

## UK POWER NETWORK'S FLEXIBILITY MARKET OFFERS NEW REVENUE STREAM FOR CUSTOMERS & ENHANCES ACTIVE OPERATION OF THE DISTRIBUTION NETWORK

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### ABSTRACT

*As UK Power Networks continues to operate and invest in the network to accommodate the new low carbon world, we will need to use smart, flexible, and innovative techniques to ensure delivery of our outputs, minimise the cost impact on consumers, and manage the uncertainty and complexity of this new world.*

*Flexibility is the future for electricity networks. The UK Power Networks Flexibility Roadmap looks at radical proposals to drive the market for flexibility services and helping to reduce our customer's bills.*

*UK Power Networks is proposing to adopt a 'flexibility first' approach to delivering additional network capacity, which we believe will lead to lower costs and increased renewable energy on the network through more competition.*

*UK Power Networks flexibility programme is looking to utilise response from generators, demand side providers, and electricity storage resources connected to our networks to support efficient network planning and operations. There can be various applications of flexibility, from facilitating outages to managing demand growth uncertainty on our investment decisions.*

### INTRODUCTION

Flexible resources connected to the distribution network can help network operators by reducing net loading on the local network during peak times. This enables more efficient network investment decisions, whilst also facilitating the operation of the smart grid as the electricity system goes through a period of unprecedented change. An earlier study by Imperial College London [1] found that deploying flexible services could save customers across the UK £17bn - £40bn by 2050.

To manage the changing electricity system we are transitioning from being a Distribution Network Operator (DNO) to a Distribution System Operator (DSO). In our Future Smart strategy [2], we described how as a DSO we will increasingly use flexibility from distributed energy resources (DER). The roles of the DSO are:

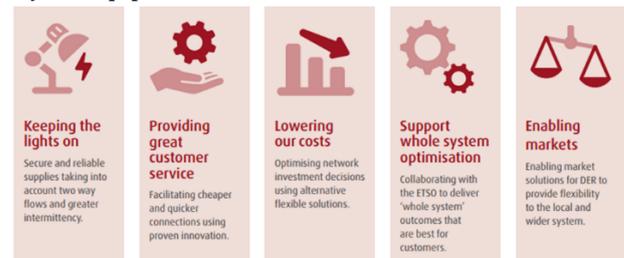


Figure 1 – The Key Roles of a Distribution System Operator.

This change responds to the the rapid deployment of renewable generation on our networks over the past decade. More recently, we are seeing the emergence of new DER such as storage and electric vehicles (EVs), and changing electricity usage patterns of our customers. By 2030, we are predicting close to 2 million EVs charging across our network under our 'Business as Usual' scenario. UK Power Networks has 60'000 plug-in cars across the network and this is forecasted to increase up to 4.1million by 2030. These fundamental system changes are challenging both how we maintain and operate our network today, as well as creating opportunities for us to do so more efficiently in the future.

UK Power Networks announced sweeping proposals through its Flexibility Roadmap [3] in 2018 that will help lower electricity costs for customers and open up new local energy markets. UK Power Networks was the first of the UK's six distribution networks to adopt a 'flexibility first' approach to delivering additional network capacity to the 8.2m homes, businesses, schools and hospitals it serves.

DER can provide flexibility to the system, directly or through a third party that aggregates multiple DER, by adjusting their demand or generation of electricity based on the needs of the system. The use of flexibility could deliver more energy with less network infrastructure, thus helping to keep costs down for our customers whilst also facilitating the low carbon transition. It also creates a new source of revenue that flexible providers can access to support deployment of flexible resources.

We have identified three core use cases where DER flexibility can support us today to operate and manage our networks more efficiently: load related reinforcement deferral, managing planned maintenance, and responding to (unplanned) network outages. In order to understand the most efficient solution in all cases, we plan to market test

through flexibility all of our new higher voltage (EHV and HV) load related reinforcement through the remainder of the current regulatory price control (to 2023). This makes up approximately 75% of our load related reinforcement program. We estimate that our market for flexibility could be more than 200 MW for our load related reinforcement deferral use case by 2023.

We are exploring a range of commercial solutions for accessing flexibility on the low voltage (LV) networks. As a starting point, we plan to market test some LV reinforcement as part of our March 2019 tender. We will continue to develop our LV flexibility products with the aim to market test our LV load driven reinforcement requirements by the end of the regulatory price control period. We also intend to trial new flexibility services from DER to manage needs on the low voltage network in particular from EVs.

UK Power Networks have set out significant commitments over the next five years to use flexibility first to traditional network reinforcements on the higher voltage networks, as well as developing new services to accommodate the changes on our network as a result of the low carbon transition. As the use of DER flexibility increases on the distribution network, effective system operations will require increased market and commercial capabilities as well as enhanced active network management systems.

This paper will be presenting the key commitments made in our roadmap and how that will reduce costs for consumers and create new markets for flexible distributed energy resources.

## FLEXIBILITY ROADMAP

UK Power Networks' flexibility requirement is focused on addressing the demand peaks at specific distribution network locations. The need materialises when there is a network constraint, which is when load exceeds a network limit. When this occurs, we will instruct providers to deliver their contracted flexibility.

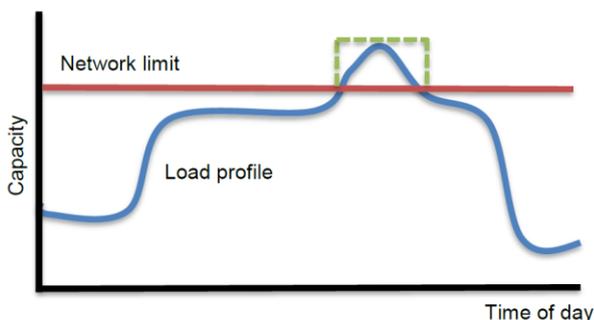


Figure 2 – Load profile and flexibility capacity for peak shaving

The Flexibility Roadmap sets out UK Power Networks' key activities over the coming years including the approach to procuring flexibility, development of products for other flexibility use cases, and how customers and

flexibility providers can get involved. The document follows from our Future Smart strategy where we identified the use of customer flexibility as one of our key DSO priorities. It also builds on the learning from the flexibility tender ran in 2017 where we successfully procured flexibility services in two network locations.

The Flexibility Roadmap was launched at a stakeholder event in late 2018 attended by over one hundred people from aggregators, end users, local authorities, developers, and policy makers. The event served to announce the opportunities but also to capture feedback from the event and encourage formal responses, of which we received 13, to allow us to continue to refine and develop our approach.

## THE IMPORTANCE OF FLEXIBILITY IN THE ENERGY TRANSITION

The move to a low carbon economy and greater decentralisation is changing the way we and other DNOs need to plan, maintain and operate the distribution networks. At the same time, technological change and new market entrants are providing DNOs with new tools and opportunities to facilitate this transition. The new role of the DSO is emerging in response to this changing environment.

In recent years we have seen a rapid decentralisation of energy production. There is now almost 25 GW of solar and onshore wind capacity installed in Great Britain. The majority of this is connected to distribution networks and has a variable energy output. We are also seeing the direct participation of consumers in the electricity market, with this trend expected to continue. Prosumerism, where consumers take more control over how they use energy through on-site generation, storage or demand side response is a key component of the energy transition.

We are already seeing the partial electrification of heat and transport. There has been a significant uptake in EVs, including private vehicles and commercial fleets. The take up of load intensive devices like EV charging points is complex to predict, in terms of both volume and location. Forecasting and managing this EV led load growth will be a key focus for our business over the next decade.

## UK POWER NETWORKS DSO VISION

Building on our successful innovation portfolio, we launched our consultation on our DSO vision and strategy – Future Smart in July 2017. This document sets out how we will transition our business over the coming years in order to continue to provide a high quality service to our customers, amid the changing energy landscape.

Using flexibility to help manage our network can benefit our customers and DER, while helping to facilitate Government policy.



Figure 3 – The flexibility services benefits and outcomes.

## CURRENT DSO FLEXIBILITY NEEDS

### Reinforcement Deferral

In order to maintain reliable supplies for our customers we must ensure that there is sufficient network capacity. We proactively forecast demand and generation growth across our network to anticipate reinforcement requirements and plan accordingly. Historically, this planning has been undertaken against the backdrop of very stable demand growth, with only limited amounts of generation connecting to our networks.

Reinforcing is a significant investment, with the impact of demand driven reinforcement contributing to customer bills over a number of decades. The increased uncertainty around future load growth means that we need to ensure any investment undertaken addresses the need in an efficient and economic manner. Hence, delaying investment can reduce that risk, ensuring that network assets are utilised as efficiently as possible until reinforcement is needed.

Rather than reinforcing the network in all cases, we plan to use flexible DER to maintain the network within its operational limits. Our aim is to market test all new EHV and HV load related reinforcement prior to deciding whether to install new assets.

### Planned Maintenance

We are constantly monitoring, upgrading and replacing assets on our networks. These maintenance regimes are critical to ensuring the long-term reliability and security of the network for our customers.

When carrying out necessary maintenance on the network, we plan to seek to use flexibility to increase network resilience and manage any unexpected increases in load. This will be based on the DER resources which have registered at designated locations. These flexible resources could also allow for more efficient and flexible scheduling of maintenance, potentially allowing maintenance events

to be completed without a need for planned interruptions.

### Unplanned Interruptions

We have improved the reliability of our network dramatically over recent years, with the number of customer interruptions falling by 42% between 2010/11 to 2017/18. Unplanned interruptions can be caused by severe weather events, infrastructure failures or accidents, which are a major inconvenience to customers with significant customer welfare, economic and social impacts.

We want to use flexibility both pre and post fault to reduce the number and duration of unplanned interruptions that our customers experience.

## FLEXIBILITY PRODUCTS STRUCTURES

Our flexibility needs align to two core product structures:

- An availability and utilisation payment product for the Reinforcement Deferral and Planned Maintenance use cases.
- A utilisation only product for the Unplanned Interruptions use case.

These product structures are well understood by DER and commonly used across Electricity Transmission System Operator (ETSO) and other DSO products. The Product Summary is illustrated below:

Flexibility Products	Reinforcement Deferral	Planned Maintenance	Unplanned Interruptions	
			Pre-Fault Response	Post-Fault Response
<b>Value Drivers</b>	The present value of deferring capital expenditure	Managing unplanned interruption risk during planned maintenance	Customer Interruption (CI) and Minutes Lost (CML) Incentives	Avoided cost of temporary generation and potentially CMLs
<b>2023 Flexibility Potential (MW)</b>	206	Available to eligible DER capacity		
<b>High-Level Requirements</b>	<b>Location Specific</b>	Yes		
	<b>Response Time</b>	30 mins maximum		<10 mins preferred, 30 mins maximum
	<b>Response Duration</b>	Full availability window - case dependent. Pro-rated payment if available for part of window		3 hours. Pro-rated payment if available for part of window
	<b>DER Type</b>	Generation, Storage and Load Reduction		
<b>Contracting Principles</b>	<b>Procurement Type</b>	Competitive tenders or administratively set prices if low liquidity		Framework agreement. Optional updating of pricing through contract
	<b>Procurement Lead Time</b>	6 months ahead and 18 months ahead	Case specific 1-12 months	DER applies if eligible
	<b>Payment</b>	Availability and Utilisation		Utilisation only
	<b>Contract Term</b>	1-4 years	Monthly or seasonal	Framework agreement

Figure 4 – UK Power Networks' DSO Product Summary.

## FUTURE DSO SYSTEM NEEDS

This section explores what types of flexibility we might need in the future, in addition to our core use cases.

### Low Voltage Flexibility Products

We expect the trend of decentralised energy to continue at lower voltage levels. As yet, we have not seen the same

level of change on our low voltage networks as on our higher voltage networks, but expect this to rapidly change with electric vehicle take up, and an increase in electrification of heating. The future challenges on our low voltage networks could be greater than the ones we are already managing on our HV and EHV networks.

There are a range of different products which we may require including load related reinforcement, voltage management, and losses. However, due to the highly locational nature of the market, the unpredictability of need, and lower value the way we engage with the market for flexibility services may need to be different from that of the higher voltages.

### **Whole System Products**

A whole system co-ordination of flexibility needs and procurement will be crucial as the energy system becomes more integrated and interdependent. We plan to work with the ETSO and other network operators to jointly develop and procure flexibility in the future.

Through the Power Potential [4] project we are already working with National Grid to trial how DER on our network can help National Grid resolve constraints on the Transmission network.

### **Demand Turn-up**

All of the core flexibility products discussed earlier, require providers to reduce the active load on the network, whether by reducing their consumption or increasing their export onto the network. In the future, it may be necessary for us to procure demand turn-up services, which would involve participants either increasing their demand or reducing their output.

This behaviour is already seen in the case of generation customers under Flexible Connections. These generators have connected in a constrained region of the distribution network. Rather than contributing to the cost of reinforcement, they have instead opted to accept a degree of curtailment during periods of constraints. UK Power Networks have already begun to investigate ways to manage this curtailment more efficiently, creating a form of flexibility market that would allow generators to trade their curtailment obligations with each other. We are looking to trial such an approach in the near future.

Whilst we do not intend to develop a specific demand turn-up product in the short-term, we expect that our development of flexibility markets for Flexible Connection customers will provide a solid foundation if and when such a product is required.

### **Maximising DER Participation**

We recognise the importance of giving DER visibility of our needs and putting in place the tools and processes that

will allow us to work efficiently with high volumes of DER assets on a frequent basis. Flexibility platforms are the obvious vehicles for DSOs to maximise participation of DER, through greater transparency of needs and ease of contracting.

There is a large amount of innovation in the areas of emerging flexibility platforms, optimisation tools, and network management software. We have pioneered this space by working with the Piclo Flex platform [5] to allow DER assets to register their interest in providing flexibility services. Also, we are working closely with our stakeholders and new entrant technology companies to be at the forefront of this innovation. This is allowing us to contribute to the development of technology solutions that meet our needs and the needs of our customers. This innovation is critical to us delivering on our DSO vision of the future.

The key areas we have identified in our Flexibility Roadmap are:

- Visibility of market opportunities for DER
- Enhanced processes
- Fairness and transparency

### **Key Activities in 2019**

With network opportunities published on Piclo Flex, UK Power Networks shall be conducting a procurement event completing in March 2019 for services starting in the winter 2019/20 and 2020/21.

We shall also be developing and consulting on our plan for engaging with the market on LV flexibility services and ensuring transparent processes.

This will be followed by further stakeholder engagement events, and seeking flexibility services to support planned maintenance and unplanned interruptions.

### **ACTIVE NETWORK MANAGEMENT SYSTEM**

There are parts of the UK Power Networks distribution network where due to constraints such as capacity, voltage or reverse power flow issues the cost of connection is very likely to be higher than expected. This is because it will include a significant element of reinforcement work in order to overcome these technical challenges.

The Flexible Distributed Generation (FDG) connection offering was started from 2014 [6]. FDG aims to provide a point of connection within the existing network without the need for/or ahead of reinforcement. The customer will be subject to temporary reduction to their export to ensure the network is kept within operational limits and the constraint is not breached. FDG offering has now evolved into Flexible connections to include all types of DERs. The connection will also implement different types of commercial arrangements with DERs.

UK Power Networks will also use flexibility from DER to reduce electricity demand during periods of highest load at certain locations on the network. These resources can be large consumers of energy that can reduce its demand, generators that can increase output, or storage that can do either when instructed by UK Power Networks.

A centralised Active Network Management (ANM) system will be designed to control and dispatch Distributed Energy Resources (DERs) to deliver flexibility services and FDG connections.

The ANM solution means a centralised software based application that is capable of the autonomous monitoring, analysis and control. The centralised ANM solution will need to interface and coordinate with other systems and components such as the distributed ANM logic schemes hosted within the UK Power Networks standard Remote Terminal Units (RTUs); the Distribution Management system applications; Electricity system Operator; DERs; aggregators and market/commercial platforms as shown below:

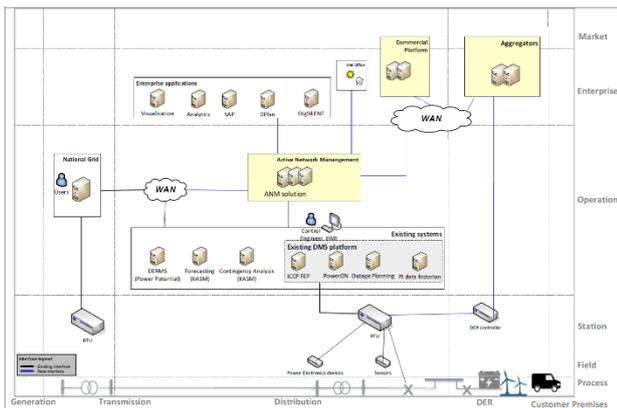


Figure 5 – UK Power Networks' ANM system conceptual architecture

The ANM solution will have the capability to support commercial arrangement and market transactions as required by the existing schemes and the emerging requirements. The commercial arrangements can include managing flexible connections using Principles of Access (i.e. LIFO, Shared quota etc.), managing commercial interactions with service providers for dispatch of services etc.

Accessing flexibility from DER through commercial contracts and enabling technical systems, will enable UK Power Networks to better manage the investments, planning, and operation of the distribution network.

## CONCLUSION

UK Power Networks are committed to using market provided flexibility where more economic than traditional asset solutions. This is a key priority in our DSO strategy - how UK Power Networks will change to facilitate the

evolution of the energy system - with the plan of deploying flexibility set out in the Flexibility Roadmap.

Starting with the flagship innovation projects Low Carbon London and Flexible Plug and Play, the journey of using flexibility on the distribution network progressed through a design consultation and tender in 2017, publication and launch event of the Flexibility Roadmap in 2018, and the next procurement round scheduled for 2019.

At every step of the way, UK Power Networks have been and will continue to be committed to engaging and collaborating with stakeholders to support the development of a nascent market that will enhance the way that the networks are managed, and which provides additional revenue streams for flexibility solutions.

The transition to a more actively managed network requires enhanced Active Network Management systems beyond that currently deployed to manage Flexible Connections. The ANM system of the future will enable market solutions to be embedded in real-time network operations using advanced optimisation of a wide range of market and network options.

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