WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

PROJECT SYNC

CLOSEDOWN REPORT

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Contents

Executive Summary

The SYNC project looked to investigate the value of demand turn-up (or generation turn-down) to the distribution network.

The project focused on the delivery of 4 techniques:

(T1) - Automated demand increase / generation limiting in line with variation in solar yields;

(T2) - Directly matching flexible load with flexible generation;

(T3) - Manually dispatched response signals from a WPD control facility (DSR); and

(T4) - Creation of suitable ToU (Time of Use) tariffs to encourage appropriate demand.

These techniques covered a wide range of areas and delivered the following key learning and deliverables:

- Literature and data investigations highlighted the limited impact of cloud cover on voltage profiles in dense PV networks;
- Creation of a load matching scheme would be possible however there commercial requirements are highly complex. With the potential to cause detriment to existing customers and changes required in the principles of access, future feasibility is limited;
- Coordination of Services with the SO is possible and can be beneficial to the SO, the DNO and the participants;
- Simple offerings with lengthy timescales are required to encourage participation;
- Currently volume in the target areas is low; and
- The potential impact of charging on DSR is high. This has now been picked up by the wider industry through the ENA's TSO-DSO project and Ofgem's TCR.

Several modifications through the project, and the coordination with National Grid's DTU service, allowed the project to be delivered ahead of time and under budget.

More details can be found in the following sections.

1 Project Background

WPD has connected significant amounts of embedded generation to its distribution network in recent years. This includes a large variety of different technologies, dominated at first by wind and more recently by solar PV.

With so much generation already connected, and significant quantities in the pipeline, most of the latent capacity within the network has now been utilised. As such WPD is looking at ways of releasing extra capacity in the most economically efficient manner. Alongside the use of traditional reinforcement, the roll out of alternative connections has been one of innovative manners this has been done, building on the flexibility of generators. These give the option of trading off capital expenditure and time delays against potential curtailment. This moves from a passively operated network to a more active one.

Whilst the inherent flexibility of generation is now being used, the flexibility of the demand side is as yet untapped.

As part of the SYNC project, we looked to test a range of Demand Side Response (DSR) techniques to help address many of the different challenges being posed by PV generation. By engaging with industrial and commercial (I&C) customers we could release additional capacity or even improve power quality.

There are 4 techniques that project SYNC looked to investigate:

(T1) - Automated demand increase / generation limiting in line with variation in solar yields;

(T2) - Directly matching flexible load with flexible generation;

(T3) - Manually dispatched response signals from a WPD control facility (DSR); and

(T4) - Creation of suitable ToU (Time of Use) tariffs to encourage appropriate demand.

The project required significant engagement and involvement of third parties including demand customers, generators, storage operators and National Grid. WPD built on the learning gained in the FALCON project and directly manage a full service program directly. By doing so we attempted to demonstrate how to maximize value to the industry and minimize the cost to customers.

2 Scope & Objectives

As with other DR projects the scope can be limited by the necessity to gain the support and engage with customer's willingness to participate. WPD, however, identified suitable areas in the South West franchise area, where there are current issues arising from high penetration levels of solar generation coupled with insufficient load at times of high yield.

The trial was limited to half hourly metered supplies. Particular focus centred on large energy users who were expected to have greater volumes of potentially beneficial latency within their processes as well as a comprehensive presence across the affected areas.

Initial work was required to develop an attractive proposition that will be acceptable to I&C site operators to vary their electrical load so that it is more compatible with peak output from embedded renewables on the same 33kV feeders. It was expected that public engagement would be primarily direct to customers but aggregator routes were also investigated to verify if they could meet the trial service requirements. The various methods were applied over a two year trial period to establish the most effective when measured against the key criteria:

- Cost of operation;
- Reliability / effectiveness;
- Ease of participant recruitment; and
- Ease of ongoing operation.

The objectives of the trial were to validate the following:

Objective	Status
Customers can be incentivised to alter their behaviour to manage operational issues arising from excess embedded generation.	✓
DR can be used as a reliable and economic alternative to manage generation constraints.	×
Generation can be adequately absorbed through customer behaviour changes to address immediate issues and potentially facilitate further connections.	✓
Which methods of operation and customer proposition are most successful at achieving the above?	✓
Develop contracts, processes, skills and systems to	✓

manage the above trials along with potential migration path to business as usual.	
Compatibility of DR Service / incentives with Energy Storage developers.	✓
Establish if adequate consumer flexibility exists to have a meaningful impact on generation constraints.	✓
Identify compatibility or conflicts that such a scheme may have with TO, SO & market.	✓

3 Success Criteria

The table below lists details and measurement of success criteria for SYNC.

Success Criteria	Status
Development of suitable proposition to present to customers along with associated contracts and public engagement collateral.	✓
Engagement of appropriate I&C customers with the ability to have the desired impact on network loads through behaviour change.	✓
Demonstrable improvement in the currently experienced issues including high voltage, reverse power, power factor and thermal constraints.	✗
The services tested offer comparable or improved performance over conventional reinforcement • Speed of deployment • Reliability • Better value for consumers	≈ Partially met

4 Details of Work Carried Out

The work carried out was split into 4 techniques.

4.1 Technique 1: Impacts of cloud cover on PV dominated networks

Alongside the steady state impacts of connecting PV on the network, there is a potential for high concentrations of PV generation to cause more dynamic issues. With generators drawing power from the same source there is the option for multiple generators to act in concert with changes in cloud cover. This could cause issues with voltage stability potentially increasing the use and wear on transformer tap changers. Whilst this has been highlighted anecdotally, WPD has had no evidence of such issues occurring on its network.

The initial T1 investigations focussed on the existence of any rapid changes on the network and any potential implications.

This was split into two sections:

Literature Review – The aim of the literature review was to find and review reported evidence of, and solutions to, network operational problems caused by rapid variations of PV output. The scope for this included the following potential problems:

- Network voltage variations;
- Increased tap changer operations;
- Issues with voltage-control schemes;
- Power-quality issues; and
- Nuisance tripping.

Investigation of Existing Data – The research aimed to identify and investigate any adverse effects that solar PV generation may already be having on WPD networks, particularly on transformer tap changers. Existing datasets were used to provide an initial assessment whilst avoiding the cost of further monitoring.

The data included:

- Measured transformer current, voltage and tap changer operations from 96 substations in the midlands. This was at 1 minute resolution and included over 300 million data points made up of: transformer voltages, currents, tap positions, tap counters and several other measures; and

- Hourly measured solar irradiance from Met-Office weather stations, this includes solar irradiance data as well as cloud cover data.

The aim was to identify and investigate correlations between the above data sets. The following datasets were also used:

- High-resolution irradiance data from CREST's own monitoring system;
- Substation geographic and network map data from WPD; and
- Solar farm geographic locations from DECC.

The investigations were carried out by CREST (Centre for Renewable Energy Systems Technology) at Loughborough University, utilising their significant expertise in the areas of both PV monitoring and data analysis.

Following the investigation, WPD presented the summary findings for industry consultation. No counter responses or counter evidence was received.

4.2 Technique 2: Load Matching

In T2 WPD sought to investigate the possibility of utilised in increases in demand to provide a direct benefit to customers through a reduction in curtailment. By matching additional demand to generation curtailed under an ANM system, curtailment could be reduced and value created for the demand. The aim of T2 was to investigate the feasibility of creating a market between demand and generation customers in such a market.

A report was produced which highlighted the significant challenges associated with such a Scheme. In addition the low levels of current curtailment on an ANM system made trialling any such market unfeasible.

4.3 Technique 3: DSR turn up

In T3 we sought to build a DSR service to help WPD manage network constraints during times of low demand and high generation. This aimed to build on the findings from project Falcon and deliver a similar DSR service in reverse. The following sections highlight the key elements of the service.

Joint service development

Very early in the project, links to National Grid's Demand Turn Up service were identified. These links were pursued to ensure effective coordination of the services. This would provide multiple benefits to customers and address some of the key learning points from previous DNO DSR trials which highlighted the importance of collaboration.

Whilst the original intention of both parties was the development of coordinated services, following multiple discussions it became apparent that the optimal way of reducing customer burden and sharing information was to operate a joint contracting and dispatch mechanism. Instead of both developing dispatch and settlement processes with continuous data sharing, as well as interlinking contracts, it was significantly more efficient to share the processes. Not only did it remove burdensome processes, it also significantly improved the simplicity of the customer facing proposition. Due to the requirement of DTU on a national scale, the dispatch and contracting was taken on by National Grid. WPD offered support in development of the contracts and signposting customers towards the service.

With a service start date of 1st May, service development began in winter 2015. Expressions of Interest were gathered during February, firm offers were submitted by providers and assessed by National Grid in April and contracting began following successful parties being notified.

Service Tendering and customer acquisition

DTU was available nationally to any large energy user or embedded generator that could provide the required response. WPD focussed on sites in its South West and South Wales areas. As per the other ancillary services, DTU was technology agnostic allowing customers to provide the response in the most cost effective manner. Providers were asked to classify the asset types used to help both providers understand the market better. In addition customers were asked to specify site operation details such as:

- Minimum contracted MW;
- Maximum contracted MW;
- Minimum utilisation period;
- Maximum utilisation periods;
- Response time to deliver full contracted MW;
- Response time to a variation in utilisation instruction;
- Recovery time; and
- Maximum number of Utilisation instructions in a single service window.

This information formed the basis of their contracted operational requirements.

In addition a minimum threshold of 1MW per grid supply point (GSP) was imposed to all participants to allow for a usable service for National Grid.

As per the other Balancing Services, the DTU service was a competitive service. Following publicity of the service, interested parties were invited to submit Expressions of Interest (EOI) in order to gauge possible participation in the service. Following this, interested parties were asked to submit their firm offers into a tender. As there was no commitment attached to the EOIs, the firm offers represented parties' intent and were used in the assessment to determine which parties were offered contracts for the 2016 service period. .

Following the decision to join the two services, WPD signposted any interested parties in the SYNC service towards National Grid and their EOI. The rapid turnaround from conception of the service to procurement and implementation meant that not all parties who originally verbally expressed interest in participating in the service were able to progress to formal EOIs or firm offers. EOIs were received from 20 parties, totalling 339-420 MW (parties were asked to submit minimum and maximum offers). Firm offers were submitted by 12 parties, totally 309 MW. Following the assessment, all firm offers were accepted.

Pricing

The structure of payments to providers was similar to that of other Balancing Services, consisting of Availability payments (for being available to respond to an instruction) and Utilisation payments (for delivery of the service). The service offered £1.50/MW/h for Availability and three options for Utilisation: £60/MWh, £75/MWh, and above £75/MWh (with no Availability payment for the latter).

The payments above applied within the specified service windows (see section 3.4). The periods between service windows were classed as optional windows. During optional windows, providers received Utilisation payments if called upon, but no payment for Availability.

As National Grid takes the most economically efficient balancing actions, the use of DTU providers was considered against the cost of alternative actions. When DTU was identified as the appropriate action, providers were utilised in order of their Utilisation payment (lowest first).

Whilst WPD would also dispatch on economic merit, the locational elements create an amended price stack. This could result in sites with lower Utilisations not being called, when sites with higher Utilisations in the right area are.

Service windows

DTU offered a flexible service with windows that reflected the different use cases. This included the overnight window and the middle of a weekend day. Customers could declare their availability for the windows week ahead. Optional windows were also available for any providers able to offer additional flexibility in their operations. The service windows are summarised in figure 1 below. As WPD was seeking to mitigate issues around PV, it would not make any calls in Window 2.

	Overnight period **Monday – Sunday** **(window 1)**	**Weekend afternoon period** **Saturday, Sunday & bank holidays** **(window 2)**
May and September	23:30 – 08:30	13:00 – 16:00
June, July, August	23:30 – 09:00	13:00 – 16:00

Figure 1: Table showing DTU service windows

Operational Process

For the operational process around the DTU trial in 2016, email communication played an integral role in facilitating communication flows. Figure 2 below illustrates the interface between DTU providers, National Grid and WPD.

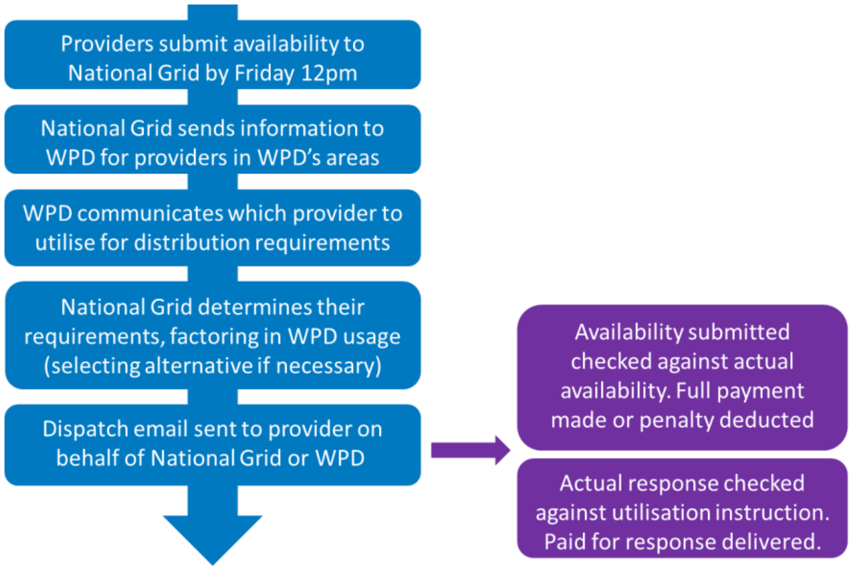

Figure 2: Illustration showing the interface between DTU providers, National Grid and WPD

DTU providers had until 12:00 on a Friday to submit their availability for the coming week of the service (Monday to Sunday). This information was emailed to National Grid via an Excel Visual Basic tool (see example in Appendix 1). The collated availabilities for WPD's areas were then forwarded on to WPD in order for WPD to determine which providers they wished to utilise.

To dispatch a unit, National Grid would email (see Appendix 2) the provider with a utilisation instruction, including the required MW response, the start time and the end time. A confirmation response was then required from the provider within 30 minutes of the utilisation issue being issued. Following this confirmation, the unit was deemed a confirmed instruction. As a number of providers' sites had fewer staff on site during DTU periods (overnight and weekends), SMS messages were also issued to notify staff that an email instruction had been issued.

Unlike other services, a number of technical parameters remained flexible for DTU, in order to remove barriers to entry. No minimum response time or duration of response were specified; instead, providers communicated the response time and duration they were capable of and utilisation instructions were always issued within these limits.

WPD could call a unit after 14:00 on the Friday until the response time of the unit, however in practice all calls would be identified and dispatched on the Friday. The actual dispatch mechanism was through an Excel Visual Basic tool that generated an automated email. Following the dispatch a confirmation or rejection email would be automatically sent from National Grid.

This simple mechanism allowed sufficient robust checks to be made on any dispatch, whilst also allowing some flexibility for changes.

Metering and settlement

Providers were asked to submit three documents:

- An availability report, submitted to National Grid before 12:00 on a Friday, detailing their availability for the coming Monday to Sunday;
- A forecast report, submitted to National Grid by providers before 14:00 on a Friday, detailing their forecast electricity demand or output over the coming week (depending on whether DTU was being provided by an increase in demand or reduction in output); and
- A performance report, submitted to National Grid monthly, containing metering data of the providers actual demand or output.

Performance was assessed post-event, rather than monitored on a live basis. In order to assess delivery of the service, data in the performance report was compared to the instructions issued by National Grid. For full delivery, there should be an increase in demand or reduction in output that correlated with the timing and magnitude of the instruction issued. The forecast report was used to determine that an increase in demand or reduction in output was the result of a DTU instruction, rather than an action the provider would have taken as part of their normal activities.

To allow maximum site participation in the first season of DTU, providers could submit metering data on either a minute by minute or half hourly basis for each participating MPAN. If a provider failed to deliver full volume within the period requested, penalties were applied. Delivering 90% or more of the volume requested in the utilisation instruction resulted in 100% of Availability and Utilisation payments. Delivering less than 90% of the volume requested resulted in a reduction in both payments. For example, if a provider delivered 8.9 MW of a 10 MW utilisation instruction, they would be paid 89% of their Availability payment for that month and a Utilisation payment for 8.9 MW for the period in question.

Legal

One of the key challenges of delivering the shared service was the development of a legal framework to support the arrangement. This was designed for customer simplicity whilst delivering the required information sharing and controls. It consisted to two parts and both were developed by setting out the general principles in Heads of Terms, prior to drafting complete contracts.

The provider contract: This set out the obligations on both National Grid and the DTU provider. This was based on standard terms for all participants and included a clause permitting data sharing with DNOs. Data sharing was necessary for multi-party use of distributed energy resources, as both National Grid and WPD required transparency on location, availability and prices in order to establish how requirements could be met and to coordinate utilisation.

The WPD-National Grid Bilateral: This set out the obligations on both National Grid and WPD in terms of operational processes and monetary flows.

Both contracts can be found on National Grid's and WPD's websites.

4.4 Technique 4: DUoS adjustments

T4 involved a desktop study into the effect of modifications in charging arrangements on summer demand.

Alongside the direct payments investigated in T2 and T3 it was acknowledged that the underlying charging methodology has a significant impact on the operation and siting of generation and demand. As such adjustments in this methodology could deliver significant underlying benefits.

The Technique aimed to stimulate discussion in the area to develop suggestions for changes.

During the period of the project, the topic of network charging and the potential impacts was brought to the fore with significant sections devoted to it in the joint Ofgem and DBEIS "smart, flexible energy system" call for evidence. In addition the topic has been picked up in the ENA's TSO-DSO project, forming one of the 4 work streams and is also being addressed by Ofgem's Targeted charging review.

As such the scope of T4 was reduced to avoid duplication and to focus on a centralised discussion on the topic. A report covering the initial investigations was published.

5 Performance Compared to Original Aims, Objectives and Success Criteria

The Objectives of the trial were to validate the following:

Objective	Status	Performance
Customers can be incentivised to alter their behaviour to manage operational issues arising from excess embedded generation.	✓	Covered through the T3 DTU trial.
DR can be used as a reliable and economic alternative to manage generation constraints.	✗	Insufficient volume was recruited as part of the DTU trial to assess reliability for a DNO constraint. WPD will keep a watching brief on further DTU growth.
Generation can be adequately absorbed through customer behaviour changes to address immediate issues and potentially facilitate further connections.	✓	Customers responding to the T3 trial changed their output. With sufficient volume this may be possible to facilitate connections.
Which methods of operation and customer proposition are most successful at achieving the above?	✓	The T3 trial and feedback showed the improvements to be made to the customer proposition.
Develop contracts, processes, skills and systems to manage the above trials along with potential migration path to business as usual if.	✓	Contracts and processes were developed as part of T3.
Compatibility of DR Service / incentives with Energy Storage developers.	✓	Delivered through the contracts.

Establish is adequate consumer flexibility exists to have a meaningful impact on generation constraints.	✓	We established that current levels of commercially available flexibility are inadequate. These will be evaluated over time to asses any growth.
Identify compatibility or conflicts that such a scheme may have with TO, SO & market.	✓	Covered through the shared service with National Grid.

The table below lists details and measurement of success criteria for SYNC.

Success Criteria	Status	Performance
Development of suitable proposition to present to customers along with associated contracts and public engagement collateral.	✓	Developed as part of T3.
Engagement of appropriate I&C customers with the ability to have the desired impact on network loads through behaviour change.	✓	Covered in the DTU trial.
Demonstrable improvement in the currently experienced issues including high voltage, reverse power, power factor and thermal constraints.	✗	Insufficient volume was recruited to show demonstrable improvements.
The services tested offer comparable or improved performance over conventional reinforcement • Speed of deployment • Reliability • Better value for consumers	≈ Partially met	This was investigated; however the limited recruitment limited the certainty of conclusions.

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

Issues	Modifications to Approach
No concerns raised by initial investigations into T1.	No additional monitoring installed and no additional analysis was required.
Low levels of curtailment on existing ANM systems.	The investigation was limited to a desktop study.
Similar requirements between National Grid and T3.	Collaboration over T3 with joint DTU trial.
Significant other work in the area through TSO –DSO project and TCR.	Reduction of scope to avoid duplication.

7 Project Costs

During the project three change requests were raised these had the following changes to the overall project budget:

CRF01 – budget reduction of £90,000 for T2

CRF02 – budget reduction of £140,000 for T3

CRF03 – budget reduction of £20,000 for T4

This took the original total budget of £864,000 down to £614,000.

Subtracting the discount offered on SGC T&M took the total budgeted amount down to £489,000.

Activity	Original Budget (£)	Amended Budget (£)	Actual (£)	Comment
T1 Resource costs	£127,738	£127,738	£30,000	As initial investigation did not reveal any issues, further work was not required
T1 Equipment costs	£45,000	£45,000	£0	As above
T2 Resource costs	£116,932	£32,432	£30,000	
T2 Equipment costs	£5,500	£0	£0	
T3 Resource costs	£77,783	£62,283	£65,326	The coordination with National Grid required additional resource
T3 Equipment costs	£5,500	£0	£0	
T3 contracts engineer	£119,336	£0		
T4 Resource costs	£37,275	£17,275	£15,000	
Customer payment pot	£150,430	£150,430	£0	No customer payments were made
Contingency	£53,506	£53,506	£0	No contingency used
Total	**£739,000**	**£488,664**	**£140,326**	

8 Lessons Learnt for Future Projects

8.1 Technique 1

- The initial investigation into rapid fluctuations in voltage due to PV has uncovered no major issues. Whilst it is certainly true that cloud cover does create large changes in

real and reactive current, the voltages observed remain within limits for the substations monitored; and
- In general the literature agrees with this observation. There are no examples of major issues, with most concerns raised from very conservative modelling.

8.2 Technique 2

- There is currently little requirement for a load matching scheme due to low levels of ANM curtailment; and
- In addition implementing such a scheme has high risks of causing detriment to other customers limiting the potential for application.

8.3 Technique 3

- There is value at both SO and DNO level for turn up services;
- There requirement do not overlap heavily, with DNO requirements focussed in the day and SO operations more active overnight;
- Coordination between parties is possible and can be effective;
- Call reliability can be high, although the availability in the right areas for DNOs is limited;
- Customers like the flexible service, although internal approval can be time consuming;
- Limitations for entry include the value available as well as the locational requirements and forecasting requirements; and
- Services require time to develop market understanding and confidence.

8.4 Technique 4

- External interest in the topic is high and can move very quickly. This was reflected in the reduction of the T4 scope.

9 The Outcomes of the Project

9.1 Technique 1

The investigations by CREST gave the following findings.

Literature review:

- The power output of PV generators varies rapidly, following the variations in irradiance. Drops in power tend to be quicker as increases are delayed by inverters adjusting their operating points. The impact of shading can be non-linear due to the stringing of the cells;
- Whilst point measurements of irradiance vary significantly, spread across the area of a sizable array there is a considerable smoothing effect;
- A short, small, increase in irradiance can be observed ahead of cloud cover due to cloud edge;
- Some studies reported higher levels of tap changing, however these were minimal across the lifetime of the asset;
- Other studies showed far more onerous issues, however these were generally based on simulations ignoring any averaging effects from spatial separation; and
- Some papers highlighted concerns around high frequency harmonics, this may merit additional study in future.

Data analysis:

- The presence of PV causes significant reduction and even reverse real current flows in transformers;
- The level of reactive import into the system also increases with PV;
- There are significant rapid variations in real and reactive current due to PV. Swings of over 250A (15MW) in under 10 minutes were present;
- The power factor varies rapidly as the direction of flow changes;
- These changes aren't present for substations with little or no PV;
- In general the voltages measured are far more stable than the currents. For the measurement points:
    - 99% of all measurements are within a 3% band
    - 99.9% of all measurements are within a 4% band
    - 99.99% of all measurements are within a 6% band
- There was no clear distinction between voltages at substation with PV to those without;
- Tap change operations at sites with high PV penetration, on days of high irradiance variability were minimal; and
- The distribution of tap changes throughout the year is shown in Figure 3. This shows that despite the high penetration of PV, the number of tap change operations decreases over the summer months.

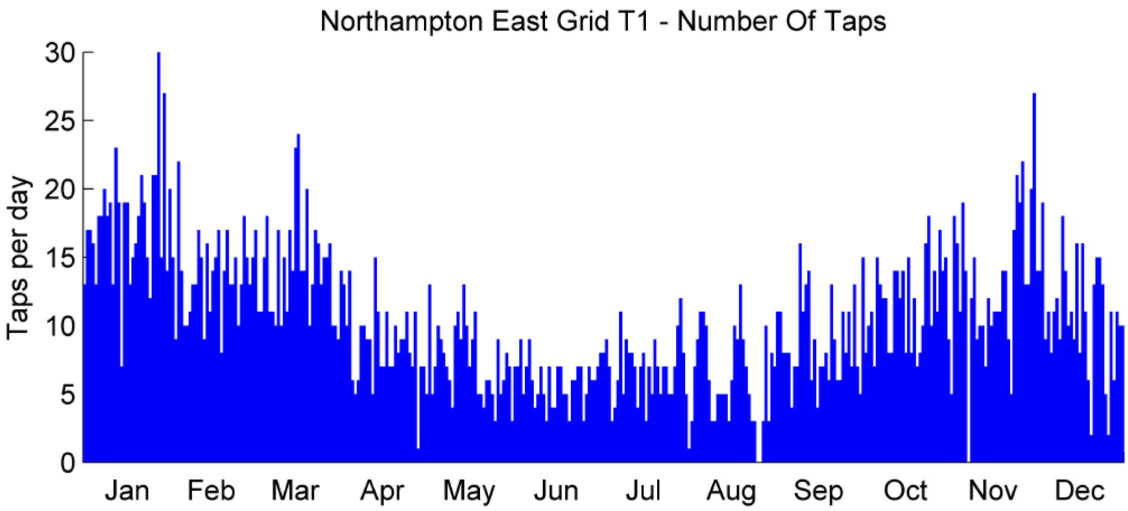

Figure 3: Northampton Grid yearly tap changes

The investigation by CREST showed little of concern from existing data

More details on the findings can be found in the T1 report here: https://www.westernpower.co.uk/docs/Innovation/Current-projects/SYNC/T1-Impact-of-cloud-cover-on-PV-results-1-0.aspx

With no concerns raised from this investigation, and no issues raised from the consultation, no further monitoring was carried out.

9.2 Technique 2

The initial investigations into technique 2 highlighted significant challenges to be overcome in the implementation of a local load matching market. These are summarized below.

9.2.1 Determining a baseline and predicting curtailment

There are significant challenges in determining adequate baselines at the level of granularity required.

9.2.2 Purchase of change in demand, fixed demand or minimum demand

The definition of the commodity traded is by no means straightforward and must balance the output required for the generator against what is deliverable by demand customers

9.2.3 Potential for customer detriment

Where load is shifted rather than added there are significant risks of detriment occurring to other customers in the ANM schemes. Protections could be implemented within systems; however the complexity and conservatism needed to ensure other customers aren't adversely affected would limit the flexibility and commercial viability of such a scheme.

In addition introducing a load matching scheme may be considered as a change to the principles of access of the ANM scheme, moving from a simple chronological LIFO stack to a more complex chronological and commercial LIFO.

9.2.4 Market Structure

Whilst a general forward or reverse auction could cover the scenarios where there is more flexible demand or generation on the system, the contracting mechanism must balance risk and reward effectively. Longer term contracts reduce uncertainty but will deliver turn up when not required; conversely short term contracts may not be sufficiently attractive to demand customers

9.2.5 Coordination with Existing DSR schemes

The scheme must coordinate with other DSR schemes such as DTU (covered in T3). The value attributed to any load matching scheme would need to be higher to make it worthwhile for demand customers.

9.2.6 Market winners and losers

Finally it should be acknowledged that in any market there will be winners and losers. By opening up a new Load matching market, some existing customers may lose out to more commercially aware competitors.

These complexities make implementing such a scheme extremely challenging.

More details can be found here:

https://www.westernpower.co.uk/docs/Innovation/Current-projects/SYNC/SYNC-T2-report-final.aspx

9.3 Technique 3

The trial over the summer of 2016 gave the following findings:

9.3.1 Operations

NG operation

Across May to September 2016, 323 utilisation instructions were issued for DTU, totalling 10,800 MWh. Of these utilisation instructions, 317 were to address downward margin issues, 4 were to manage transmission constraints, and 2 were for WPD (figure 4).

The majority of utilisation instructions were issued by National Grid during window 1, the overnight period. There was a significant increase in utilisation of the service during July onwards, linked with an increase in overnight wind speeds during that time. This was in contrast to the trend over the last few summers; from 2012 to 2015, the highest overnight wind speeds were seen in May and June. Utilisation during window 2 (weekend day time) was significantly lower, due to lower than average solar radiation on weekends (figure 5).

Providers were asked to deliver DTU for 4.3 hours on average, the average notice of a utilisation instruction (i.e. the time between receiving an instruction and responding) was 7.3 hours, and the average price for utilisation was £61.41/MWh (availability was fixed at £1.50/MW/h).

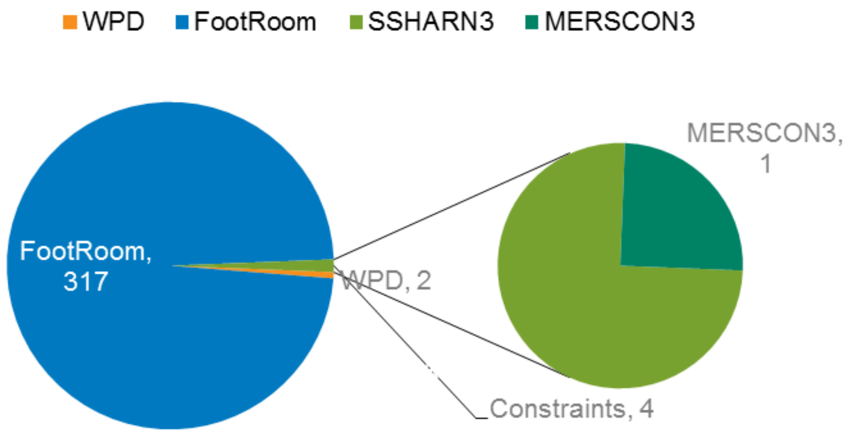

Figure 4 – chart showing reasons for DTU utilisation instructions (MERSCON3 and SSHARN3 are constraints on the transmission network)

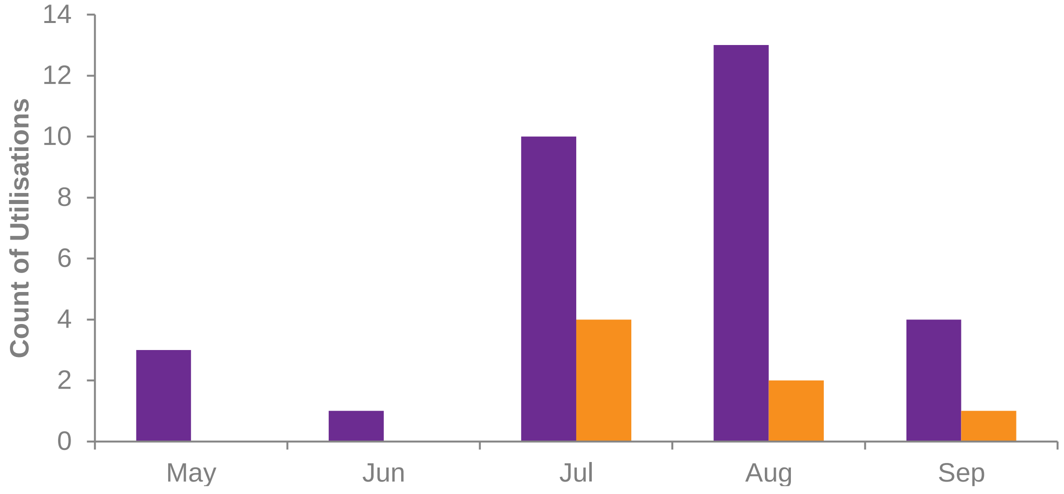

Figure 5 – DTU utilisations per month, by window

Overall, the introduction of DTU delivered significant savings for National Grid during the period May to September 2016, by providing an alternative solution to economically securing negative reserve.

WPD operations

Throughout the trial WPD experienced relatively low availability from providers in its South West and South Wales regions during window 2. There were multiple periods of little or no availability in the areas which limited WPD's ability to test the service. In addition the particular connection arrangements of some providers restricted the benefits they could provide the DNO. WPD attempted and made two successful calls that were dispatched through the National Grid customer interface to test the functionality of the service but did not proceed to more functional testing of constraint management.

The customer feedback, detailed in section 5.3 detailed some of the reasons behind the low availability. WPD will monitor the effect of addressing these concerns on availability in 2017.

9.3.2 Trial analysis

Availability

DTU was not introduced as a firm or committed service, providers were able to declare their availability on a Friday for the coming week (Monday to Sunday). In the first few weeks of the service in particular, there was a discrepancy between the volume of accepted firm offers and the volume being declared available for service provision. Verbal feedback suggests this was partly due to providers refining their operational processes following contracting. To increase availability from the start of the service in 2017, additional time will be factored to introducing the service requirements and the service start date.

Call reliability

Of the utilisation instructions issued during the first year of DTU, 88% of the expected volume was delivered.

Customer Feedback

A number of providers shared feedback on their experience of the first year of DTU and this has been used to identify improvements that can be implemented to increase ease of participation in the service.

Several themes were identified:

General preference for a flexible service.

For 2016, DTU was procured as a flexible service. Providers were given the flexibility to decide a week ahead of real time which windows they wished to be available for. There was no long term commitment to provide the service and providers did not need to be available for every window.

Feedback indicated that most providers valued the ability to declare availability closer to real time, as they could not give as accurate a view of their availability more than a week ahead of real time. This was less challenging for businesses with steady and predictable demand or generation profiles.

Recruiting customers and getting internal approval were the most common time consuming/challenging steps identified by providers

In order to understand the challenges providers faced in preparing for service provision, feedback was gathered on the most time consuming steps. A number of aggregators identified growing their customer base as a challenge, particularly given that DTU was a new service, and gaining internal approval or sanction was also raised.

Alternative options to assessing delivery of the service should be explored

For 2016, delivery of the service was assessed based on providers' forecast activity (demand or output) and their actual activity. If the different between the two were equal to the MW volume specified in the utilisation instruction, the provider was deemed to have delivered the service.

Many providers did not produce forecasts routinely, or produce forecasts to the same level of detail, and therefore this was an additional activity to undertake. Others raised concerns about the accuracy of their forecast.

In order to address this feedback, a baseline methodology is under development, using the average demand or output of pervious days to establish a baseline. This is similar to other Balancing Services.

Barriers to entry included the locational requirement for achieving 1 MW and the length of the overnight period

National Grid specifies entry volumes for Balancing Services in order to make services usable. The threshold for DTU in 2016 was 1 MW, which could be aggregated at a Grid Supply Point (GSP) level. This meant that a number of sites could be combined to achieve 1 MW, providing they were located in the same GSP. A number of providers, for example those with sites in different locations, found this challenging. The 1 MW threshold will remain for 2017; however, in order to increase participation in the service, the locational restriction will be lifted, so sites can be aggregated from across the country.

Some providers also found it difficult to declare availability for the whole overnight window due to the 9.5-10 hour duration. To overcome this, there will be greater granularity within availability windows in 2017.

Increased participation with service maturity

Several providers highlighted the difficulty of committing resource to develop a capability associated with a trial. As the DTU service matures this will increase market confidence and grow participation. In addition increased industry understanding of the service will enable wider acceptance of the scheme as well as changes to operating practices such as maintenance schedules.

9.3.3 Conclusions

National Grid

For National Grid, DTU fulfilled the desired objectives of providing another economic alternative for negative reserve. Utilisation followed weather patterns and providers responded with good reliability. Providers gave useful feedback which will influence the next steps.

WPD

For a DNO, low availability of providers in the right areas limited the value of the service. In order to use DSR as an alternative to reinforcement, the DNO must be confident that a response can be triggered when required. In addition the number of utilisations required would be significantly lower than those provided by National Grid. As such WPD is keen to see how the service develops following the changes to better understand the potential to use DTU as part of business as usual.

Full details on the T3 trial are available from the joint WPD/NG report available at www.westernpower.co.uk/docs/Innovation/Current-projects/SYNC/Demand-Turn-Up-joint-report.aspx.

9.4 Technique 4

As discussed in section 4.4 the scope of Technique 4 was reduced to focus conversations in the emerging centralised forums.

The initial investigations did suggest 5 options for future pricing.

9.4.1 Introduction of seasonal charging

One potential option would be to add seasonal charges. These would allow the differentiation of tariffs between seasons and acknowledge the differing network conditions in winter and summer. This will make the charging more cost reflective, but without other changes would push revenue collection further into the winter months.

9.4.2 Introduction of location specific charges

Changing the granularity of charging and focussing on a less hypothetical model would allow much stronger pricing signals for reinforcement. This would prevent the financial incentives for specific behaviours being attenuated across all customers and provide a more cost reflective charging structure. This would help new sites consider more network friendly locations by adding an operation cost to the placement of sites in low capacity areas. Stronger price signals will however lead to more volatility and could be very punitive in some locations.

9.4.3 Considering generation led reinforcement

This would acknowledge that DNO networks are no longer purely demand driven. As such there are operational and reinforcement costs associated with generation. As such the recoverable revenue could be split and the processes run in reverse for generation. The provision of credits could be kept in both methodologies to acknowledge the benefits of generation at times of peak demand and demand at times of peak generation.

9.4.4 Capacity charging

This option would involve charging for DNO networks on a predominantly kW rather than kWh basis. This acknowledges that the costs to DNO's are based on power requirements rather than energy. Networks are built around contracted maximum demands and so reflecting this more strongly in charging may be more cost reflective. There are multiple variations based on when and how often the power values are taken. There are maximum demand charges in the current methodology; however they currently make up a small percentage of DUoS revenues.

9.4.5 Flat charging with DSR over the top

This would move away from the any locational/seasonal issues for base costs, setting out a fixed based cost. This could be derived on a kWh basis to recover a set revenue. DNO's could then raise specific and localised DSR programmes on top of this to incentivise the right behaviours in the right locations. This has the benefit of being able to target the incentives accurately and avoid any over incentivising due to the summation of DUoS and DSR charges.

More details on the T4 work can be found here: https://www.westernpower.co.uk/docs/Innovation/Current-projects/SYNC/T4-discussion-paper-final-2.aspx

10 Data Access Details

No raw data was collected as part of this project.

Data on the associated DTU calls can be found on National Grid's market information page: www.nationalgrid.com/uk/electricity/balancing-services/reserve-services/demand-turn?marketinformation

11 Foreground IPR

IPR	Owner
T1 Assessment methodology	Loughborough University
T2 Project Investigations	WPD
T3 Bilateral contract	WPD/National Grid
T3 Dispatch processes	WPD/National Grid

12 Planned Implementation

12.1 Technique 1

No concerns were raised and so there is no requirement for any follow up action.

12.2 Technique 2

There is currently limited ANM curtailment, limiting the requirement for load matching. There are also potential risks with customer detriment. There is no planned implementation of T2. However, WPD is progressing with other commercial innovation in projects like the Plugs and Socket, where a local energy market is being investigated, and the investigation into Virtual Private wires. These projects seek to investigate alternative options to make the most of local flexibility.

12.3 Technique 3

WPD is maintaining a watching brief with the National Grid DTU programme. Should volume grow in the correct areas implementation will be considered.

12.4 Technique 4

Investigations will feed into existing industry processes (TSO-DSO project and TCR).

13 Other Comments

N/A

14 Contact

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

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Glossary

Abbreviation	Term
ANM	Active Network Management
DBEIS	Department for Business, Energy and Industrial Strategy
CREST	Centre for Renewable Energy Systems Technology
DECC	Department for Energy and Climate Change
DNO	Distribution Network Operator
DR	Demand Response
DSO	Distribution System Operator
DSR	Demand Side Response
DTU	Demand Turn Up
DUoS	Distribution Use of System
ENA	Energy Networks Association
FALCON	Flexible Approaches for Low Carbon Optimised Networks
GSP	Grid Supply Point
LIFO	Last in First Out
MPAN	Meter Point Administration Number
MW	Mega Watt
PV	Photo-Voltaic
SMS	Short Message Service
SO	System Operator
SYNC	Solar Yield Network Constraints
TCR	Targeted Charging Review
TO	Transmission Operator
ToU	Time of Use
TSO	Transmission System Operator
WPD	Western Power Distribution