WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

VISIBILITY PLUGS AND SOCKET
PHASE 1 – INTERIM LEARNING REPORT

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1 Glossary

Abbreviation	Term
API	Application Programming Interface
BSP	Bulk Supply Point
CLEM	Cornwall Local Energy Market
CMZ	Constraint Managed Zone
DNO	Distribution Network Operator
DSO	Distribution System Operator
EFFS	Electricity Flexibility and Forecasting Systems (an NIC funded innovation project)
ENTIRE	An NIA funded innovation project focussing on providing flexibility services in the East Midlands.
ESO	Electricity System Operator
GDPR	General Data Protection Regulations
IPR	Intellectual Property Rights
MPAN	Meter Point Administration Number – a unique identifier for a customer's meter point.
MVA	Mega Volt-Amps a measure of power capacity
MWh	Mega Watt hours – a measure of power over a period of time i.e. the cumulative energy associated with a service.
Quote and Tender	The purchasing method used in Phase 1 where a bid is notified to the system to which providers respond with offers.
Spot Market	The purchasing method used in Phase 2 where services are purchased via regular auctions.
VPaS	Visibility Plugs and Socket
WPD	Western Power Distribution

1.1 Purpose of this document.

The Visibility Plugs and Socket project has two trial phases. This document is intended to share the learning from the first trial phase only as an interim update. The final report will include the learning from both trial phases and a comparison between the phases.

2 Executive Summary

The Visibility Plugs and Socket (VPaS) project aims to explore how Distribution System Operators (DSOs) could purchase flexibility services using a third party market platform. This project operates in tandem with Centrica's European Regional Development Funded Cornwall Local Energy Market (CLEM) project, which has a wider scope, including increasing the capacity of installed renewables.

Third party market platforms are of interest due to their potential to provide a cost effective means for DSOs to purchase flexibility services. Flexibility providers may prefer them due to their strong local brand or because they provide access to additional opportunities, such as energy trading. A local trading platform would be able to increase the visibility of these transactions to authorised parties, reducing the risk of conflicts in the use of services between market participants currently unaware of each other's actions.

WPD and Centrica jointly designed two mechanisms for purchasing flexibility services. Phase 1 involved a "Quote and Tender" method similar to that used by our Flexible Power services, first trialled under Project ENTIRE. Phase 2 involves a spot market where both WPD and National Grid Electricity System Operator (ESO) can procure flexibility services concurrently but the market clearance algorithm will perform checks to avoid conflicting use of services.
Phase 1 ran from May to August 2019 and included a series of 13 events at primary substations and bulk supply points. These were published on the flexibility platform to which flexibility suppliers across 12 locations with a combined capacity of approx. 11 MVA were signed up. Three of the 12 sites participated via the aggregator Kiwi Power. Centrica acted as the aggregator for approximately 20 domestic customers with battery installations.

The Centrica project found that customer recruitment is still difficult and time consuming, even with a dedicated local team. This is exacerbated by Cornwall having a relatively low proportion of industrial and commercial customers that would be able to provide services. Relating customers to the network using postcodes was not effective and even a Meter Point Administration Number (MPAN) based approach had limitations with abnormal network arrangements occurring throughout the trial period changing the actual point of impact of services from that intended. The prices offered were generally in line with the prices currently offered for WPD's Flexible Power services. It may be that service providers consider these prices to be standard or that there were not enough participants to reduce prices as might be expected in a liquid market.

Service delivery was validated by Centrica using half hourly meter readings rather than one minute resolution metering as was the case for ENTIRE. This may have reduced the accuracy of the delivery calculations but lowered barriers to entry. Services were delivered as required for 8 out of 13 planned events with 60% of the expected MWh being delivered on average.

From a buyer's perspective, while the web platform design could be improved, it functioned correctly and quickly became easy to use. The process to validate delivery and raise invoices was developed and used to authorise payments.

Phase 2, using the spot market for purchasing services, began in August 2019 and will run to December 2019. The learning from this second phase will be reported in the project's closedown report in April 2020.

3 Project Background.

The Visibility Plugs and Socket (VPaS) project was instigated in response to the issue identified by the Smart Grid Forum Workstream 6, which was the necessity for market participants and network operators to have visibility of each other's proposed flexibility actions and requirements. Visibility was expected to become an increasingly important issue as Distribution Network Operators (DNOs) transitioned to DSOs. Work on this project began before the instigation of the Open Networks project which has a number of overlapping areas of interest.

The project was designed to work in parallel with Centrica's CLEM project which had a wide range of objectives including increasing the capacity of installed renewables. As part of the CLEM, Centrica envisioned a market platform that could bring together flexibility service purchasers and providers. This would share relevant data within the system about flexibility service requests and purchases to improve co-ordination between the various parties. The ambition for Centrica's market platform was wider than just supporting flexibility services. As the name suggests, it was intended that it would support local energy trading, peer-to-peer trading and any other related service that could help attract the largest number of participants and therefore keep any charges to cover platform operating costs down.

An early system concept diagram is given below in Figure 1 below. This shows how a common Energy Service Bus would provide the "socket" to which many specialist "plugs" could connect e.g. a plug for DNOs, another for the ESO etc.

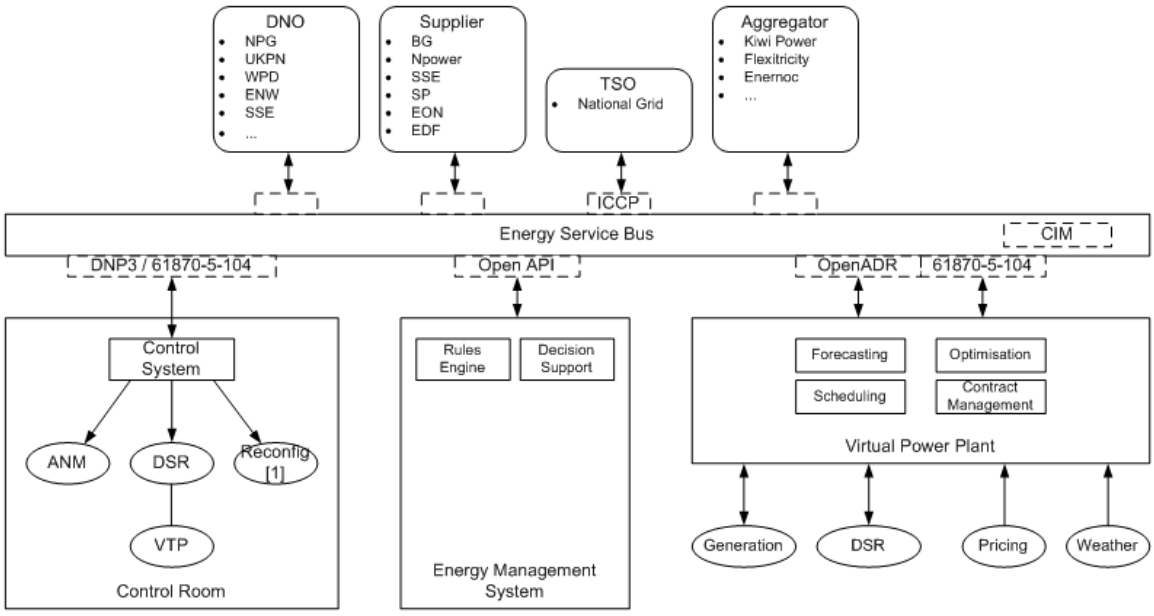


Figure 1 – CLEM system concept diagram

The CLEM and VPaS projects have been working together in parallel but the separate

projects have separate funding streams and Intellectual Property Rights (IPR) arrangements. Centrica have been responsible for recruiting flexibility service providers and developing the market platform whereas WPD have provided supporting data and explored the options for optimisation. Work to define the two purchasing methods to be trialled and their market rules has been carried out jointly. WPD 's involvement with CLEM will extend beyond the VPaS project with the Network Innovation Competition (NIC) project Electricity Flexibility and Forecasting Systems (EFFS) also expecting to use CLEM during trials.

3.1 Trial Background

VPaS has two trial phases with each phase focussing on one of methods by which flexibility services are procured. The key features of the trial phases are given below in Table 1.

Feature	Phase 1	Phase 2
Purchasing method	Quote and Tender	Spot Market
Trial duration	May 2019 to August 2019	August 2019 to December 2019
Conflict resolution	None	Included in the market clearing algorithm and Transmission/Distribution coordination is also supported via the services dashboard providing visibility of services purchased by each party.
National Grid participation	No	Yes

Table 1 Key feature comparison for VPaS Trials

The original plan was for there to be at least 6 months' separation between the end of the first phase of the trials and the start of the second phase allowing for learning from the first phase to be incorporated in the second phase.
Project timescales subsequently changed as a result of two main factors.

1. Delays in customer recruitment
2. A major reorganisation within Centrica which resulted in changes to key project staff

This resulted in significant delays to the first trial phase. However, as the second market mechanism has turned out to be very distinct from the quote and tender method, it also seems less likely that learning from the first phase will significantly reshape the second phase of the trials. Therefore the project end date has not been extended but rather the trials have been re-planned to run in quick succession.

3.2 Event Profiles.

Event profiles were derived by creating average profiles for high load days for Truro Shortlanesend primary and Truro Bulk Supply Point (BSP) transformers. The thresholds were set to ensure that the load reductions reflected the expected scale and duration of services. E.g. longer than an hour but under four hours. The shape and duration of the load reduction was then used for other primaries and BSPs and scaled accordingly.

This resulted in service requirement profiles that varied over time. i.e. the requirement for one half hour would be different to the requirement for the next half hour. This presents a potential conflict with the way in which service providers are expected to prefer to operate i.e. to deliver services that are constant over time. Phase 2 supports service delivery with constant volumes.

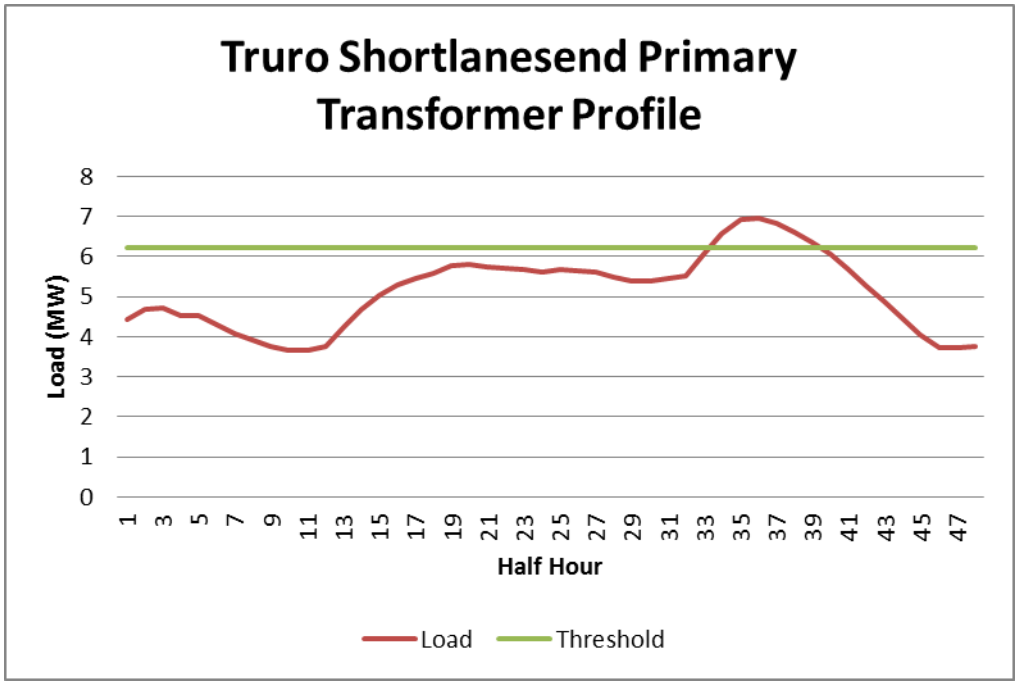


Figure 1 - Primary Transformer Profile

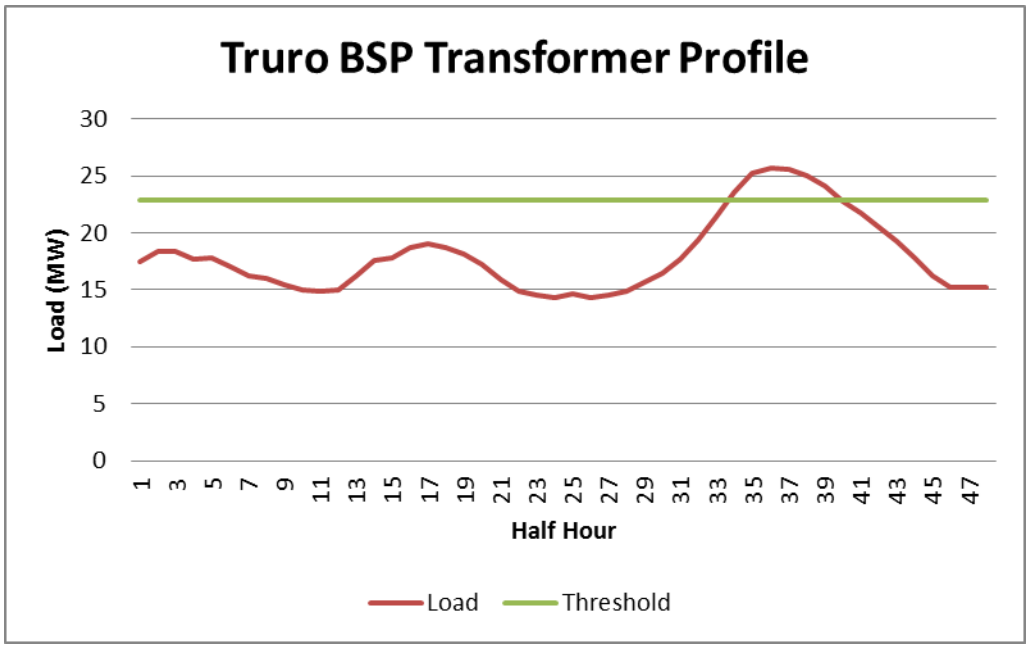


Figure 2 - BSP Transformer Profile

3.3 The Quote and Tender Purchasing Method.

This method was designed to enable the DNO to publish requirements in the form of a bid.

Phase 1 trial operates as follows.

1. The purchaser of flexibility services indicates their requirements for flexibility services by creating a bid or service request.
2. The flexibility providers have a period of time to provide offers in response to the bid. This varied between one and two weeks.
3. At the end of the time period, the flexibility purchaser has the option download the set of bids as a csv file and upload this data into a separate optimisation tool.
4. The flexibility purchaser then selects the optimal selection of offers on the system as indicated by the optimisation tool to create contracts for service delivery
5. The service provider is responsible for delivering the service as required. The DNO is not responsible for providing a control signal to initiate response.
6. Validation of service delivery is carried out by the platform operator on behalf of the service purchaser.
7. A process to produce, validate and authorise invoices allows the buyer to make a single monthly payment to the platform operator, who then makes payments to the service providers. This process is given in more detail in Appendix 1 – Post event validation and invoicing.

Contract terms were based on those used for Project ENTIRE but adjusted to reflect the use of the third party platform provider. A sample contract is given in Appendix 3 Sample contract.

4 Pre-Trial Learning

4.1 Platform Development

The platform went through several iterations including not simply changes to the user interface but a change to the underlying technology and programming language used to generate the web pages and manage the data. This was prompted by the difficulty in recruiting resources to support the original development language. Developing a user-friendly interface was made harder by the lack of clarity on how users would use the system in practice. Rather than automating an existing business process carried out by existing staff, the system has been designed around assumed use by assumed users. This made it hard to validate the best way of displaying the information and the most natural way to navigate between screens. The output from the Open Networks project is expected to help standardise terminology used for flexibility services and similarly the learning from the EFFS, FUSION and TRANSITION projects is likely to result in recommendations for the way in which flexibility services are managed which may help standardisation. Ultimately, as the use of flexibility services increases, we are expecting to interact with market platforms via Application Programming Interfaces (APIs) to remove the time taken by staff inputting data manually. At that stage the screen layouts would become less important. Some example

screens are given to show the look and feel of the phase 1 platform in Appendix 2 – Phase 1 Platform sample screens.

4.2 Market Design.

The terminology of bids and offers was adopted to allow for consistency with the Phase 2 market, but was actually very confusing to use. The term "service request", for example seems a more natural term for the requirements specified by the DNO.

The original aim of this purchasing method was to build on the work of Project ENTIRE but to introduce the opportunity for more flexibility in the process timescales and pricing. So while ENTIRE had fixed prices for Arming and Utilisation we wanted to provide the opportunity for providers to compete on price and suggest their own prices. Similarly, while Project ENTIRE was based on fixed timescales by which availability would be notified and their use confirmed, it was hoped to see whether it was possible to customise these timescales. However as the project progressed it became clear that having so many variables would be counterproductive and make it harder to manage flexibility services.

4.3 Customer Recruitment

Customer recruitment was carried out by Centrica from their project office in Truro. The customers recruited to provide flexible resources for the VPaS trials overlap to a certain degree with those participating in the wider CLEM project. Recruitment involved a media campaign and presentations at live events where potential participants could ask questions directly to the project team.

The Centrica vision for the market platform was that it provided multiple services and became a natural choice for customers due to the convenience and strong brand. However, in a trial that only involved a limited number of events for a single service, the attractiveness for the customer is significantly lower. The schedule of events planned by WPD was streamlined to ensure that the payments to customers were justifiable, but keeping these costs low inevitably made it harder for Centrica to attract customers.
One key issue was how to identify which customers were relevant to the different primaries and bulk supply points so that it would be clear which customers would be eligible to provide services for the various requests.

To avoid General Data Protection Regulation (GDPR) issues, originally partial postcodes were provided for customers served by the various primary substations in Cornwall, however this sometimes failed to provide definitive mappings as the same postcodes were relevant to more than one primary. Centrica's participation agreement included clauses allowing them to share customer MPANs with WPD which made it possible to provide more accurate information about the relationship of the customer to the network.

During the course of the project WPD introduced an online postcode checker on its Flexible Power website that allowed customers to use full postcodes to check their membership of constraint management zones. This was used as an initial filter with additional manual validation taking place for those customers with relevant postcodes. WPD are now looking

to develop this further by adding MPAN level validation which should make it easier for customers to identify themselves with constraint managed zones (CMZ).

5 Participating Customers

Customers that participated included;

- Several clusters of residential customers
- Diesel generation sets at three different locations
- A flow battery
- A gas turbine generator

The recruited capacity at different network locations is given in Table 2 below. The capacity at Bulk Supply Points reflects the capacity at primary substations that are supplied by those bulk supply points and the capacity should not be double counted.

Flexibility Requirement Location	Total Capacity MW
Fraddon BSP	2.441
St. Austell BSP	8.6
St. Tudy BSP	0.062
Truro BSP	0.033
Bodmin Primary	0.01
Bugle Primary	1.6
Devoran Primary	0.015
Drinnick Primary	1.6
Fraddon Primary	0.8
Newquay Trencreek Ln Primary	0.016
Newquay Trevemper Primary	0.011
Par Harbour Primary	7
Penzance Causewayhead Primary *	0.45
St Agnes Primary	0.018
St Columb Major Primary	0.014
Truro Treyew Rd Primary *	2
Wadebridge Primary	0.052

Table 2 - Participating customer capacity

*These sites were unable to provide services for the phase 1 trials as export connection agreements were not in place.
While the flow battery was able to provide services for part of the trials, it later suffered technical difficulties which prevented further participation.

6 Event Schedule and Results

While a schedule of events was agreed in advance, it was necessary to revise the schedule several times during the trial. This was partly because assets that were expected to be able to take part in the trial were unable to secure an export agreement as quickly as they had hoped.
A summary of the final schedule of events is given below in Table 3. Events are deemed to be successful if a flexibility provider responds to the request and delivers a service, even if that service was not fully delivered.

Event	Event Date	Event Location	MWh required	MWh Offered	Price £/MWh	Comment
1	22/05/2019	Wadebridge Primary	0.12	0.04	300	Successful event, A very small requirement was used for the first event to limit the impact on the budget from any technical problems
2	29/05/2019	St Austell BSP	4.30	3.99	305-320	Successful event
3	06/06/2019	Fraddon BSP	2.88	1.34	600	No offers accepted - price unacceptably high
4	14/06/2019	Penzance Causewayhead Primary	0.59			Event did not happen - no export agreement in place
5	17/06/2019	St Austell BSP	5.16			No offers
6	25/06/2019	Fraddon BSP	3.36	2.78	300	Successful event
7	03/07/2019	St Austell BSP	3.44	2.84	300	Successful event
8	11/07/2019	Par Harbour Primary	7.00	6.66	300	Successful event
9	17/07/2019	St Austell	0.02		220	Successful event
10	23/07/2019	St Agnes Primary	0.03			No offers
11	02/08/2019	Wadebridge Primary	0.05	0.047	n/a	Although no contracts were generated via the platform, the residential battery clusters were discharged for events 11 and 12. The MWh Offered here represents the full capacity of the batteries connected at the event locations (The events were set up to target a full discharge of the battery)
12	08/08/2019	Truro BSP	0.03	0.076	n/a	As above
13	12/08/2019	Fraddon BSP	3.36	1.38	300	Successful event

Table 3 - Schedule of events

7 Trial Execution Learning

While the trial learning is discussed more fully in the next section there are some areas of general learning.

7.1 Events Without Offers.

The most unexpected result was that there were many requests that were placed on the system for which no offers were received. This may reflect the relatively low number of service providers which increases the impact of one provider not participating. If there are several potential service providers then if one does not participate their impact may not be noticeable. However, if there is only one service provider at a location their participation or non-participation is critical. This highlighted the difference between the current state of the market and that for which the system is designed i.e. a mature, liquid market. In such a market, buyers would routinely receive a surplus of offers and would be able to draw conclusions as to the impact of location, notice period etc. from the degree to which the service was oversubscribed and the average price. It would be useful for future system development to allow for customers to provide feedback on why they chose not to make an offer as well as providing and offer. E.g. asset unavailable, asset providing a service to another party at that time, service volume / duration too small/ short to be attractive, other markets expected to be more lucrative etc. This would then differentiate between the case where a service provider was unaware that there was a request in their area, or was aware of the request but unable to provide an offer, from those cases where there was a deliberate decision not to respond to the request.

While the platform design included a feature letting users subscribe to notifications affecting a particular area, such as new service requests, this had not been implemented at the time of the trial. Centrica's are working with Exeter University to look into motivators for participating on the CLEM platform as well as barriers preventing participation. Centrica found that the trial, with a limited duration and number of events, offered low financial rewards to potential participants and this was a barrier to uptake. However, for the scenario where the platform was being used to procure a wider range of services on a business-as-usual basis then more customers would participate.

7.2 Complexity vs Simplicity

Originally, the phase 1 system was designed to build on the process developed for Project ENTIRE but to allow additional flexibility which would allow the DSO to adapt the process as time went on. This additional flexibility was reflected in being able to set variable timeframes for publishing requirements, arming and dispatching services. However, in the end this flexibility was not exploited and offers were routinely submitted by the Thursday of the week before service delivery for review and selection by WPD on the Friday of the week before service delivery. While there may still be merit in having more flexible schedules, this may be better managed by flexibility service providers that could devote time and attention to managing their flexibility portfolio, rather than this being an addition to their core business.

7.3 Network Reconfiguration

The project generated additional learning around the impact of abnormal running arrangements. The default network hierarchy, based on normal running arrangements, was provided to Centrica to help associate customers with their relevant primary substation, BSP and GSP. Before the trial it had been assumed that abnormal running arrangements would be infrequent and of short duration and so could be ignored. However, during the trial it emerged that abnormal running arrangements around St Austell BSP had the effect of shifting the point of impact of flexibility services to a different BSP. Thus services procured and delivered in good faith would not have the desired impact.

This suggests that DNOs need to not only publish a default network hierarchy but also to make future network changes available to those who may be affected by them, i.e. aggregators, market platform providers and ESO. While there would be fewer changes for primary and 132kV networks, the number of outages on HV networks is considerably higher suggesting that for both practicality and accuracy, these updates need be generated by the control room system which would hold the details of planned schedules and also the current network connectivity.

Most UK DNOs use PowerOn by GE as their Distribution Management System. The most recent version of this has the ability to export network data in Common Information Model format, however it is not known whether this can export data for both the current state of the network (which will reflect the outages for that moment in time) as well as the default switch positions. There have been developments recently to support features to allow for switching operations to be replayed after the event. However, predicting *future* network states based on anticipated switching is unlikely to be as accurate. This is because as well as the planned outages, there will always be unplanned outages. Unplanned outages will also cause the network to be switched so that it is in a different configuration to the default network state, but the events causing unplanned outages cannot be predicted ahead of time.

As part of the EFFS project, the ability to create future looking versions of the network will be investigated which will help determine whether this is still useful information despite not being able to take unplanned outages into account. The increasingly flexible nature of networks may result in a move away from a default topology to a number of running arrangements that are applied under different conditions. The need to exchange expected changes to network hierarchy, and whether this requires filtering to exclude changes that affect a small number of customers or have a short duration, might best be determined via the Open Networks project which has an industry wide perspective.

8 Trial Learning Objectives and Results

The learning objectives for the phase 1 trial were defined by a set of questions given below.

Learning Objective Questions

- How does flexibility capacity vary by area and voltage?

- Did any customers sign up directly or were they all via an aggregator?
- How do advance procurement timings affect customer participation?
- How do prices bid compare with fixed pricing of Flexible Power?
- How did prices change during the trial as bidders had more information about previous trades and the success/failure of their own bids?
- How well did the optimisation tool operate for the V1 trial?
- How effective were the flex services at impacting the network loading? – i.e. did 100kW reduction by the customer result in a 100kW reduction on the affected network or was this lost in the noise?
- How reliable was service delivery under each market model and how does this compare to ENTIRE?
- Did there appear to be any seasonal variation in reliability or prices?

These questions are addressed in the following sections.

Q1. How does flexibility capacity vary by area and voltage?

Most of the customers that took place in the trial were connected at 11kV with the exception being the domestic customers. Customers were recruited across the Cornwall region which meant that several locations were used for the trial to include as many as possible. Please see Table 2 for the details.

Capacity varies greatly across the primary substations with one large installation having the same capacity as several smaller ones. This variation was compounded by the changes in availability of assets during the trial making it difficult to draw conclusions on how the flexibility capacity in a region could be estimated. This variation in participating assets can be thought of as the combination of two factors;

1) The variation in the available assets that could be used to provide flexibility services, which may reflect the area's mix of domestic, commercial and industrial properties and degree and type of connected distributed generation
2) The variation in the participation rates of customers in the various areas, which may reflect the targeting of recruitment programs, the presence of community energy groups, local green initiatives etc.

It is very hard to determine the first item. While it has been proposed under Open Networks as a key enabler of DSO transition[1], as yet there is no central register of flexibility assets that are providing services currently. This would then need to be expanded to include assets that had potential but were not being used. For example backup generation that does not have the ability to export energy but could still be used to support demand side reduction, building control systems, refrigeration warehouses, water pumping stations etc. Some insight may be gained into latent capacity or the methodology to assess latent capacity from project FUSION by Scottish Power Electricity Networks. One of the early

[1] Open Networks , Workstream 1, Product 8 concerns a system wide resource register.

project deliverables for FUSION is an assessment of the flexibility capacity in the East Fife area and it may be possible to repeat the assessment methodology in other areas. Differences in participation rates were inevitable as Centrica could only include the domestic customers that had batteries and control systems fitted under the wider Cornwall Local Energy Market project. The recruitment events were designed to maximise participation rather than to focus on specific areas.

Q2. Did any customers sign up directly or were they all via an aggregator?

Some customers participated via the aggregator Kiwi power. The domestic customers were aggregated by Centrica. There was one installation that bid without going through an aggregator.

Q3. How do advance procurement timings affect customer participation?

Some events had two weeks' notice rather than one week.

The notice period for the different events is given in Table 4 Advance notice below.

Events with 14 day notice	Events with 7 day notice
2,5,6,7,8,9,10,12	1,3,4,11,13

Table 4 Advance notice

While it would be expected that events with a longer notice period would generate more offers or have a higher chance of receiving offers, this is not evident from the data.

Q4. How do prices bid compare with fixed pricing of Flexible Power?

The Flexible Power published price of £300/MWh appears to have strongly influenced the customer's perception of the "going rate" for services. It was the most frequently occurring price by a considerable margin as shown in Figure 3 Frequency of Offer Prices. This value was also used for project ENTIRE and so a customer using a search engine to find information on flexibility prices would be likely to treat that as a reasonable starting value.

The highest price of £600/MWh was for an event where the required capacity was much smaller than the customer's actual capacity. It is believed that the customer put in a high price in order to make participation worthwhile. It is also possible that the customer perceived themselves as having a monopoly position. The £600 MWh reflects the highest price paid under Flexible Power, for the Restore service, and it is likely that this published figure was used to determine the highest value a DNO might reasonably pay.

Figure 3 Frequency of Offer Prices

Q5. *How did prices change during the trial as bidders had more information?*

During the trial there were very few repeated offers from the same customers. The customer that offered a very high price which was not progressed to a contract subsequently bid at a much reduced price and was successful.

Q6. *How well did the optimisation tool operate for the V1 trial?*

An optimisation tool was developed to support the project requirements. This took the form of an Excel spreadsheet that was enhanced with the Excel Solver add-in. This allowed for an optimal selection of bids to be provided that would reduce costs but ensure sufficient services were selected to cover the capacity requirements for each half hour. The Phase 1 platform includes a feature to allow offer details to be downloaded as a CSV file. While it was possible to transfer the data from the CSV file into the optimisation tool the number of offers for each event was never so high as to require support from the optimisation tool. However the learning from developing this tool has been used to inform the EFFS project.

While not one of the original questions, it was observed that the providers would generally provide offers covering the whole of the event, with only one offer missing out the first half hour of requested service.

All offers reflected the shape of the capacity curve i.e. there was no customer that offered a consistent minimum capacity for the event expecting the platform to optimise by building together bids to fit the curve.

Q7. *How effective were the flex services at impacting the network loading?*

The capacities of service used for the trial were very small relative to the loads at primaries and BSPs. The loading at these sites can vary considerably due to other reasons so that the impact of the flexibility services can be imperceptible.

Figure 4 - Drinnick Event Impact, below shows the loading on the feeder to which the flexibility service provider was connected. The event day, 29th May was a Wednesday so

for comparison other Wednesdays before and after the event are shown. While the peak load on the event day does appear to flatten between periods 35 and 38, a similar profile is seen for 01/05/2019 which was not an event day.

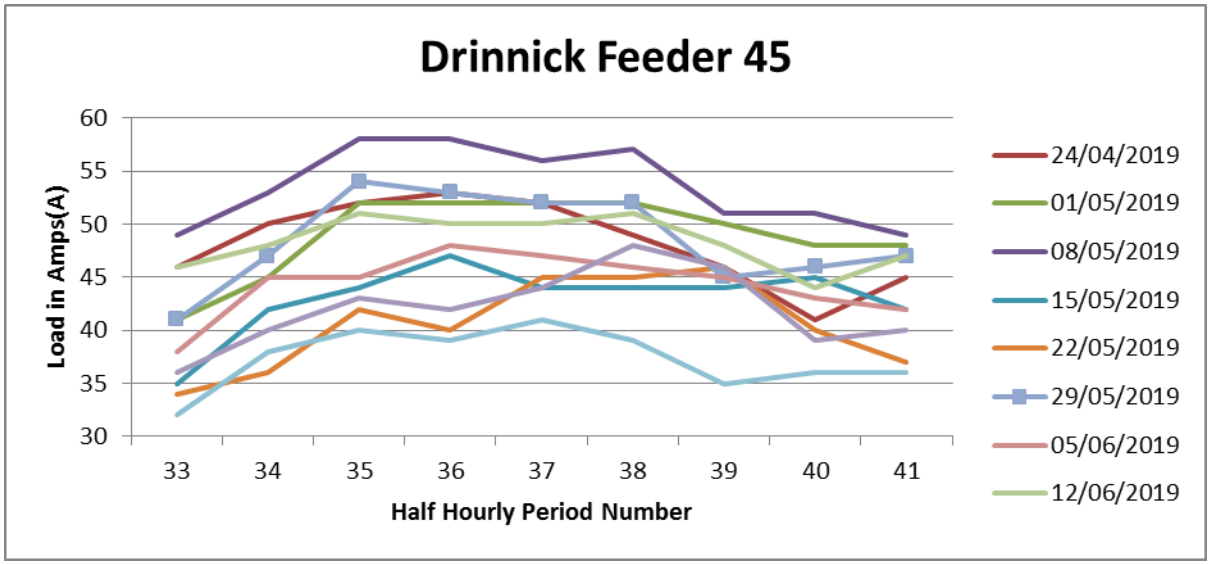


Figure 4 - Drinnick Event Impact

If a greater capacity of services was available then it would have been possible to include one or two events with a large enough capacity to demonstrate an impact a primary substation but it is questionable whether this would provide value for money for customers, given that impact has been demonstrated on project ENTIRE.

Figure 5 - Network Impact (Project ENTIRE), is reproduced from the Project ENTIRE Operational Trials report [2](section 4.6 Network Impact). It compares two consecutive days, one where the generator operated for an event period and the other where it did not, and the effect of this in decreasing peak loading on transformers at the primary substation.

[2] https://www.westernpower.co.uk/downloads/39673

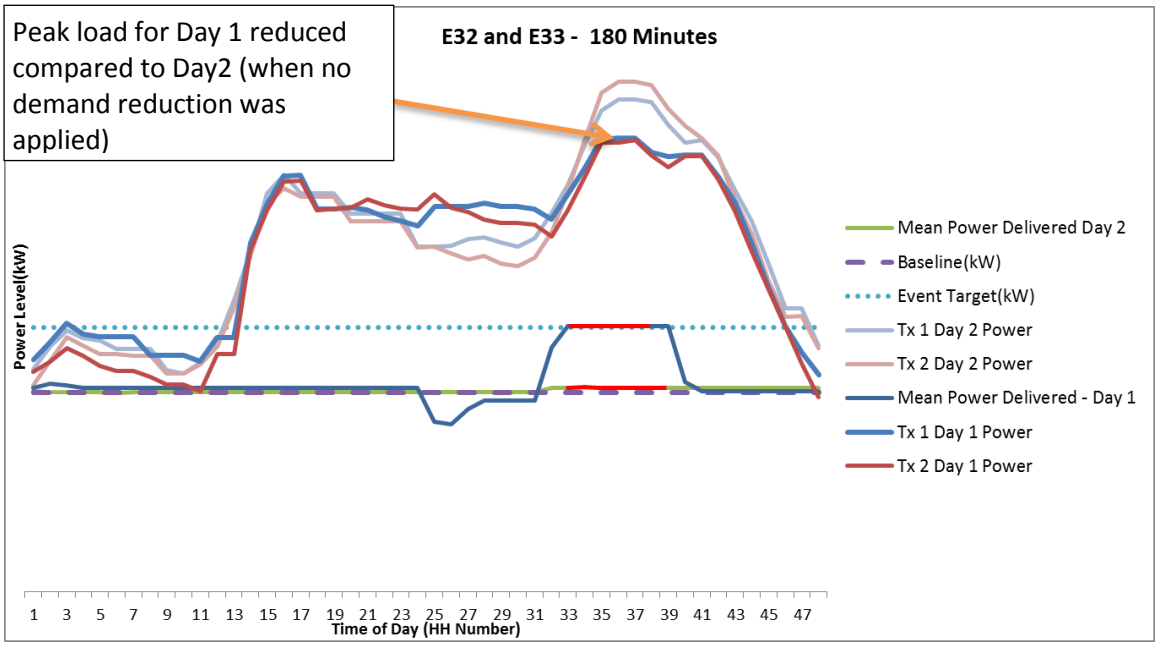


Figure 5 - Network Impact (Project ENTIRE)

Q8. *How reliable was service delivery under each market model and how does this compare to ENTIRE?*

In the following section we will only consider the reliability of services which progressed to contracts. The lack of offers progressing to contracts reflects a wider range of variables and is not directly comparable to the results from Project ENTIRE.

An example of the event performance as assessed with half hourly data is given below in Figure 6 - Event Performance.

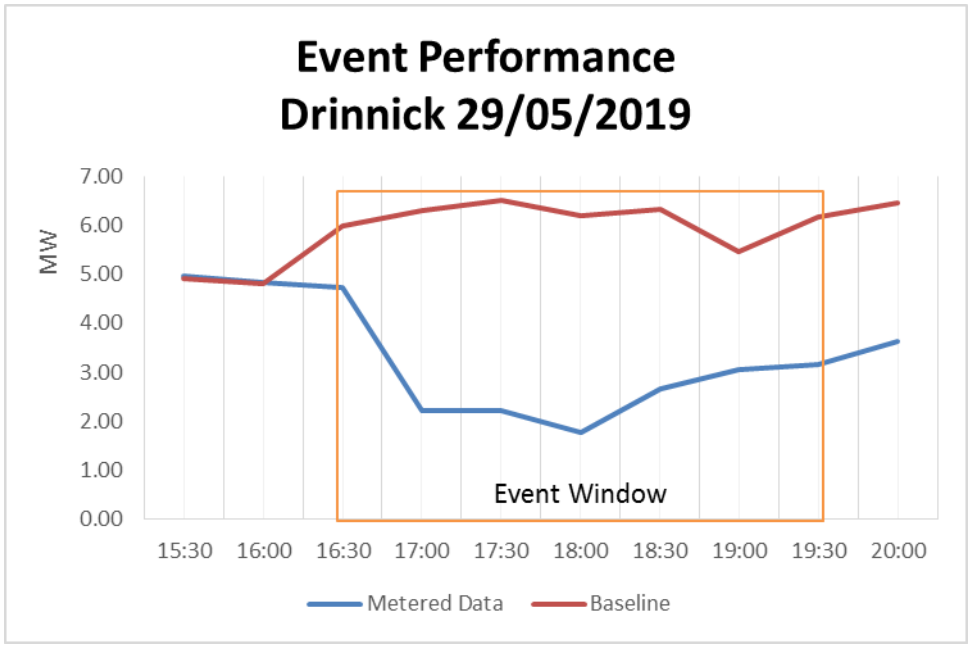


Figure 6 - Event Performance

This shows a clear difference between the metered data for the event day and the baseline. In this example the load reduction exceeds the requirement significantly for each half hour, ensuring that the delivery percentage is always 100%. It can also be seen that the reduction in load begins before the event window and continues after it. The baselining methodology is given at the end of Appendix 3 Sample contract. This is expected to develop further in Phase 2.

Event	Service Procured (MWh)	Service Delivered (MWh)	Delivery Proportion Percentage
1	0.04	0.00	0%
2	3.99	3.99	100%
6	2.78	1.686	61%
7	2.84	2.84	100%
8	6.66	6.146	92%
9	0.032	0.008	25%
11	0.047	0.030	63%
12	0.076	0.029	39%
Average			60%

For the residential properties, there is a notable difference between the response calculated using half hourly data (measured at the properties grid connection point) and the data collected directly from the batteries monitoring systems. This was particularly evident in the first event, when the battery level metering data showed that 50% of the procured service was delivered, where as the half hourly data calculated a negative response.

This could be due to the small size of the residential clusters used to respond to the events and the greater fluctuations in energy use at an individual residential level (when compared to larger industrial consumers). As the residential properties were spread throughout Cornwall, there were not many properties underneath any given primary substation or BSP, therefore there were not enough properties in some events to reduce inherent volatility.

The reliability for the events undertaken within Project ENTIRE is given in the table below.

	No. of events ENTIRE	Percentage of events ENTIRE	No. of events CLEM	Percentage of events CLEM
Events Continuously Above Target (100%)	9	22%	2	25%
Events Continuously Above 95%	9	22%	0	0%
Event Continuously Above 63%	6	15%	2	25%
Not Continuously above 63%	17	41%	4	50%

Table 5 - Project ENTIRE Delivery Reliability

The performance for the best and worst categories appears to be comparable, however a better view will be gained when this analysis is repeated after Phase 2 as that will provide a

larger sample size. Project ENTIRE also had a relatively small sample size which limits the strength of conclusions from the comparisons. Comparison should also take into account the apparent under-reporting of domestic customer performance and it may be better to exclude events using domestic customers when comparing to ENTIRE, which solely used industrial and commercial customers.

Q9. Did there appear to be any seasonal variation in reliability or prices?

There is too small a sample size to assess seasonal variation. While price comparisons will be made between the V1 trial which covers Spring and Summer and the V2 trial which covers Autumn and Winter, it may not be possible to determine whether differences are due to the season or the difference in purchasing method.

9 Summary and Recommendations

The Phase 1 platform was successfully used to procure flexibility services at a range of locations covering a range of technology types. However there were some events for which no offers were received reflecting a variety of reasons from the service provider not having time to respond to bids on the system to problems with export connection agreements. In terms of having clear reminders and notifications for system users, this reflected the prototype nature of the platform, which would include notification features if fully developed.

The services were delivered with prices showing a great deal of consistency around the average £300/MWh value. In terms of delivery, while a number of events were delivered that met or exceeded the requirement, a number of events under-delivered bringing down the average delivery proportion to 60%. The under-delivery of domestic customers appears to be exaggerated and the appropriateness of the baselining methodology will need further examination.

The process to calculate delivery proportions and create an invoice was successful, though the payment of invoices was delayed due to document formatting issues.

The communications problem that resulted in scheduled events not taking place has been resolved with the Phase 2 trial being shared and reviewed regularly. So far this has been successful at ensuring that no events are “wasted” and events that have been postponed have successfully been rescheduled within the existing plan time-frames.

The issues with customer to network mapping are already being addressed by developing a facility that uses MPANs rather than postcodes.

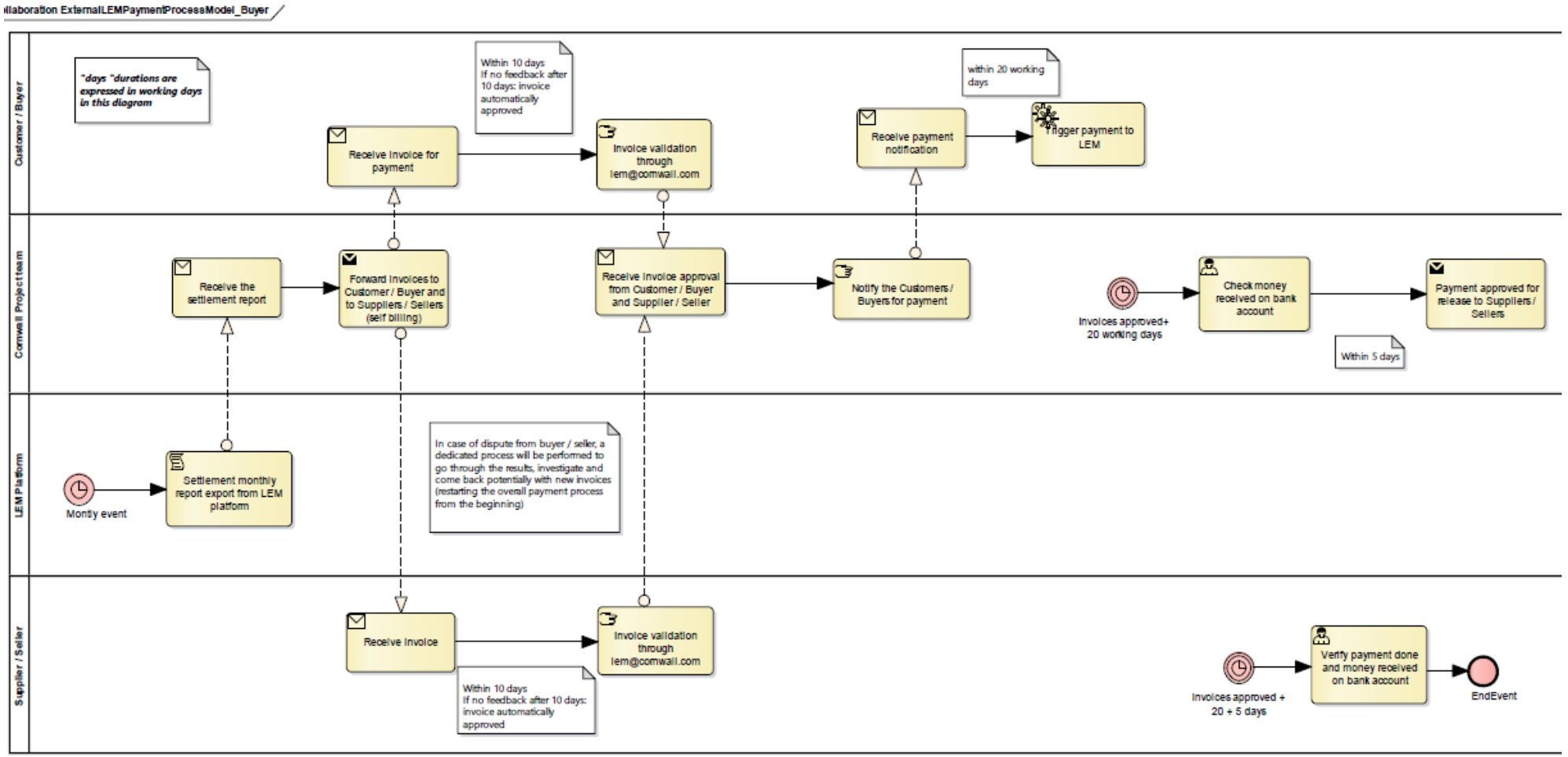
The requirement to share network hierarchy information and planned changes in network configuration which may affect the delivery of flexibility services will be informed by the work in EFFS which will involve determining future network configurations.

9.1 Next steps

The phase two trial has already begun and will conclude in December 2019. The learning from the phase 2 trial, including a comparison of Phase 1 and Phase 2 results will be published in the project closedown report due in April 2020.

Work has also begun to allow an interface between the Phase 2 platform and the EFFS system for a trial in early 2021. This will allow system-to-system data transfer rather than relying on a user to process the bids and contracts through a web interface. This would be necessary to support higher volumes of flexibility services over multiple platforms where manual updates would be adversely time-consuming or prone to error.

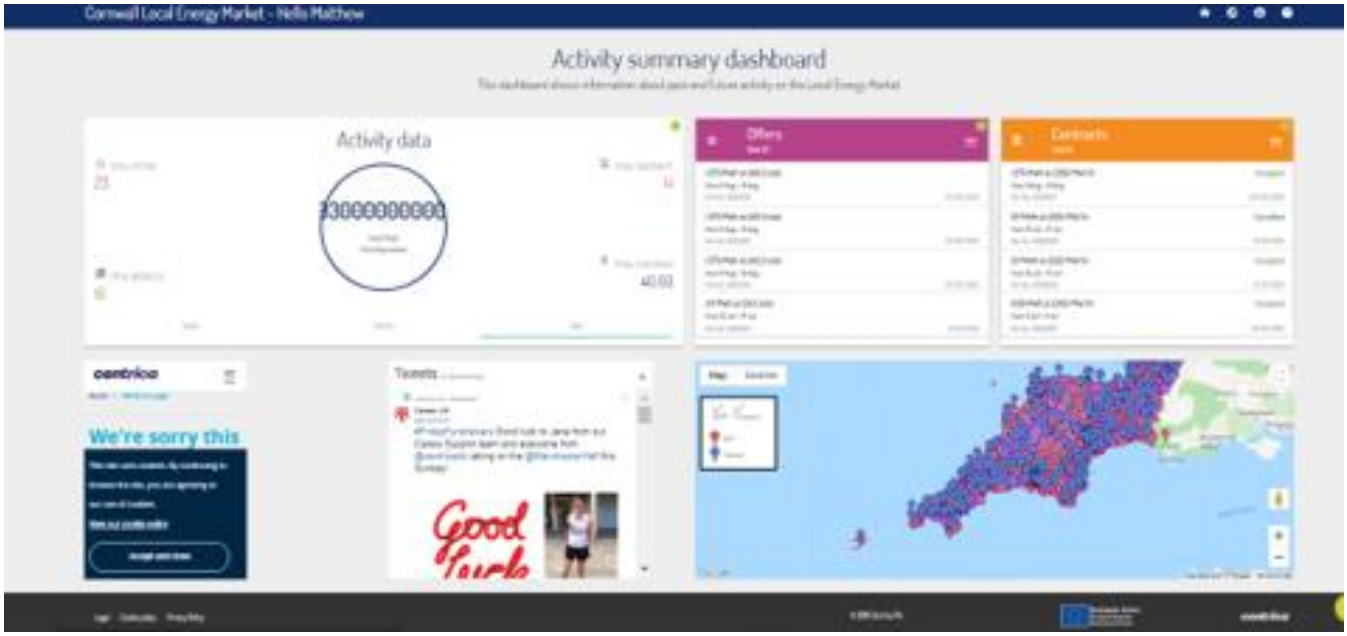
10 Appendix 1 – Post event validation and invoicing.



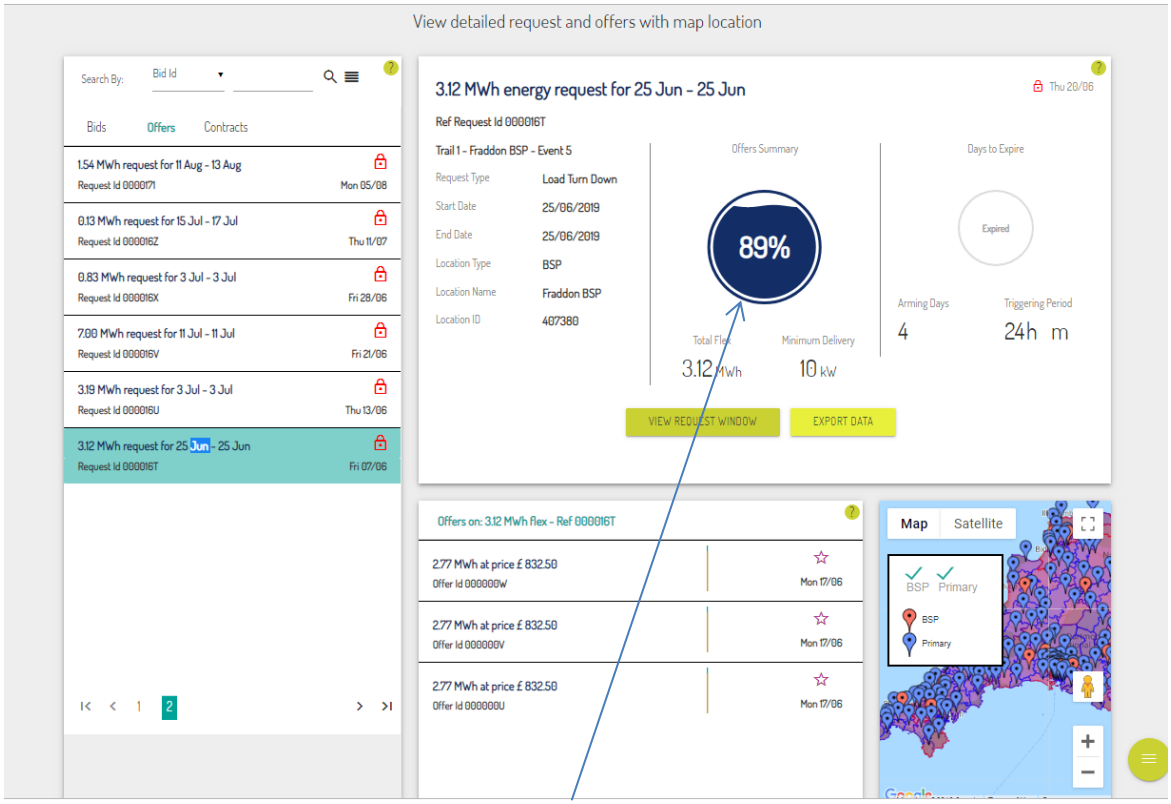
11 Appendix 2 – Phase 1 Platform sample screens.

The following screens are intended to give an indication of the look and feel of the Phase 1 system rather than to provide readable information. The welcome screen, given below includes a news feature, interactive map, activity tracker and lists the items expected to be of most interest to the user.

Welcome screen

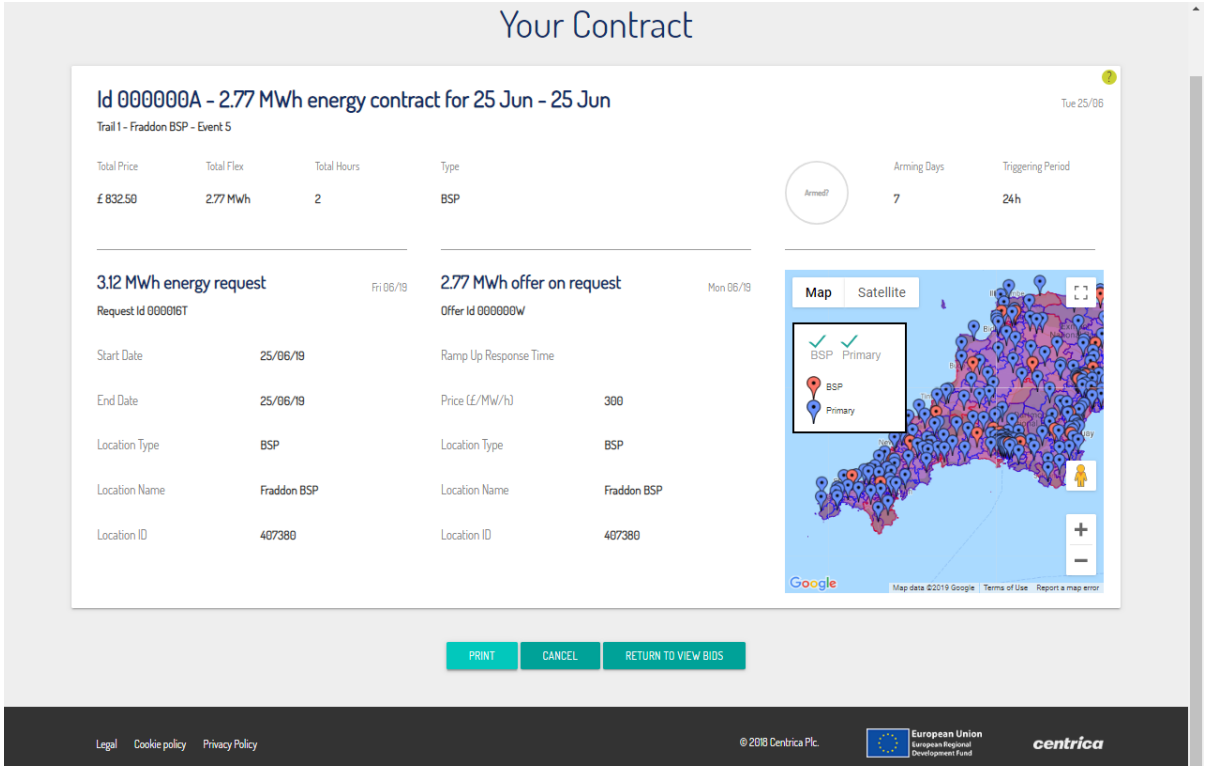


Offer detail for an event



The Offer screen shows whether there are sufficient offers to meet the requirement.

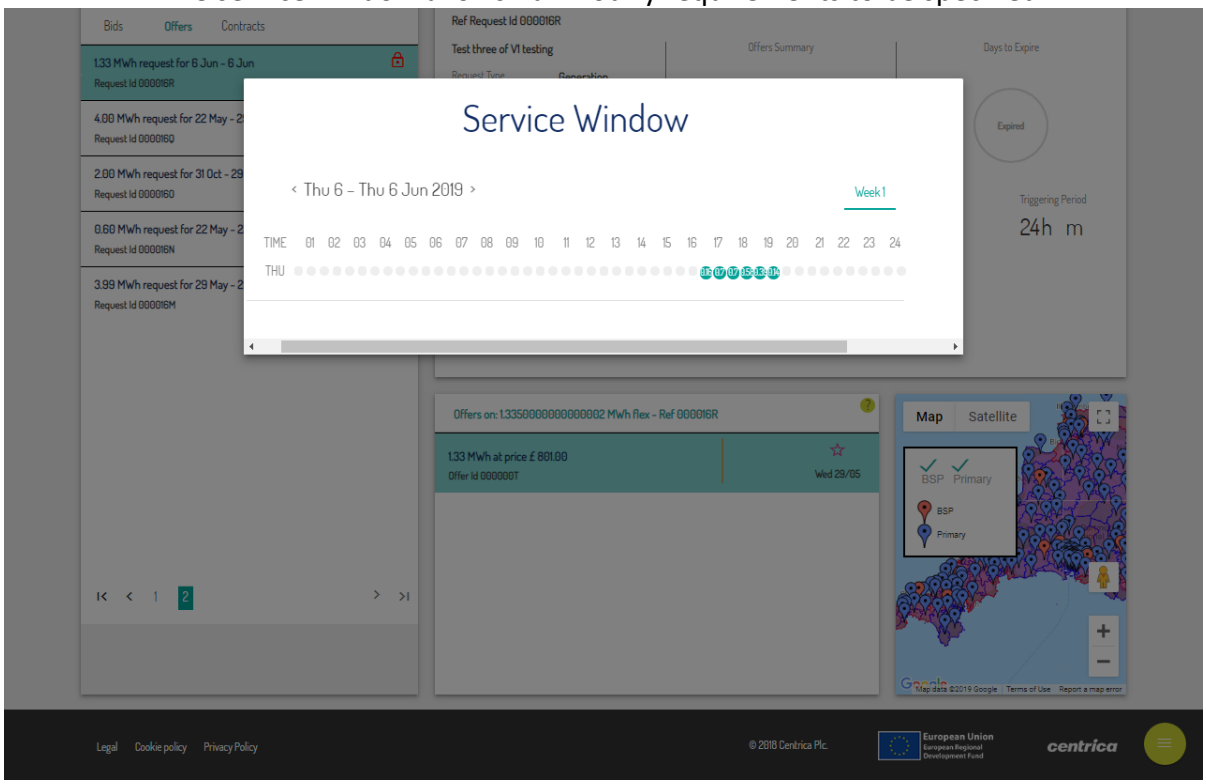
Contract Detail



The details of a contract can be displayed.

Service window.

The service window allows half-hourly requirements to be specified.



12 Appendix 3 Sample contract

Please note this contract was developed further for the phase 2 trials and so this version has been superseded.

Cornwall Local Energy Market - Flexibility Services Agreement

Between:

(1) Western Power Distribution (South West) plc (company number: 02366894 whose registered office is at Avonbank, Feeder Road, Bristol BS2 0TB (**"WPD"**); and

(2) _____ Limited (company number: _____) whose registered office is at _____ _____ (the **"Participant"**).

Date of Agreement (date of signature by both parties)	[Populated upon contracting through platform]
WPD Authorised Person(s)	[insert name(s), address and email address of WPD individual(s)]
Participant Authorised Person(s)	[Populated from Offer]

Table 1 - Key Contractual Parameters

CLEM System ID(s)	Bid/Offer ID
Service Type	Secure / Response
Location Name	[from Offer e.g BSP, Primary, 33kV Cable, 132kV cable]
Location ID	
Start Date of Flexibility Service	[Populated from Offer]
End Date of Flexibility Service	[Populated from Offer]
Total Contract Value	As per the offer that is contracted
Contract Total Amount (MWh)	[Populated from Offer]
Minimum Arming notification period	One week ahead of the start of the Service Day
Minimum Triggering notification period	24 hours ahead of the first Half Hourly period within the Service Day where the Contracted Capacity is not zero.
Arming Fee £ per MW/h	[Populated from Offer]
Utilisation Fee £ per MWh	[Populated from Contract]
Energy Partner Authorised Person(s)	[insert name(s) of Energy Partner individual(s)]
Contact Method	[Populated from platform]

Control Room Contact	WPD to confirm

Table 2 - Detailed Service Requirements

Service Day (Date & Day of week)	**Half Hour Period**	**Flexibility Action**	**Contracted Capacity(MW)**
Monday dd/mm/yy	**00:30- 01:00**	**Generation increase / Load decrease**	**0.3**
Etc. list non-zero periods only			

1. General Acknowledgement

The Participant hereby acknowledges that: (a) the provision of, or the permitting by the Participant of the remote despatch by WPD of, Flexibility Services pursuant to this Agreement and (b) the participation in Cornwall LEM programme is entirely voluntary.

2. Participant Warranty and Indemnity

2.1 The Participant warrants to WPD that the provision by it, or the permitting by the Participant of the despatch by WPD, of Flexibility Services will not cause the Participant:

(a) to be in breach of the Electricity Safety, Quality and Continuity Regulations 2002 (as amended from time to time) (available from WPD on request) or of any regulations made under Section 29 of the Electricity Act 1989 or of any other enactment relating to safety or standards applicable in respect of the business of the Participant;

(b) to be in breach of any provisions of the Grid Code or (where applicable) the Distribution Code or make its compliance with any provision of either of these impossible;

(c) (where any Site is Embedded (as defined in the Grid Code)) to be in breach of or to otherwise be non-compliant with any connection agreement governing the terms of connection of any plant and apparatus to, and/or any agreement for the supply of electricity to the plant or for the acceptance of electricity into, and its delivery from, any electrical distribution or transmission system;

(d) to be in breach of any restrictions and conditions attaching to relevant authorisations of the Environment Agency; or

(e) to be in breach of any other agreement or arrangement of whatever nature with any other person.

2.2 If at any time during the term in which Flexibility Services may be provided by the Participant or despatched by WPD, this would cause the Participant to be in breach or non-compliance as described in clause 2.1, the Participant agrees that it will, in advance of any despatch by WPD or Instruction to despatch issue a notification of unavailability or, following the despatch by WPD or receipt of an Instruction, not comply with such Instruction or operate any Manual Override available to the Participant.

2.3 In the event that, in contravention of clause 2.2, Flexibility Services is despatched which causes the Participant to be in breach or non-compliance as described in clause 2.1 above, then Flexibility Services shall be deemed to be unavailable from the Site during any Contracted Arming Window or Contracted Availability Window (as relevant) and the Participant shall indemnify WPD against all and any claims made against WPD arising out of or resulting from such breach or non-compliance. Such indemnity shall include any legal costs and expenses reasonably incurred in the contesting of such claims including court costs and reasonable attorney's fees and other professional advisors' fees.

2.4 In the event of any such claim referred to in clause 2.3 above being made against WPD, WPD shall as soon as reasonably practicable give notice of the claim together with all relevant supporting documentation to the Participant. The Participant shall be entitled, upon written notice to WPD and subject to WPD receiving from the Participant such reasonable undertakings as WPD shall reasonably require to assume, at its own expense, sole conduct of all proceedings relating to such claim including the right to contest such claim in the name of WPD and WPD shall supply the Participant with all information, assistance and particulars reasonably required by the Participant in connection therewith.

WPD shall not accept, settle, pay or compromise any such claim without the prior written approval of the Participant (such approval not to be unreasonably withheld or delayed). The Participant shall reimburse WPD's reasonable expenses incurred in connection with the provision of any such information, assistance or particulars in the contesting of any such claim.

2.5 The amount or amounts for which the Participant may be liable to WPD pursuant to paragraph 2.3 shall not exceed the sum of £250,000, provided that, in the event that the Participant's liability pursuant to paragraph 2.3 equals or exceeds £250,000, WPD may by notice in writing immediately terminate this Agreement.

3. Electricity Regulations

To the extent that the terms of this Agreement conflict with any of the rights or obligations of the parties under the Electricity Act 1989, the Utilities Act 2000, the Energy Acts 2008 – 2016, the National Terms of Connection and any other licences, codes or industry agreements related to such legislation (the **"Electricity Regulations"**), the terms of the Electricity Regulations shall prevail.

4. Site(s) / Group

4.1Any known Sites that will provide Flexibility Services are set out in the table immediately below:

Aggregators may not be able to determine all the specific sites will deliver Flexibility Services. However, any known Sites that will provide Flexibility Services should be set out in the table immediately below.

Site(s) / Group	**MPAN(s)**	**Site / Group Capacity (MW)**	**Location**

WPD and the Participant agree to be bound by the terms of this Agreement (as defined in paragraph 1.1 (Definitions and Interpretations) of the terms and conditions attached at Schedule 3).

Signed on behalf of Western Power Distribution (East Midlands) plc:

Signature: _____

Name: _____ _____

Role: _ _____ _____

Signed on behalf of: _____:

Signature: _____

Name: _____ _____

Role: _ _____ _____

Schedule 1
(Cornwall LEM Flexibility Services)

WPD has placed its demand for LEM Flexibility Services on the Cornwall Local Energy Market platform ("LEM Platform") in the amount and for the time periods described on the LEM Platform and reflected in this Agreement. The Energy Partner has made an offer to delivery LEM Flexibility Services as specified in Table 2 of this Agreement.

WPD agrees to buy LEM Flexibility Services from the Energy Partner, and the Energy Partner agrees to sell LEM Flexibility Services to WPD, in accordance with the Key Contractual Parameters given in Table 1 of this Agreement.

The Energy Partner agrees that should it become aware of any circumstances which may affect the ability of a Site(s)/Group to meet the requirements of this Agreement, it must notify the Control Room Contact in advance by email as soon as reasonably practicable.

WPD will confirm that the Flexibility Services for each Service Day are Armed no later than the Minimum Arming Notification Period given in Table 1 of this Agreement

WPD will confirm that Flexibility Services for each Service Day are Triggered no later than the Minimum Triggering Notification Period given in Table 1 of this Agreement

For the Flexibility Service, the Energy Partner agrees that:

(a) Delivery of the Flexibility Service is carried out at each Site(s)/Group in accordance with this Agreement;

(b) Delivery of the Flexibility Service is in accordance with Table 2 of this agreement unless terminated earlier, as requested by the Control Room Contact; and

(c) it shall notify the Control Room Contact by telephone if a Site(s)/Group is unable to carry out the Delivery.

There are two primary payments for LEM Flexibility Services: Arming Payments and Utilisation Payments set out in clauses 8 and 9 below:

The Arming Payment due for payment by WPD to the Energy Partner (via the Platform Operator) under this Agreement will be calculated as follows:

(a) Arming Payments will be summated over all the Service Days for which the service was Armed and remained available after arming. In the case where an Energy Partner notifies WPD that they cannot deliver a service for a Service Day which has already been Armed then no Arming Payment will be due for that Service Day.

(b) The Arming Payment given to a Site(s)/Group for a Service Day is as follows:

$$AP_{sd,s} = (\sum_{t=1}^{48} AF_{s,} . CC_{s,t} . PP_{s,t})$$

Where:

$AP_{sd,s}$ is the Arming Payment for Site(s) / Group during a Service Day (*sd*)

$\sum_{t=1}^{48}$ sums the payment for Arming for every half hourly period in each Service Day in outlined in this Agreement

AF_s is the Arming Fee for that Site(s) / Group in £/MW/hour, as outlined in Table 1 of this Agreement

CC_s is the Contracted Capacity in MW for that half hourly period as set out in Table 2 of this Agreement

$PP_{s,t}$ is the Payment Proportion for the Site(s)/Group for the half hourly period(t) which is defined in clause 10 of this schedule, below.

The Utilisation Payment due for payment by WPD to the Energy Partner (via the Platform Operator) under this Agreement will be calculated as follows:

(a) Utilisation Payments will be summated over all the Service Days for which the service was Triggered. In the event that after a Service Day has been Triggered, WPD's control room subsequently request the service is not delivered or terminated early a then Utilisation Payments are payable for that Service Day with a Payment Proportion of 100%

(b) The Utilisation Payment given to a Site/Group (s) for a Service Day (sd) is as follows:

$$UP_{sd,s} = (\sum_{t=1}^{48} UF_{s,} . CC_{s,t} . PP_{s,t})$$

Where:

$UP_{sd,s}$ is the Utilisation Payment for Site / Group (s) during a Service Day (*sd*)

$\sum_{t=1}^{48}$ is the summation of the payments for Utilisation for every half hour period (t) in each Service Day in outlined in this Agreement

UF_s is the Utilisation Fee for that Site/ Group (s) in £/MW/hour, as outlined in Table 1 of this Agreement

$CC_{s,t}$ is the Contracted Capacity in MW for that Site/ Group (s) in the half hour period (t) as set out in Table 2 of this Agreement

$PP_{s,t}$ is the Payment Proportion for the Site/ Group (s) for the half hour period(t) which is defined in clause 10 of this Schedule below.

The Payment Proportion (PP) is a multiplier of the full price that is due to the Site(s) / Group for every Half Hourly Period(t) in a Service Day (sd) based on the Contracted Capacity and the Actual Delivery. The Payment Proportion acts to reduce payments where the Actual Delivery has been less than the Contracted Capacity and acts to increase payments, for Services that reward over-delivery, where the Actual Delivery has exceeded the Contracted Capacity up to an upper threshold, the Payable Over-delivery (PO). The calculation includes a lower limit of service delivery at which point the penalties for under-delivery increase, which is the Delivery Target Threshold. This value is set to reflect both the degree to which Actual Delivery can be accurately measured and the importance of having reliability in Service Delivery. This mechanism covers both under-delivery and late delivery as it is calculated for each half hour. For example, if a service is delivered half an hour late, then the Payment Proportion adjustment would result in no payment being due for the first half hour when no service was delivered.

1.1 The Delivery Proportion *($DP_{s,t}$)* is defined as the ratio of Actual Delivery in MW to Contracted Capacity for a site, s, in a half hour,t. This ratio is a value that represents a percentage and is rounded to two significant figures to ensure it represents a whole percentage.

This proportion is calculated using the baselining methodology provided by the Platform Operator. This is attached for information in Schedule 4 but does not form part of the contract between WPD and the Energy Partner.

1.2 The Delivery Target Threshold (*DTT*) determines the acceptable under-delivery for a Site(s) / Group. For every % point under that level, a fixed proportion called the Penalisation Multiplier, (PM) of the full payment is deducted.

10.3 Thus, the Payment Proportion is a value between 0 and 1+*PO* (or 0 and 100%+*PO*%). The calculation contains three cases:

1) $if\ DP_{s,t} \geq (1 - DTT)\ and\ DP_{s,t} \leq 1 + PO,\ PP_{s,t} = DP_{s,t}$
2) $if\ DP_{s,t} < (1 - DTT),\ PP_{s,t} = Max\left(0,\ 1 - DTT - PM.\left[1 - DTT - DP_{s,t}\right]\right)$
3) $if\ DP_{s,t} > 1 + PO,\ PP_{s,t} = 1 + PO$ (acts to limit payment for over-delivery)

10.4 Values DTT, PO and PM for different services are given in Schedule 2, below which also includes graphs of values of PP for different values of DP.

2. **Monthly Payments**

Payments are made on a monthly basis for both Arming and Utilisation. The Monthly Arming Payment is the aggregation of Arming Payments for service days falling within the Month. Payments due against different contracts will be aggregated into a single payment.

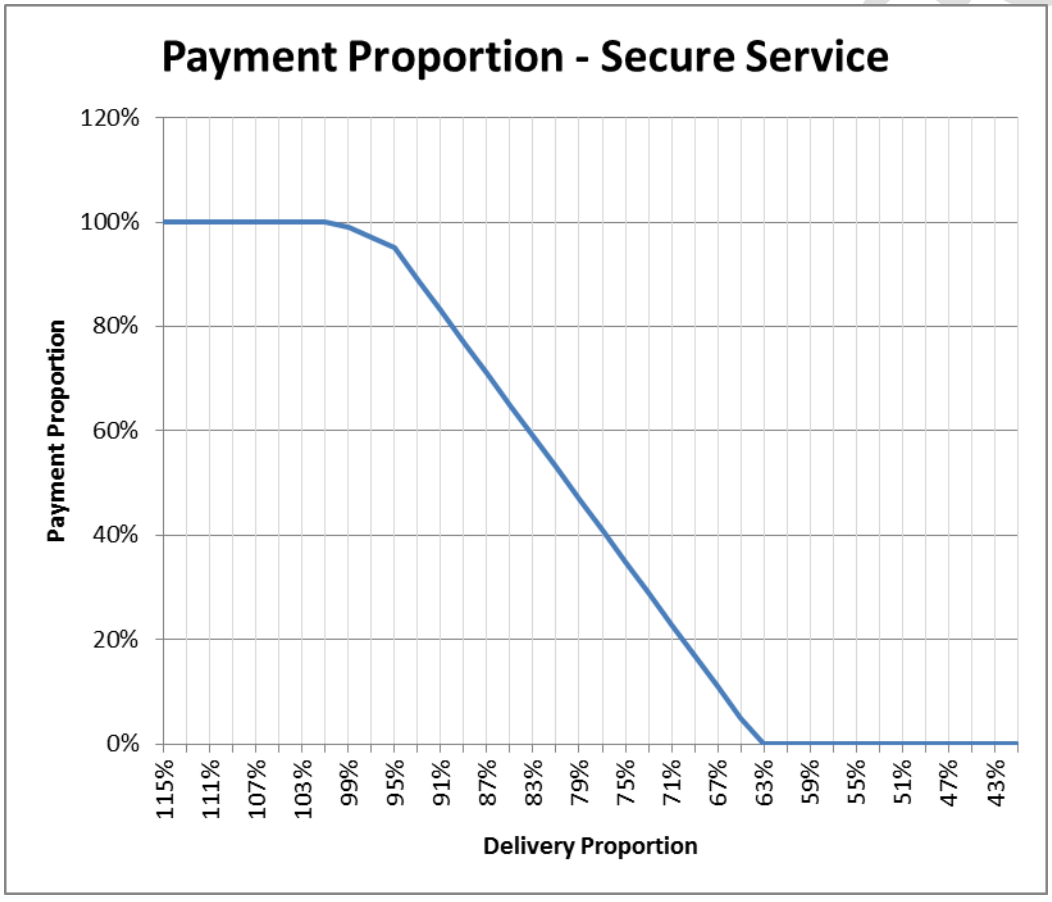
Schedule 2
(Payment Mechanism Values)

This Schedule may be updated from time to time in writing as agreed between the parties. Any agreed update shall be deemed to be incorporated into this Schedule and this Schedule shall be read and construed accordingly.

For the purposes of the Cornwall Trial, the Services that WPD will be procuring are the same as those under other DSR trials.

1. Secure Services:

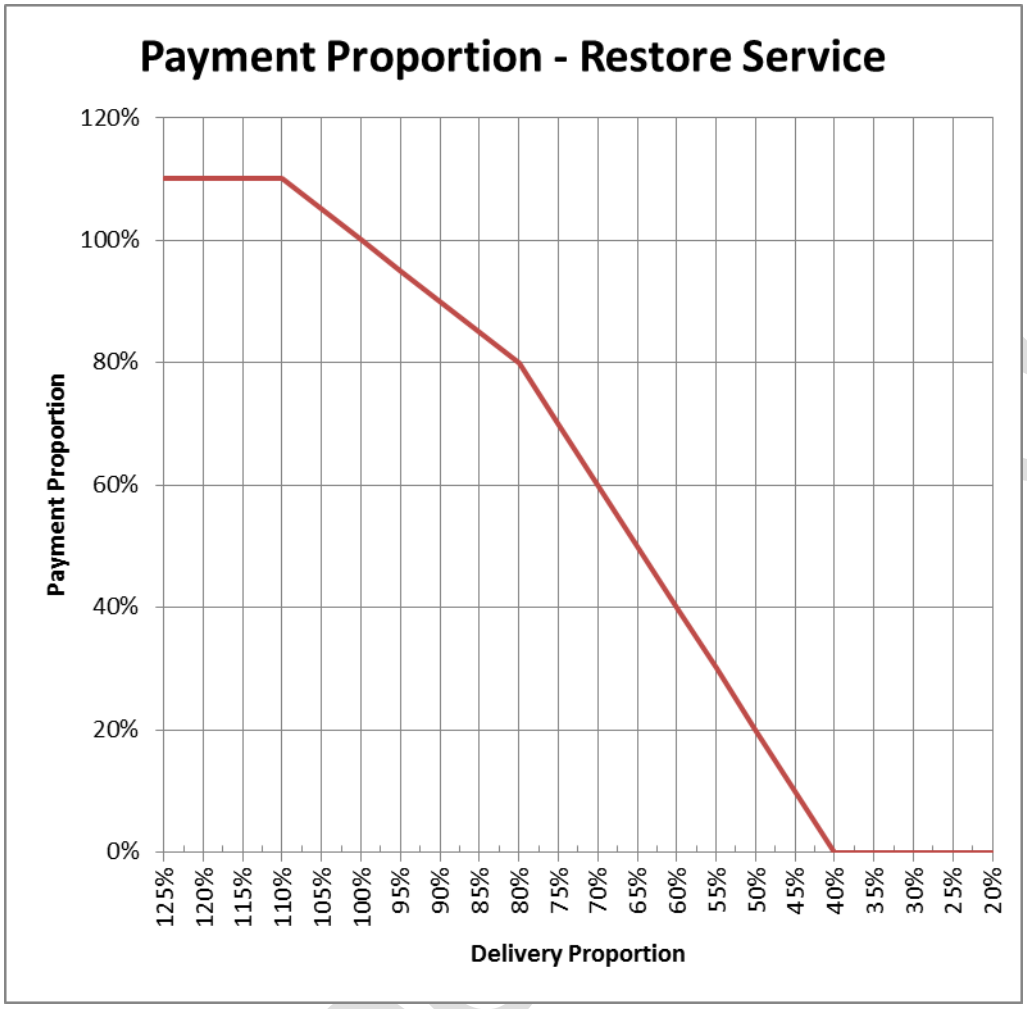
Attribute	Value
Delivery Target Threshold *(DTT)*	5%
Penalisation Multiplier *(PM)*	3
Payable Overdelivery *(PO)*	0%



2. Restore Services:

Attribute	Value
Delivery Target Threshold *(DTT)*	20%
Payable Overdelivery *(PO)*	10%

Penalisation Multiplier *(PM)*	2



Schedule 3 (Terms and Conditions)

It is agreed as follows:

1. Definitions and interpretation

1.1 In this Agreement, unless the context otherwise requires, the following words have the following meanings:

"Agreement" means this agreement (including the details set out on the front page, the Terms and Conditions, and any other schedule or annexure to it) made between the parties;

"Applicable Legislation" means all Policies and laws, statutes, acts, regulations, codes, judgments, orders, directives or determinations applicable to the performance of the Services;

"Arming Fee" has the meaning given in to it in clause 8 of Schedule 1;

"Arming Payment" means any payment calculated in accordance with clause 8 of Schedule 1;

"Centrica" means Centrica plc, a company registered in England under number 3033654, whose registered office is Millstream, Maidenhead Road, Windsor, Berkshire SL4 5GD.

"Charges" means the payment calculated in accordance with the Schedule to this Agreement;

"Contact Method" means the contact method specified on the front page of this Agreement;

"Contracted Capacity" means net MW consumed or generated by a Site(s)/Group during each Half Hourly Period as set out within Table 2 of this Agreement;

"Control Room Contact" means the individual at the WPD facility from where network is monitored and managed, who is specified as the contact on the front page of this Agreement;

"Date of Agreement" means the date specified as the date of signature on the front page of this Agreement;

"Delivery" means the regulation of the amount of electricity consumed and/or generated by a Site to maintain the Contracted Capacity in accordance with this Agreement;

"Delivery Proportion" has the meaning given to it in clause 10.1 of Schedule 1;

"Delivery Target Threshold" has the meaning given to it in clause 10.1 of Schedule 1;

"**Group**" means a collection of one or more Sites

"Half Hourly Period" means each full thirty (30) minute period within a Service Day;

"**LEM Flexibility Service**" means Flexibility Services for network management procured by WPD from Energy Partners on the LEM Platform;

"Payable Overdelivery" means the % of overpayment above 100% that will be available in respect of Utilisation Payments for WPD Restore Services as set out in clause 10.3 of Schedule 1;

"Payment Proportion" means the value defined in clause 10.3 of Schedule 1 for which values can be calculated using the data in Schedule 2;

"Penalisation Multiplier" has the meaning given to it in clause 10.2 of Schedule 1;

"Policies" means any instructions, rules or policies issued by WPD from time to time, including without limitation Policy Document: LE7 Relating to Bribery;

"Services" means the Delivery to be provided by the Energy Partner in accordance with this Agreement;

“Service Day” means a period of 48 half hours starting from midnight one day until midnight the following day.
"Site" means each of the sites set out on the front page of this Agreement;
"Utilisation Payment" means any payment calculated in accordance with clause 9 of Schedule 1;
"VAT" means value added tax chargeable under English law for the time being and any similar, additional tax.
1.2 In this Agreement, unless the context otherwise requires: (a) words in the singular include the plural and vice versa and words in one gender include any other gender; (b) a reference to a statute or statutory provision includes: (i) any subordinate legislation (as defined in Section 21(1), Interpretation Act 1978) made under it; (ii) any repealed statute or statutory provision which it re-enacts (with or without modification); and (iii) any statute or statutory provision which modifies, consolidates, re-enacts or supersedes it; (c) references to: (i) any party include its successors in title and permitted assigns; (ii) a "person" include any individual, firm, body corporate, association or partnership, government or state (whether or not having a separate legal personality); (iii) clauses and schedules are to clauses and schedules of this Agreement and references to sub-clauses and paragraphs are references to sub-clauses and paragraphs of the clause or schedule in which they appear; and (iv) the headings are for convenience only and shall not affect the interpretation of this Agreement.

2. Commencement and Duration

This Agreement shall commence on the Date of Agreement and shall continue in force until final payment is made for all Service Days contained in this Agreement, unless terminated earlier in accordance with its terms.

3. Delivery

3.1 The Energy Partner shall: (a) carry out its obligations as set out in the Schedule to this Agreement in accordance with Applicable Legislation and the terms of this Agreement; and (b) permit WPD to collect and on request shall provide to WPD, any metering data in respect of each Site.
3.2 The Energy Partner may sub-contract its obligations set out in the Schedule to this Agreement to any third party provided that such appointment shall not relieve the Energy Partner of any obligation under this Agreement, and the acts or omissions of any such sub-contractor shall, for the purposes of this Agreement, be deemed to be acts or omissions of the Energy Partner.
3.3 The Energy Partner may not assign, transfer, charge or otherwise encumber, declare a trust over or deal in any other manner with this Agreement or any right, benefit or interest under it.
3.4 Any metering equipment provided by WPD shall at all times remain the property of WPD, and neither the Energy Partner nor any of its sub-contractors shall have any right, title, or interest in or to such equipment.
3.5 The Energy Partner shall not, and shall procure that its sub-contractors (if any) shall not, sell, lease, hire, charge by way of security, modify, move, interfere with or otherwise deal with any metering equipment provided by WPD in any way, without the prior written consent of WPD.

4. Payment

4.1 In consideration of the provision of the Services in accordance with the terms of this Agreement, WPD shall pay to Centrica the Charges as set out in this clause 4, which Charges Centrica shall thereafter

convey to the Energy Partner in accordance with the agreement between the Energy Partner and Centrica regarding use of the LEM Platform.

4.2 Subject to clause 10.6, WPD's liability to the Energy Partner shall not exceed the amount of the Charges and WPD shall not be liable for any other payments incurred by the Energy Partner in the provision of the Services.

4.3 WPD shall calculate the Charges for each calendar month during which this Agreement is in force in accordance with the Schedule to this Agreement.

4.4 Within 28 days of the end of each calendar month during which this Agreement is in force, WPD shall provide a statement of the Energy Partner's performance in providing the Services and the Charges due in respect of that month. On receipt of this statement, the Energy Partner shall be entitled to issue its invoice to WPD for the Charges incurred in that month.

4.5 Each invoice must: (a) contain all the following information: (i) the Site(s) where the Services have been carried out; (ii) the Month(s) to which the invoice relates; (iii) the Energy Partner's details for payment; (iv) the Payment for the period of the invoice, excluding VAT; and (v) any other information that WPD may reasonably request; and (b) be sent to: Western Power Distribution, Accounts Payable, Elliott Road, Prince Rock, Plymouth, Devon, PL4 0SD, (c) be dated using the date on which it is issued.

4.6 All payments shall be released by WPD by the end of the month following the month of the date of the Energy Partner's invoice. Payment by WPD shall be without prejudice to any claims or rights, which WPD may have against the Energy Partner and shall not constitute any admission by WPD as to the performance by the Energy Partner of its obligations under this Agreement. Prior to making any such payment, WPD shall be entitled to make deductions or deferments in respect of any disputes or claims whatsoever with or against the Energy Partner.

4.7 All sums payable under this Agreement shall be exclusive of VAT. WPD shall pay an amount equal to such VAT to the Energy Partner in addition to any sum or consideration on receipt of a valid VAT invoice from the Energy Partner.

4.8 If WPD fails to pay to the Energy Partner any undisputed amount payable by it under this Agreement, the Energy Partner may charge WPD interest on the overdue amount from the due date up to the date of actual payment at the rate of 2% per annum above the base rate of the Bank of England. Such interest shall accrue from day to day and shall be compounded annually.

4.9 WPD may, without limiting any other rights or remedies it may have, withhold or set off any amounts owed to it by the Energy Partner against any amounts payable by WPD to the Energy Partner under this Agreement.

5. Confidentiality

5.1 Except with the consent of the disclosing party or as required by law, a court order or by any relevant regulatory or government authority or to the extent that information has come into the public domain through no fault of the receiving party, each party shall treat as strictly confidential all commercial and technical information relating to the other party received or obtained as a result of entering into or performing this Agreement including but not limited to information which relates to the provisions or subject matter of this Agreement, to any other party or to the negotiations of this Agreement.

5.2 The Energy Partner acknowledges that WPD may share any metering data and the performance of each Site under this Agreement with its contractors and project partners and may disseminate any learning arising from this arrangement with the wider electricity industry.

6. Anti-Bribery

The Energy Partner shall not engage in any activity, practice or conduct which would constitute an offence under the Bribery Act 2010 and shall promptly report to WPD any request or demand for any undue financial or other advantage of any kind received or offered by the Energy Partner in connection with this Agreement.

7. Force Majeure

Neither party shall be deemed to be in breach of this Agreement, or otherwise be liable to the other, by reason of any delay in performance or non-performance of any of its obligations under this Agreement to the extent that such delay or non-performance is due to an event beyond the reasonable control of that party.

8. Termination

8.1 Either party may by notice in writing immediately terminate this Agreement, if the other party commits a material breach of this Agreement which in the case of a breach capable of remedy shall not have been remedied within 30 days of the receipt of a notice identifying the breach and requiring its remedy.

8.2 All rights and obligations of the parties shall cease to have effect immediately on termination of this Agreement except that termination shall not affect: (a) the accrued rights and obligations of the parties at the date of termination; (b) the continued existence and the validity of the rights and obligations of the parties under clause 5; and (c) any provisions of this Agreement necessary for the interpretation or enforcement of this Agreement.

9. Dispute Resolution

9.1 Subject to sub-clause 9.3, if a dispute arises out of or in connection with this Agreement, the parties shall: (a) within 30 days of written notice of the dispute being received by the receiving party in good faith seek to resolve the dispute through negotiations between the parties' senior representatives who have the authority to settle it; and (b) not pursue any other remedies available to them until at least 30 days after the first written notification of the dispute.

9.2 The appointed representatives shall use reasonable endeavours to resolve the dispute. If the dispute is not resolved in accordance with this clause, either party may propose to the other in writing that the matter be referred to a non-binding mediation. If the parties are unable to agree on a mediator either party may apply to the Centre for Dispute Resolution (CEDR) to appoint one.

9.3 Nothing in this clause shall prevent any party from having recourse to a court of competent jurisdiction for the sole purpose of seeking a preliminary injunction or such other provisional judicial relief as it considers necessary to avoid irreparable damage.

10. General

10.1 This Agreement (and any appendices attached to it) sets out the entire agreement and understanding between the parties and supersedes all prior agreements, understandings or arrangements (whether oral or written) in respect of the subject matter of this Agreement.

10.2 To the extent that any provision of this Agreement is found by any court or competent authority to be invalid,

unlawful or unenforceable in any jurisdiction, that provision shall be deemed not to be a part of this Agreement, it shall not affect the enforceability of the remainder of this Agreement nor shall it affect the validity, lawfulness or enforceability of that provision in any other jurisdiction.

10.3 The rights, powers and remedies conferred on either party by this Agreement and the remedies available to either party are cumulative and are additional to any right, power or remedy which it may have under general law or otherwise.

10.4 Either party may, in whole or in part, release, compound, compromise, waive, or postpone, in its absolute discretion, any liability owed to it or right granted to it in this Agreement by the other party without in any way prejudicing or affecting its rights in respect of that or any other liability or right not so released, compounded, compromised, waived or postponed.

10.5 The Energy Partner acknowledges that it has entered into this Agreement in reliance only upon the representations, warranties, conditions and promises specifically contained or incorporated in this Agreement and, subject to clause 10.6, WPD shall have no liability to the Energy Partner in respect of any other representation, warranty, condition or promise made prior to the date of this Agreement, unless it was made fraudulently, or implied into this Agreement.

10.6 Nothing in this Agreement shall limit or exclude either party's liability for death or personal injury caused by its negligence, or the negligence of its employees, agents or subcontractors; its fraud or fraudulent misrepresentation; and any other liability which cannot by law be excluded or limited.

10.7 No single or partial exercise, or failure or delay in exercising any right, power or remedy by either party shall constitute a waiver by that party of, or impair or preclude any further exercise of, that or any right, power or remedy arising under this Agreement or otherwise.

10.8 No announcement concerning the terms of this Agreement shall be made by or on behalf of either party without the prior written consent of the other, such consent not to be unreasonably withheld or delayed.

10.9 Nothing in this Agreement or in any document referred to in it or in any arrangement contemplated by it shall create a partnership or joint venture between the parties or render a party the agent of the other, nor shall a party hold itself out as such (whether by an oral or written representation or by any other conduct) and neither party shall enter into or have authority to enter into any engagement, or make any representation or warranty on behalf of, or pledge the credit of, or otherwise bind or oblige the other party.

10.10 This Agreement may be executed in any number of counterparts and by the parties on separate counterparts, but shall not be effective until each party has executed at least one counterpart. Each counterpart, when executed, shall be an original of this Agreement and all counterparts shall together constitute one instrument.

10.11 Any notice to either party under this Agreement shall be in writing signed by or on behalf of the party giving it and shall, unless delivered to the party personally, be left at, or sent by prepaid first class post or prepaid recorded delivery to the address of the party as set out on the

front page of this Agreement or as otherwise notified in writing from time to time. A notice shall be deemed to have been served at the time of delivery, if delivered personally, or 48 hours after posting.

10.12 No term of this Agreement is enforceable pursuant to the Contracts (Rights of Third Parties) Act 1999 by any person who is not a party to it.

10.13 This Agreement and any dispute, claim or obligation (whether contractual or non-contractual) arising out of or in connection with it, its subject matter or formation shall be governed by the laws of England and Wales.

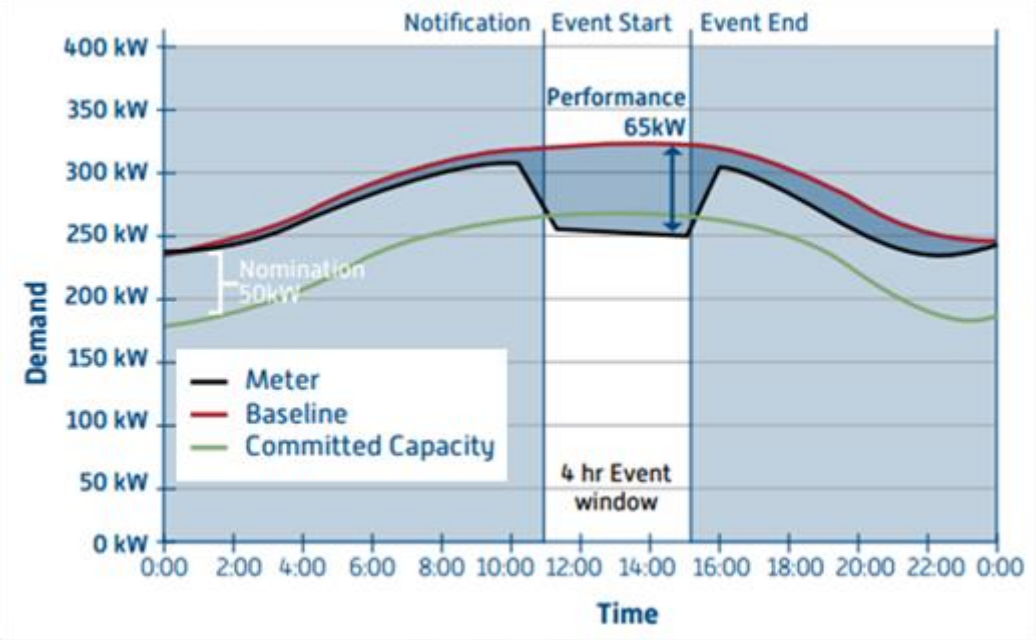
10.14 Subject to clause 9, the parties irrevocably agree that the courts of England and Wales shall have exclusive jurisdiction to settle any dispute or claim (whether contractual or non-contractual) arising out of or in connection with this Agreement, its subject matter or formation.

This Agreement has been signed on the date stated as the "Date of Agreement" on the front page of this Agreement.

Schedule 4 – Baselining Methodology

1. **Overview**

A baseline is a short-term forecast of expected energy usage during a given time period. Baselines are typically calculated using time-series meter data using a simple and well-defined methodology. Demand Response program administrators use baselines to retrospectively measure demand side resource performance during a flexibility activation (i.e. events) to calculate settlements. Below is an illustration of a baseline for demand turn down, showing metered load as the black trace, the baseline as the red trace and the committed capacity, which is the baseline minus the committed curtailment amount.



Cornwall LEM Baseline Calculation

The LEM baselining approach is summarized below:

- The inputs are:
    - A time-series of 30 days of historical meter data from 5 minutes to 30 minute interval length up to at least one hour before the event start.
    - Event start datetimes
- Select Y previous days
    - If a weekday, select 10 most recent weekdays, excluding holidays or previous event days.
    - If a weekend or holiday, select 5 most recent matching weekend days (Saturday = Saturday, Sunday/Holiday = Sunday/Holiday)
- Calculate the average load by interval for the event day, which becomes the "unadjusted baseline"
- Calculate an additive adjustment factor, which is
    - The average baseline load from 90 to 60 minutes before the event
    - Minus the average metered load from 90 to 60 minutes before the event start
- The adjusted baseline is equal to the original plus the additive adjustment factor.

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