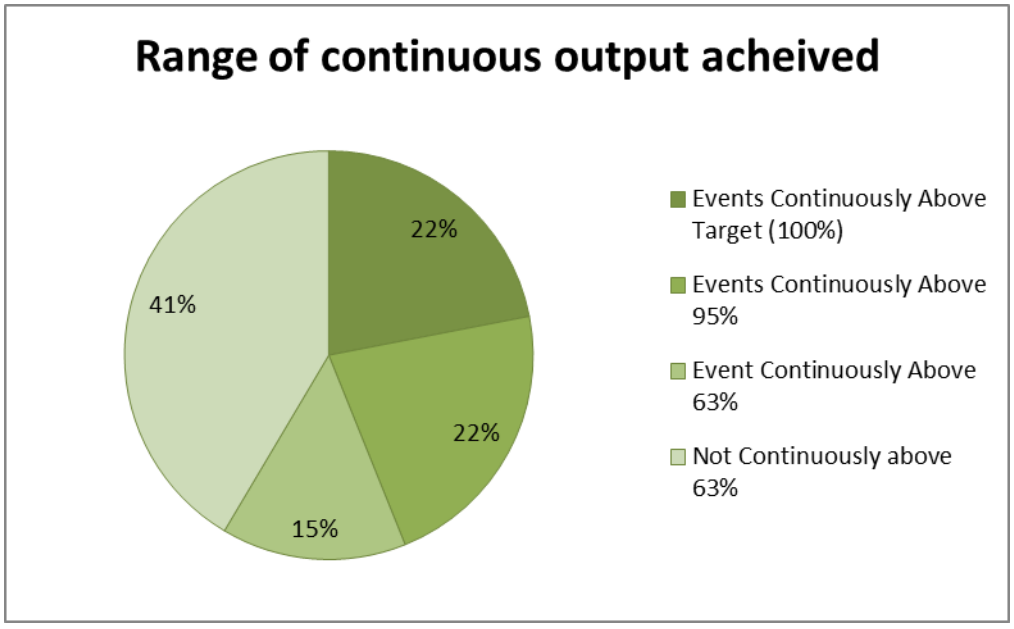

Figure 12: Range of Continuous Output Achieved

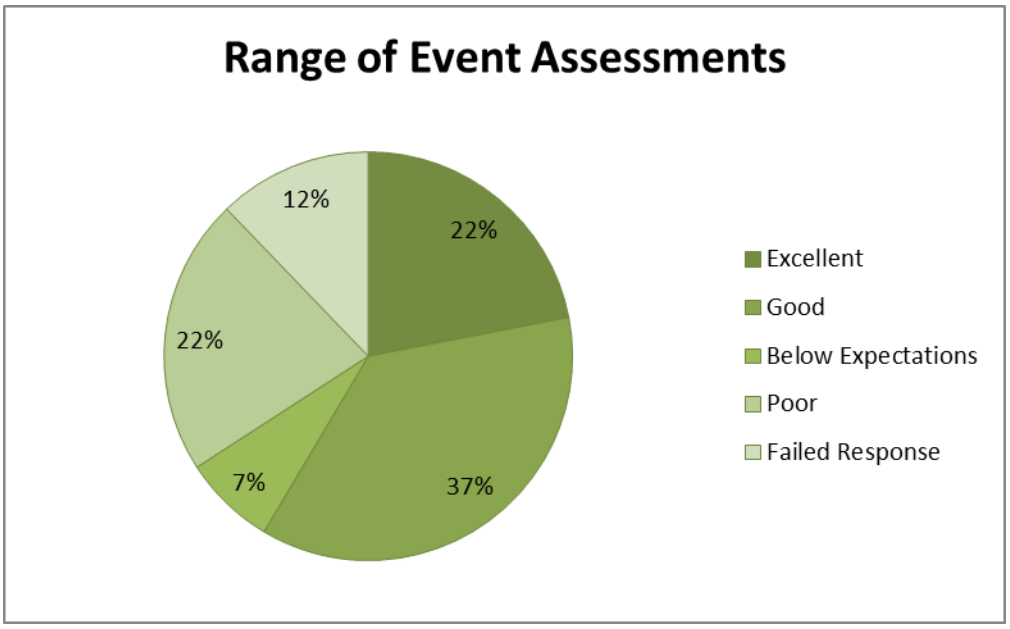

Figure 13: Range of Event Assessments

This process highlighted the minor difference between DNO requirement and the performance driven by the payment mechanics. Several other "types" of events were also identified such as No response, slow ramp up/ early drop off and under response. This highlighted the need to over procure flexibility service both for the potential of under delivery but also the potential of no response from a site.

Overall data point distributions of minute by minute delivery (excluding no response events) showed good clusters around 100% delivery (Figure 14) This highlighted that deliver was as expected over most minutes. There was a noticeable cluster around the 96% grace factor.

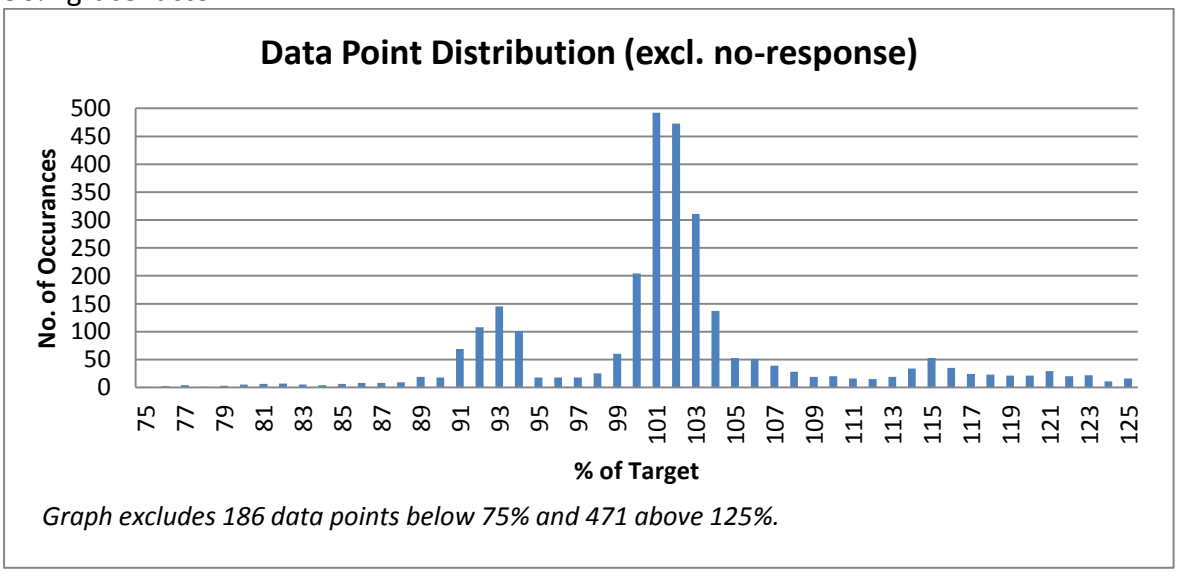

Figure 14: Data Point Distribution of Event Delivery Excluding No-response Events

The analysis also highlighted an interesting feedback loop within the trial baseline. When highly utilised, the calls in a previous month impacted the baseline in the latter month. This could be improved by altering the baseline to consider previous calls. In

addition the challenge around metering positions was also highlighted. Metering as the asset provided clean data and simple baselining, but potentially ignored the effect of other site activities.

Finally the network impact was assessed. The visible impact of the calls on the network depended highly on the size and location of the site, as well as its proximity to DNO network monitoring. Where this well matched, response was highly visible. Where not, limited impact could be seen, especially where other dispatchable generation was active on the network.

5 Performance Compared to Original Aims, Objectives and Success Criteria

Objective	Status
The trial will identify and address many of the key challenges a DNO is presented with as they develop DSR and other commercial service capabilities within what is a traditional engineering and asset management organization. In doing so WPD will create a roadmap for WPD's other regions as well as other DNOs to assist development of a commercial service capability and deliver increased value to their customers. In order to start this transition, it is necessary to ensure that the data held regarding customers with generation or sufficient volumes of flexibility to affect the network operation, is accurate and comprehensive. It is therefore our intention to carry out a deep audit of customer assets within the trial zones and ensure that they are compliant with the current standards, while taking advantage of this interaction to engage with them to educate and where appropriate recruit for demand side management activity. By carrying out this project we will ensure that the underlying assumptions regarding our networks are correct and that we have increased visibility of dynamic users that will effect operational decisions as we migrate to local system operation.	**Completed.** Commercial services and processes developed and transitioned into BaU. Generator audit and Agreed Supply Capacity review conducted to increase understanding of underlying network.

Success Criteria	Status
NETWORK: Identify, audit and update all generation connected to the 11kV network within the trial zone(s). This should enable the return of any unused export capacity to network planners. Identify all connected generation above 150kW and identify where these may affect dynamic network operation. We will also interact with other WPD initiatives to advise where increased telemetry may be required to monitor active locations in the network and update future forecasting models.	**Completed** The ASC studies have been completed with limited success. Over 5MW of capacity has been returned however progress was limited by data quality and complex customer change processes. The generation audit has also been carried out with no significant changes identified.
SYSTEMS: Identify, develop and demonstrate new policies, processes and systems that are required in order for WPD to operate standalone DSR services. (monitor, control, meter and settle)	**Completed:** Customer and operational processes have been developed alongside basic systems. In addition

across all UK Distribution Networks.	recommended future developments have been passed across to the BaU owners of flexibility services to ensure their continued development. Draft policies have also been created and are under review.
OPERATIONAL: Identify new skills and roles that currently don't exist within the DNO organisational structure and either train existing staff to address gap or create appropriate job specifications for future recruitment.	**Completed** The knowledge captured as part of the project has fed into WPD's wider DSO strategy. This has fed directly into the creation of new roles (Flexible Power Commercial Officer) as well as new systems (as part of the EFFS project).
COMMERCIAL: Develop an economic business model for combined internal and external DSR service provision that demonstrates enhanced value to customers. This will integrate savings with additional opportunities that could generate new incremental revenues from third party DSR schemes and cost avoidance. Broadening the scope of what a DNO can do with DSR we would expect to achieve improved efficiencies for overall GB system operation.	**Partially Completed** The project has developed services that sit alongside existing market propositions in a complementary way. The combination of such services with external services was removed from the project scope following the project review.
MARKET: Agree a new set of conditions that allow and incentivise DNOs to operate DSR services that not only address internal constraint issues but incentivise the efficient use of these new capabilities to support overall GB System operation requirements. This will enable the use of customer assets and WPD's own stand by generation to participate in external DSR schemes, including ESO balancing services.	**Partially Completed** The project designed stackable services to facilitate wider market participation. The utilisation of WPD generation was de-scoped to remove any potential conflicts of interest.
KNOWLEDGE: Document and share all key learning that is achieved in order that the results should be replicable	**Completed** Learning has been documented and compiled into four final reports. In addition the learning has fed heavily into the ENA's Open Networks project.

6 Required Modifications to the Planned Approach during the Course of the Project

Five internal change requests were raised against this project. These were made to ensure maximum value was generated from the project at minimal cost.

CRF001 – Following a re-assessment of the network, this change altered the target area of the project. Instead of two Grid Supply Points, the target changed to five areas made up of one GSP and four Bulk Supply Points. This refocused the project on an area of higher potential need increasing the value of procured flexibility. The project budget and timescales were not been affected as the same systems and resources could accommodate the additional complexity.

CRF002 – This change request was associated with CRF001 and adjusted the project benefits following the changes in geographical areas in CRF001. This ensured that stated project benefits aligned with the new target area. This had no impact on the cost and timescales of the project.

CRF003 – Following the identification of potential conflicts of interest as well as potential regulatory complications, this change de-scoped the use of WPD generation assets within the trial. This removed expected costs for asset upgrades; however potential project revenue was also removed. This had no impact of project costs or timescales.

CRF004 – This change focused on amending the wording of the project PEA document to avoid confusion. This included the removal of the WPD generation assets as per CRF003 as well as adjustments to the project scope to reduce confusion and clarify what was in and out of scope. This had no impact of project costs or timescales.

CRF005 - This change implemented the outcomes of the project review. The review is covered below and had a significant impact on project costs and timescales.

Project Review

The Project underwent a major review following discussions with Ofgem.

Ofgem highlighted that they did not see models in which the DNO operates as a commercial operator in the long term interests of customers. As such these elements of the project were removed to ensure that the trial continued to deliver relevant and valuable learning.
We also took the opportunity to update the project design in conjunction with learning gathered as part of the project. This included:

- Removal of stacked service. Only the Constraint Management CMZ products would be offered with no direct access to alternative services. All efforts we made to still deliver a product that the wider industry could stack;
- Removal of managed service: The managed service would no longer be offered. As such the assessment asset health and reliability was dropped from the system requirements;
- Splitting of 5 CMZ zones to 14 subzones: to allow for more granular control of contracted assets, the original 5 zones were subdivided into 14 subzones. The same overall area was covered;
- EOI stage: An expression of interest stage was added to the process to allow a quick assessment of the available flexibility in the target areas;
- New start date: the trial started in April as Triad avoidance was no longer required;
- The trial was shortened to a single year of operation. This allowed us to deliver maximum learning at minimal costs. As we did not expect large levels of response to be built for the service, operation over 1 year allowed us to reduce project costs and facilitate a faster transition to BaU;
- New interface options: participants could use an API as an alternative to the outstation;
- New CMZ services. Following the detailed design of the project, 2 additional CMZ products were developed; and
- A consultation was held on the value of DNO data to the DSR market.

7 Project Costs

Activity	NIA Eligible Budget	Actual
Design	85	141.158[6]
Build	636	627.84
Test	40	44.375
Trial	314	97.945[7]
Report	60	31.416[8]
TOTAL	**1135**	**942.734**

[6] The Design phase took significantly longer than planned due to the project review.
[7] The Trial phase required much less resource due to the reduced number of participants.
[8] The Reporting phase required less resource than planned due to the reduced number of participants

8 Lessons Learnt for Future Projects

8.1 Known Limitations

As part the trial design and operation, various trade-offs were made to ensure the service remained as simple and understandable as possible. As such there are some known limitations to the services developed including areas such as baselining, limiting declarations. These should be investigated in further work; however any solutions must continue to weigh up the benefits of a more optimal solution versus the costs of complexities.

8.1.1 Baselining

One limitation was with the baseline. Due to the monthly update of the baseline, changes in participant operations can take time to filter into changes in the baseline. As such a demand site, whose load increases over winter might not be reimbursed for the full level of the response as the baseline would be lower than actual usage. Participants could mitigate the potential impact on operational performance by lowering declared responses; however this would reduce potential earnings. A solution to such an issue could be to move to a weekly baseline; however this would be far more volatile and may be easier to game. It should be acknowledged that any baseline is always a compromise between various factors such as cost reflectivity, simplicity, limiting volatility… As such any changes to baselines would need to be designed carefully.

8.1.2 Fixed MW Declarations

Within the service, participants declared a single MW value for their volume available. This works well where response is provided by a single fixed asset such as a standby generator. However for load response, or the turn up of a normally a running generator, the magnitude of response that can be provided may vary over time depending on the activities being carried out. For example, an organisation may be able to provide a higher response when their demand is higher as there is more load to shift. The single declaration gave participants choices to make between being available for longer durations with lower magnitudes, or shorter durations with higher magnitudes. The fixed declarations were chosen to simplify the process, both from participant perspective and form a systems perspective. In reality it posed challenges. This could be resolved by adding the ability for variable MW declarations over time, or by providing better market information on the potential usages to help participants inform their choices.

8.1.3 All or Nothing Acceptance

Another known limitation was the requirement for operators to accept or reject whole declarations. As such if a single 4MW bid were available, and the requirements were only for 1MW, he full 4MW would have to be accepted. This has costs impacts as well as potential environmental issues and could even have perverse effects of future meritocracies. Again this limitation was added to limit the permutations possible and make things simpler for participants. This allowed for simple binary communications of acceptance. In future it might be possible to allow more flexible acceptance, however

this must be done within constraints of participant operation as certain sites may operate in an all or nothing manner.

8.1.4 Weekday Operations

Within the project services were limited to weekday operations. This coincided with the expected times of requirements as well as reducing operational burden for all parties by avoiding weekends. Weekend running could be added, however impacts on baselines and the fixed volume declarations should be considered.

8.1.5 Fixed Pricing

One of the most visible limitations of the service was the fixed prices utilised. However these were also one of the best received. Fixed pricing limits price competition and mean that the services could be provided at a lower cost. However the simplicity afforded by the pricing strategy was very well received by participants as it simplified participation, removing the burden of price setting. As DNO markets develop and become more liquid, it may become appropriate to add price competition into the services, however this should focus on the simplicity of price setting and encourage participants to enter true marginal running costs (potentially with a pay as clear auction).

8.1.6 Meritocracy

Within the project, no dispatch meritocracy was utilised. This was done to increase the volume of calls, simplify the customer proposition and help understand participant reliability. Due to this design the capability to disaggregate acceptance and dispatch was not added to the system build scope. As the services transition to BaU a meritocracy will need to be established to ensure the correct participants are dispatched in the correct order. This should aim to minimise the costs of running the service, whilst also encouraging reliability and network redundancy. The addition of variable pricing could also facilitate this meritocracy

8.1.7 Limited New Participants

With the project review, it was acknowledged that potential to bring in new participants to flexibility markets was limited. Due to value proposition, participation in the Flexible Power services in isolation has limited commercial viability. As such participants would need to find additional revenue sources to make business cases work. Due to the relative sizes of the value propositions the DNO service does not provide sufficient incentive to begin participating.

8.1.8 Limited DNO Value

The Flexible Power proposition was created to reflect as accurately as possible the value and certainty to be expected from DNO led DSR services. These requirements are limited to relatively short durations in the year and are potentially time bound. As such, whilst the per unit value of a DNO service may be high, the yearly potential income is relatively low compared to other services.

8.1.9 Geographic Limitations

The Flexible Power services were limited to a 14 zones in the Midlands. This was done to manage the scale of the trial and the resource required. Whilst this had little impact or regionally based companies, this limited the value to nationally based companies who could not reflect the same services across all sites. This aspect of the trial does however reflect the expected future world where only parts of the DNO networks have requirements for flexibility services at any one point in time.

8.1.10 Forecasting and Optimisation

The provision of forecasting and service optimisation was not directly provided within the project as this was the focus of the EFFS project. The focus on the Entire was on how procure services rather than the development of processes to determine what to procure. As such for the trials requirements were developed to help prove operation reliability, mimicking expected requirements rather than from a full forecasting system. In addition no optimisation was carried out. As mentioned previously all participants were dispatched identically to avoid the requirement for optimisation. The topic of optimisation is large and learning from project Entire has fed into the EFFS project and wider adoption of optimisation as part of BaU.

8.1.11 Limited Network Management System (NMS) Link

The link between Collar and the NMS is limited, allowing for the simple transmission of a start and stop signal between the two. In future, more information will need to be transmitted between the systems. This could include the volume of DSR being provided and future availability. However this must build on the learning generated on the reliability of metering data provided as well as the cyber security implications of increased linkages.

8.1.12 Admin Functions

The addition of new participants to Collar and the assessment of data provision were conducted exclusively by Kiwi Power as part of the trial. This limited the development work required for the limited volumes within the trial. This also allowed for fluidity in the process as it was being tested. Going forward additional functions will be needed to manage new participant additions to the portal, as well as the monitoring and troubleshooting of the API.

8.1.1 Limited Volume

The small operational trial participant numbers limited the conclusions that can be drawn from the operational trial data due to the sample size.

8.1.2 Limited Monitoring

The use of existing network monitoring points limited the impact that could be detected on the network. However this level of monitoring is representative of the network

8.2 Learning Generated

Understandably, with such a diverse project with a wide scope, there were many different aspects to the learning that was acquired.

8.2.1 Clarification on DNO Role in Flexibility Services

The project review highlighted a clear direction from the regulator on the role of a DNO in the provision of flexibility services. This was to avoid involvement in any potentially competitive processes and to focus on the procurement of services to help manage the distribution network.

8.2.2 Information

Understandably, good information is vital in services such as those described in this document. Key feedback included the value of improving the information available on when calls may happen. As such a great deal of work had taken place in parallel with this trial improving the quality of data and understanding new ways to use it to better understand how the network is operating and identifying limits. This is not isolated within the scope of Entire, and new projects are commencing to improve the way in which DNOs can forecast the demand on the network, rather than just managing the infrastructure through which it flows. With good forecasting data it will then be possible to use this in optimisation tools that will help advise all sorts of operational and investment decisions.

8.2.3 Contract Improvements

Several comments and suggestions were made on the contract and how it could be improved. This included the removal of several references to non-essential policies (such a reference to a legal policy). In addition, several other improvements were identified such as the removal of the contract as the documents for the declaration of new sites. The customer portal was identified and the better means of communicating this information.

8.2.4 Pricing Structure

The payment principals were generally well received by those who have offered feedback on the Flexible Power service. Any concerns expressed have related to the perceived ‘fixed price’ and concern it doesn’t create a market. However other feedback has also identified this very same aspect as a positive. This is because there is generally an immoderate quantity of administration required to undertake to win a contract, often with diminishing profits due to competition. Knowing in advance what they would be likely to receive for some is very appealing. This will continue to evolve as the service grows and could result in competitive auctions taking place where there is more capacity being offered than is required for a CMZ.

8.2.5 Market Compatibility

One of the overriding objectives of the trial was to ensure that the services in development would be compatible with the current market and structured in a manner that would allow it to be adaptable within the developing market conditions to remain that way. For this reason there was a focus on:

- contracting non-exclusively,
- developing stackable service propositions,

- endeavouring to develop ubiquitous services that could be accessed by the majority of potential participants
- understanding and avoiding conflict with existing services

In particular with this last point, it was identified at an early stage that National Grid had specific times each week which required their participants to submit declarations by. For STOR this was on a Friday and Frequency services were Thursday afternoon. This effectively determined the midnight Wednesday midnight cut-off for our automated declarations process and that we would release capacity that wasn't accepted, back to participants enabling them to try again with National Grid.

8.2.6 New Use-Cases

The Flexible Power services were created with specific use cases in mind. There are however further potential use cases have been identified as the project progressed. These include the utilisation of the Dynamic service to manage use cases with pre-fault intervention. This could sit alongside Secure services but be called at a later point to reduce cost exposure. A Demand Turn Up service could also be developed.

8.2.7 Complexities of Non-Standard Customers.

In spite of all the efforts made in the design and development of a service that would encourage participation from all interested parties, even within the limited geographies of the trial we encountered anomalies. In particular, there were sites which due to complexities in how they currently operate that prevented us from being able to enrol them at this time. The first was due to a complex configuration of multiple feeders onto a large estate that could not resolve a metering arrangement that could work with the programme. The other had existing running regimes that conflicted with our baseline methodology and therefore inoculated them from being able to offer capacity at other times. These examples highlight the diversity of potential participants and the likely need to develop variations on the current service and associated systems to increase the opportunities for inclusion.

8.2.8 Service Development – Change Control

As the service develops it is vital for a change management and document control process to sit behind this. With so much published information in relation to the services, assistance notes and contracts it is vital that all service developments are tested against a process that assesses their wider impact. Flexible Power has a publicly available library contained within the Flexible Power web site, and the documents contained within this are subject to the change control process, therefore we recommend that participants did not download and rely upon local document records and rely upon obtaining them from the library in order to ensure that they always work with the most recent version. This was particularly true of the contract which has been subject to several revisions already to reflect some of the operational enhancements that have been introduced.

8.2.9 Positive Feedback on Service Design

Through the initial engagement and throughout the project, feedback was generally positive on the design of the services and their user friendliness.

8.2.10 Value of Further Simplification

Despite all efforts to simplify the processes and documents, significant effort was spent clarifying the content to potential participants. As such there is value if further simplifying the process where possible. Key areas of focus could include the sign up forms, the contract and the communication of the process as a whole.

8.2.11 Requirements for Deadlines

In order to be as accommodating as possible of potential participants only a limited number of recruitment deadlines were set within the project. Where deadlines were set, a flurry of activity was seen close to the date. Where no deadlines were set many processes were delayed or deprioritised by participants.

8.2.12 Challenges of Aligning Service Provider and Asset Owner

Several challenges were observed the project trying to align the requirements, information and contracts between the various parties involved. Whilst not the responsibility of the DNO, the management of such interactions can have large impacts on the delivery of flexibility.

8.2.13 Differences Compared to Existing Market Services

Despite the attempts to design simple and accessible services, the difference between DNO requirements and those of the rest of the market proved a larger barrier than expected. Whether it be the specific geographic requirement of the DNO service, of the relative openness in terms of potential declarations, these differences took more time and resource to explain than expected.

8.2.14 Challenge of Lead Conversion

A key piece of learning was of the significant resource and time required to convert interest in the service into a formal response. Even response to the relatively light EoI process proved challenging. Bring customers all the way to being operational was even more challenging. Aligning the three requirements of a signed contract, a build API and full details on the assets proved very challenging. This is highlighted by the fact that six contracts were signed but only two organisations went live.

8.2.15 Busy Market Place

Throughout the project participants expressed the limitation of their available resource. This was due primarily to the business of the flexibility market. Over the duration of the project the following market changes took place: Embedded benefit review, launch of National Grid's System Needs and Product Strategy (alongside associated product changes), launch of Targeted Charging Review and Significant Code Review, widening of Balancing Mechanism to accommodate project Terre, suspension of the Capacity market. In addition a number of acquisitions took place for a number of aggregators. All this created a significant burden of industry participants limiting available resource for trials.

8.2.16 Trial Fatigue

A key limitation to customer sign up was expressed as trial fatigue. There have been a number of DNO led flexibility trials, most with limited or no route to BaU roll out. This has dented participant confidence in the value participation in such trials. Even where a trial will be cost neutral or even slightly positive over its short duration, there is limited appetite in using scarce resource to participate in a trial.

8.2.17 Remote Terminal Unit (RTU) Output Voltage

During the initial installation it was highlighted that the standard RTU outputted voltages at -54V DC rather than the +48V expected by Kiwi. As such additional optocouplers (to convert from -54V DC to volt free) were installed to allow the signals pushed by the RTU to be accepted.

8.2.18 API

The API was implemented as a new technology for which there were no prior examples within the industry to base this upon. It therefore required to be simple set up and secure enough to address any cyber security concerns with participants. This was initially met with some concern by participants due to lack of experience in setting up but with access to the User Acceptance Testing (UAT) environment to develop and test they all succeeded within a reasonable timescale.

8.2.19 Cloud Computing

The use of a cloud computing approach enabled the low cost development of system that would not require any proprietary hardware to operate the service. The control console only required to be a web connected PC and participants would only require a minimum of a web connected PC to administer as well as some form of web connected device to send and receive asset signals. The system was developed and deployed in just over a year and can be further enhanced and developed centrally, with no specific need for hardware changes to any of its users.

8.2.20 Software Change Control

Change control affected the way that we deploy new software enhancements. In addition to the Production and UAT environments which participants have access to there is a third which is only accessible internally and used for system development. This environment is called DEV. Initially we would migrate the entire DEV software version to UAT then PROD whenever a new feature was to be released. This unfortunately meant that there were a couple of minor incidents where there were conflicts between completed features and those still in development, restricting the ability to move new features across. The developers therefore introduced a system where each feature was given its own toggle switch that could enable and disable it, and ensured that we didn't have to wait for all features under development to be completed before migration.

8.2.21 Document Management

The systems capabilities require to be supported closely in conjunction with documentation. The document library contains several guides for the many aspects of

the service but amongst these is the contract, which due to the performance based service, requires to encompass many variables. Keeping the documentation updated with the service developments is vital. Change management procedures are therefore vital and the web site is used to make the most current versions publicly available.

8.2.22 Baseline Limitations and Distortion

The principle that has been developed for the baseline was originally based on a concept where it may have to be done manually. For this reason, it involved the capture of data for the first 3 weeks of the month, still allowing sufficient time to analyse and publish revised baselines prior to the start of the following month. During the trial it was demonstrated that we can automate this process within the system and therefore we don't require to limit the data collection to the unusual arrangement of just the 3 weeks.

The time of day from which the readings were utilised was intended to reflect the periods of highest expected consumption, which was assumed would reflect the times when flexibility would be most frequently required. It was also expected that this would in turn coincide with the periods during which participants would potentially have the highest baseline and therefore at its most generous in terms of potential earnings. While this is to a large extent true of the majority of sites, we did encounter examples where this was not applicable and actually limited some potential participants from offering capacity at any time. This was generally the case in scenarios where a participant reduced demand and increased generation to avoid demand or sell generation during Distribution Use of System (DUoS) red periods and peak charging tariffs for electricity.

Also the inclusion of periods where generators are providing flexibility services in the current baselining calculations can distort the baseline, causing increases over time. This can lead to loss of income for the generator and would seem likely to discourage the long term participation of generators in a DNO flexibility marketplace.

8.2.23 Need for Over-Procurement

An expected learning point, but definitely affirmed by the trial is that to provide a reasonable guarantee of the requested level of delivery, a greater quantity of flexibility services must be procured. The level of over-procurement deemed necessary will depend on the risk appetite of the DNO, and will depend on the criticality of the asset.

8.2.24 Need for Contingencies

This trial saw that in 12% of events participants did not respond. This reinforces that a pragmatic approach must be taken when procuring flexibility services to manage this risk.

8.2.25 Automated Issue Identification

Some events in this trial were not successes due to participants not being aware of changes in baseline, or potentially that they were underperforming. Developing systems to clearly identify changes in baseline, output, and other potential issues would help

participants fulfil their obligations and engage in the process, and the DNO identify issues more proactively.

8.3 Potential for Development

Within the trial several areas for future development were identified. These are a mix of improvements to allow processes to scale up, as well as new requirements identified from project learning.

8.3.1 Managing Relationships

The conventional role of the DNO can broadly be described as that of an asset owner and manager. In this respect there is limited direct contact between a DNO and its customers unless there is a fault, a new connection or maintenance taking place in their area. With the introduction of the new service propositions it is necessary for new roles to be created within the DNO to manage such relationships and offer a point of contact where related communications can be addressed. Even with as much automations and self-service principles developed to minimise the burden on the current business, with new activities there is a need to introduce new skills to support them. As part of the decision to further invest in the Flexible Power proposition and introduce it to BaU a full time role was created to oversee operations and publicly represent the service.

8.3.2 Signposting

Throughout the trial, Flexible Power representatives were in regular contact with participants and through this gained valuable feedback that has led to developing greatly increased intelligence to be published. It has become increasingly apparent that the more detail that can be provided to participants of when they might be required, they will make extended efforts to be available to provide capacity. As such, analytical capabilities have been developed alongside improved communications capability to regularly publish signposting notices. These cover multiple time horizons ranging from future tendering requirement through to forecasts of specific days when services will be desirable.

8.3.3 Enhanced Procurement Information

Alongside the development of the signposting information, further information on the expected call times and ultimately value available to participants as part of the service would be greatly valued by potential participants. Such tools have been developed as part on the roll out of BaU zones

8.3.4 Variable Pricing

The current pricing is determined upon savings that can be achieved, largely through delaying the costs of expensive capital upgrades. This ultimately means there is a cost threshold above which capital upgrades become more economically attractive. Therefore there is a ceiling for the price that a DNO should pay to contract flexibility and that is the starting price that can be offered to the market as a published price. This is then effective up until a point where a DNO has a liquid market and is offered a greater capacity than it requires. In such circumstances, participants are required to submit a bid with their tender to provide lower price at which they would still be willing to

contract. An auction would then be processed with all successful contracts being awarded at the highest clearing price.

8.3.5 Wider Industry Sharing

As the dialogue within the industry has increased and gained momentum it has become apparent that the work being carried out has a very direct relevance to other DNOs and a great deal of learning has already been shared both directly and via the Open Networks project. With all DNOs faced with the challenge of developing their own flexibility programmes there is a clear opportunity to extend the sharing beyond the knowledge and gain greater value from Project Entire by facilitating access for other DNOs to the developed technology. Collaboration meetings have been arranged with all DNOs to demonstrate the capabilities and open Flexible Power for use by any who wish to adopt it. By sharing the ownership of the complete service, including technical systems Flexible Power can reduce overall costs of operating flexibility for the industry and therefore cost to customers.

8.3.6 Faster Dispatch

For simplicity the trial operated all the services with a 15-minute dispatch notice, but in the case of Restore it would be beneficial if this could be delivers quicker. It is therefore updated post-trial to dispatch participants instantly with a link directly from the DNO control room main systems. Payments to participant then commence from the next full minute, rather than having to ramp up and wait before starting to receive payment, bringing increased benefits to both parties.

8.3.7 Weekend Operation

Within the trial the service was restricted to week days only to ensure that any commercial participants were not excluded as they wouldn't be able operate at the weekend. This would become a restriction going forward as fault conditions and maintenance work for which DSR could be used is not restricted and can occur over periods including weekends. The BaU services have therefore been revised to include the ability to operate the service at weekends. This presented the potential complication of many organisations having reduced operations at weekends, inviting a different baseline to be used. While this has been recognised, it does not require an immediate modification and could be impacted by other potential enhancements. For these reasons it will remain under observation.

8.3.8 Wider Market Integration

Flexible Power has been very specifically designed as a tool set for the management of new relationships and encompassing many of the functionality challenges of supporting such services. There can only be a single system in the control room to operate the functional aspects but it is also recognised that with a growing number of opportunities within an increasingly distributed energy market, there may be other developments with which Flexible Power will require to interact. Currently the services are based upon commercial providers on a week-ahead basis but Flexible Power has been designed with a view to enabling further development which may include domestic flexibility or integration with wider flexibility platforms.

8.3.9 Commitment to Flexibility

To combat trial fatigue, a waterfall approach to the roll out of the learning from the project was implemented. As such new zones were rolled during the project, building on an improved process developed as part of the project. 18 new zones we launched in June 2018. The expression of interest generated over 260MW of response over 87 sites.

WPD has also committed to the assessment of flexibility services against 90% of Load Related Reinforcement as part of the DSO forward plan.
Another round of procurement was launched in February 2019 with an additional 12 zones put to the market. The intention is to open new zones to the market on a bi-annual basis.

8.3.10 Enhanced Account Management Systems

Several system issues such as missing metering data were only identified accidentally, or by participants. Proactive highlighting of such issues would allow for more active account management to limit both the technical and reputational risks associated.

8.3.11 Customer Relationship Management (CRM)

A key element for further development is the use of a more developed CRM tool. This would increase the ability to track participants through the process and allow for more complex recruitment analysis. As part of the transition to BaU, a new CRM tool has been scoped.

8.3.12 Pricing and Volume Flexibility

As the service develops, the ability for participants to be more flexible in the provision of volume and price over the week may provide additional interest to providers with less predictable outputs.

8.3.13 Procurement Compliance as Volume Increases

As the volumes of flexibility procured by DNOs increases, the thresholds for enhanced requirements under the Utilities Contract Regulations increase. As such adaption of the Flexible Power Process to accommodate these regulations will be required. Ahead of the second round of BaU zones the compliance was addressed with the establishment of a dynamic purchasing system.

8.3.14 Disaggregation

Current systems accept all or no volume of a period of time in a trial zone. To move to BaU the systems will need to be improved to allow for the dispatch of individual providers within a zone.

8.3.15 Optimisation

Related to the disaggregation, it will be likely that the control room operators will require some assistance at making decisions on how best to construct the best configuration of participant capacity in order to get the best results. This may be optimised using various criteria such as reliability, fairness of value allocation or lowest cost. While it is not anticipated that this functionality will be developed within Flexible

Power Systems, it will be necessary to integrate with external resources to allow them to carry this out. This is being investigated as part of the EFFS project.

8.3.16 Variable Pricing

The current pricing is determined upon savings that can be achieved, largely through delaying the costs of expensive capital upgrades. This ultimately means there is a cost threshold above which capital upgrades become more economically attractive. Therefore there is a ceiling for the price that a DNO should pay to contract flexibility and that is the starting price that can be offered to the market as a published price. This is then effective up until a point where a DNO has a liquid market and is offered a greater capacity than it requires. In such circumstances, participants are required to submit a bid with their tender to provide lower price at which they would still be willing to contract. An auction would then be processed with all successful contracts being awarded at the highest clearing price. The systems will need to allow for pricing to be allocated on a zone by zone basis, and reflect this in the back office settlements as and additional variable. This is in effect and extension of the disaggregation development work.

8.3.17 Future Architecture

With these services having been developed on a Cloud Computing principle it brings many benefits including scalability and addressing the communications between participants and central control it does also establish new challenges. The architecture therefore has to be considered in conjunction with wider policies for system design and operations. This is particularly true should the link between Collar and the NMS by strengthened. This architecture must balance the ease and simplicity of communication provided by the wider cloud based APIs, versus the increase security risk.

8.3.18 Wider Market Integration

Flexible Power has been very specifically designed as a tool set for the management of new relationships and encompassing many of the functionality challenges of supporting such services. There can only be a single system in the control room to operate the functional aspects but it is also recognised that with a growing number of opportunities within an increasingly distributed energy market, there may be other developments with which Flexible Power will require to interact. Currently the services are based upon commercial providers on a week-ahead basis but Flexible Power has been designed with a view to enabling further development which may include domestic flexibility or integration with wider flexibility platforms.

8.3.19 More Volume

Due to the limited scale of the trial achieved, the validity of conclusions is limited and going forward with the roll out of flexibility services further analysis will be needed to confirm or revise these assumptions. Greater volumes of procurement and dispatch will add to the learning started here to determine the normal reliability and service a DNO can expect when procuring flexibility services.

8.3.20 More in Depth Examination of Technology Types and Other Risk Factors

While it is preferable to keep flexibility service procurement as technologically agnostic as possible to help create a fluid and open marketplace, analysis needs to be done to assess the risk factors involved in different technologies, and greater or lesser diversity of supply.

8.3.21 Standard Flexibility Risk Management Methodology

For the full scale successful role out of flexibility services it seems necessary for the development of a standard risk management methodology to be developed across the industry, as the ER-P2 documents provide an industry wide standard assessment of risk for the planning of the physical network.

8.3.22 Common Metering Requirement

To simplify the metering requirements, and limit costs to service providers, a common industry approach to the metering of flexibility services would provide significant benefit.

9 Dissemination

The knowledge generated as part of the project has been disseminated to the industry throughout the project. This included:

- Presentations at LCNI conference in 2016, 2017 and 2018;
- Presentations at Balancing act conferences in May 2017 and June 2018;
- Presentations at the Energyst DSR event 2017 & 2018;
- Input into ENA Open networks project, including but not limited to Workstream 1 Product 2;
- Presentations at customer panels in June 2017 and December 2018;
- Input into Power responsive via steering group as well as specific events such as annual conferences and a workshop for local authorities;
- Presentations at various community energy workshops; and
- Final closedown webinar.

10 The Outcomes of the Project

10.1 Service Design

In general the design of the services was received with positive feedback. Participants were particularly pleased with the simplicity provided by the simple pricing strategy. Minor changes were made to the process including bringing forward the weekly process by a few hours to provided stackable services across a wider pool of services (helping participant's access frequency response markets).

Key future developments were also identified such as the production of better information on how much services would be called allowing participants to estimate a clear £/kW/year value for participation.

10.2 Systems

The systems developed were also well received, by both participants, but also other industry professionals such as the other DNOs. The simplicity of interface and set up were praised as well as the integrated approach taken from dispatch to settlement. The systems will be further developed as additional functionality and scale are added to DNO services.

10.3 Recruitment

The trial highlighted high interest in the services and positive feedback for the processes. As such these have been taken forward and will be refined as operational experience is gathered. WPD has also committed to the roll out of flexibility to increase participant confidence in the value of the service. Once initial participation has been established it is anticipated that scaling up will require minimal effort from participants.

10.4 Operational Trials

Due to the limited participation in the trial, the data does not provide a significant sample size. The high-level results of the operational trials show a wide range of responses from no response at all to significant over delivery. Most events however clustered around full delivery of volume. The trials also highlighted the requirement to review the baseline methodology within the services as well as working towards a common industry standard for flexibility metering.

10.5 Overall Outcomes

The project has significantly brought forward the ability of DNO's to procure flexibility services. By establishing processes and systems DNO's now have a much better understanding what can work for both the DNO and participant. This has fed extensively into wider industry processes. Whilst operational experience may be limited, it is expected this will increase over time.

11 Data Access Details

Anonymised operational dispatch 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

The following IPR has been developed during the project:

- Flexible Power Branding and logos;
- Customer proposition;
- Customer Journey;
- Generator identification App;
- ASC reports;
- Flexible Power marketing documentation;
- Flexible Power customer processes;
- Flexible Power customer contract;
- CMZ product designs; and
- API definition.

This IPR is being shared with other network licensees as required.

13 Planned Implementation

A waterfall approach to the roll out of the learning from the project was implemented. As such new zones were rolled during the project, building on an improved process developed as part of the project. 18 new zones we launched in June 2018. The expression of interest generated over 260MW of response over 87 sites. The volumes are highlighted in the tables below.

	Total	Compliant	Potential	Non-compliant	Out of zone
Sites	87	67	6	6	8
MW	261.4	166.9	2.3	5.9	86.3

Table 3: EoI Responses

	Total	Compliant and potential
Generation sites	19	12
Demand reduction sites	64	58
Storage sites	4	3
Generation MW	203.8	132.5
Demand reduction MW	10.7	10.3
Storage MW	46.9	26.5

Table 4: EoI Response Breakdown

Following this stage 16 zones were taken forward for full procurement.

WPD has since committed to the assessment of flexibility services against 90% of Load Related Reinforcement as part of the DSO forward plan.

Another round of procurement was launched in February 2019 with an additional 12 zones put to the market. The intention is to open new zones to the market on a bi-annual basis.

Some recommendations from the project have already been implemented as part of the BaU roll out such as the provision of improved information on the potential volumes available and the likelihood of call for each of the zones. Improvements have also been made to documentation and processes simplified.

Significant interest has also been shown from other DNOs in the processes and learning developed as part of the project. This has fed directly into industry processes such as Product 2 of Workstream 1 of the Energy Networks Association's Open Networks project. Discussions have also been had directly with DNOs on the use of various elements of the project from the systems developed to the Flexible Power branding.

14 Contact

Further details on replicating the project can be made available from the following points of contact:

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