

Consultation Report

FutureSmart

A smart grid for all: Our transition to Distribution System Operator



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1 | Foreword



These are exciting times in the world of energy. The ways in which we produce and consume electricity are transforming in front of our eyes.

Coal, once the mainstay of our generation sector, was not used at all to generate electricity on April 21, 2017 for the first time in decades. A month later, at one point on 26 May, solar generation was meeting nearly a quarter of all electricity demand in Great Britain¹. Not only is the type of generation changing, but where it connects to the electricity system is too. Whilst large coal-fired stations are connected to the high voltage transmission system, 12 GW of solar capacity² is now connected to the distribution networks. Generation is becoming more distributed and closer to the end consumer.

Distribution Network Operators are therefore key players in the changes sweeping the industry, and UK Power Networks is at the heart of it. About a third of the UK's distributed generation, around 8.5 GW, is connected to our networks.

And it is not just about renewables. In the last two years, grid-scale storage has emerged with advancements in electricity storage technology. UK Power Networks alone has received close to 16 GW of applications for battery storage with almost 1 GW of connections offers accepted. At the same time, we are starting to see the pickup of electric vehicles and new technologies such as smart meters and in-home control systems which are transforming the way end-consumers are interacting with the energy system.

Role of networks in a changing world

In order to support the transition to a decarbonised and more de-centralised electricity system, we recognise that our role has to evolve. Power flows are no longer uni-directional across our networks making the task of operating them and maintaining reliable supplies more complex, and potentially more costly in the absence of new innovative solutions. A coordinated approach to system operations and planning with National Grid, the GB System Operator, is needed to deliver value for consumers. Meanwhile, distributed energy resources (DERs) that are flexible, such as storage and demand side response, can help us and National Grid to manage our systems, and they are looking to us to create markets so that they can realise the value of their flexibility.

Our traditional business of building and maintaining network assets will persist, and our core objectives of keeping the lights on, providing great customer service, and lowering our costs, will not change. The way we deliver our objectives will evolve. In this new world we will be an enabler of markets, meeting the evolving needs and expectations of our consumers and supporting a diverse range of new business models, such as battery storage operators and community energy schemes.

This is our transition from Distribution Network Operator to Distribution System Operation (DSO).

Our journey has already begun

Our focus to date has been on laying the foundations for a successful transition to a DSO. Since 2010 we have invested heavily in innovation, and our successful innovation projects are helping us to develop DSO capabilities across our business, based on practical insights.

Engaging with our customers and stakeholders

At a time of unprecedented change in our industry it is more important than ever that we listen, collaborate and share. Engagement provides us with valuable insights into the thinking, expectations and priorities of all our network customers and stakeholders – from domestic consumers to suppliers, regulators to media organisations, new businesses to new flexibility providers, and technology companies to vehicle manufacturers.

Importantly, we are collaborating with industry peers to progress the transformation of the energy system. We are working closely with transmission and distribution network operators across GB through the Energy Networks Association 'Open Networks' project to define the future of energy networks and develop whole system solutions.

In producing this report, we have considered recent publications such as the call for evidence for "A Smart, Flexible Energy System" from the Department for Business, Energy & Industrial Strategy (BEIS) and The Office of Gas and Electricity Markets (Ofgem)³ and the Future Power Systems Architecture (FPSA) project⁴. We will continue to work with our industry partners and new entrants as the transition to DSO progresses.

This consultation document, **Future Smart**, describes UK Power Networks' vision of the future DSO role, and the transition we believe is necessary for our industry to deliver 'a smart grid for all'.

We hope that it will further your understanding of the future role of the DSO and our plans, and I encourage you to provide us with feedback, give us your ideas and continue to challenge us.

Basil Scarsella | Chief Executive Officer

¹<http://www.bbc.co.uk/news/business-40058074> ²<https://www.gov.uk/government/statistics/solar-photovoltaics-deployment>

³ <https://www.gov.uk/government/consultations/call-for-evidence-a-smart-flexible-energy-system> ⁴ <https://es.catapult.org.uk/what-we-do/fpsa> ⁵ <http://www.bbc.co.uk/news/uk-39675418>

2 | Introduction

This report, **Future Smart**, sets out UK Power Networks' vision for the Distributed System Operator (DSO) and our view on the roadmap to achieve it.

Section 3

In Section 3 we begin by introducing UK Power Networks, who we serve, where we operate, and our vision for our business in the future.

Section 4

In Section 4 we describe how the nation's journey to a low carbon economy is driving a revolution in the energy landscape. The world is changing fast and UK Power Networks, and other Distribution Network Operators (DNOs), are already playing a pivotal role in delivering this change and responding to the evolving needs and expectations of our customers.

Section 5

In Section 5 we outline how the wider GB energy market could evolve in response to the changing energy landscape. The changes will have profound implications for distribution networks, and DSOs will need to adapt rapidly to ensure that customers are able to benefit from a future smarter energy system. In addition, how customers buy and sell energy will change, and here we describe how we think future market design could evolve.

Section 6

In Section 6 we present our vision of a future DSO, providing a definition of the concept and identifying the roles that a DSO would undertake. We distinguish between "emergent DSO" roles, which are an extension of current activities, and "full DSO" roles which will enable greater market participation for distributed energy resources (DERs), and support a whole system approach to planning and operating the electricity system.

Section 7

In Section 7 we describe the capabilities – existing, requiring development, or entirely new – that we need as a DSO, and map those capabilities to the DSO's roles. This section also identifies and prioritises the steps needed to be able to take on the full DSO role.

Section 8

In Section 8 we present other key issues that will affect the development of a future DSO, and the steps we are taking with key stakeholders to explore and resolve these issues.

Section 9

In Section 9 we explain how you can respond to this consultation and provide us with feedback on our DSO vision.

A day in the life of...

Finally, throughout this report we illustrate a number of potential participant experiences as 'A day in the life of' stories to bring to life the future a DSO could enable. These are not intended to be exhaustive and we welcome your views too.



Our **Future Smart** report demonstrates that we are committed to enabling the low carbon future, whilst delivering value to our customers and local communities who rely on our networks for a secure supply of electricity.

This symbol which appears throughout the document indicates where we are asking for your feedback and response to help us to shape our plans.



Help us Shape 'A Smart Grid for all'

We would like you to take part in our consultation, which will help us to meet your needs and expectations, both now and in the future. The more feedback we get, the better we can shape our plans. Whilst we would welcome any feedback in whatever form, we are particularly interested in written responses to the following questions:

Section 4 | Changing Energy Landscape

1. Are there drivers that we have not considered that could change the pace and scale of the transition?

Section 5 | Energy Market Evolution

2. To what extent will the mechanisms that we have described form part of the future market design?

Section 6 | The DSO Role

3. How does your view on the definition of DSO marry up or vary to what we have set out?
4. How does our description of the transition to DSO in two broad phases - the 'emergent DSO' and the 'full DSO' - align with your view of how network operators will transform?
5. Are there any other roles and responsibilities you expect a DSO to perform under the 'emergent DSO' or 'full DSO' model?

Section 7 | Transition to DSO

6. We have organised the capability model into three groupings. Do these in your opinion accurately describe the main DSO capability requirements?
7. Are there other DSO capabilities we should consider?
8. How does your view of the capabilities that the DSO will need vary to what we have set out?
9. Which capabilities most supports your needs and why?
10. Do you broadly agree with the content of our roadmap? Are there steps you think that should be added?
11. Are the timings in our roadmap appropriate? Should any be advanced or pushed back?
12. Do you agree with our DSO strategy for the next two years? Are there any other priorities you would wish us to consider focusing on?
13. Which of the priorities is most important to you?

Section 8 | Further Key Issues for Development

14. Are there any other key issues that need to be addressed to support the transition to DSO?
15. Which key issues do you think industry should prioritise?

Section 9 | Responding to this consultation

16. We have presented a number of potential participant experiences as 'A day in the life of' stories. We would be interested to hear about other participant experiences you would like us to consider to inform how we transition.
17. Has this document increased your understanding of what a Distribution System Operator is? If not, please let us know the areas in which you are looking for more clarity.
18. Do you think UK Power Networks is doing enough to facilitate the low carbon transition, and connect DERs to the distribution system? If not, please let us know what we could do.
19. Has this paper presented new industry information on the topic of DSO? If not, please let us know further areas you would expect us to explore.
20. Are we being bold enough in our vision for the future electricity system? If not, which areas do you think our vision could be enhanced?

How to respond to this consultation – please find on our microsite [FutureSmart.ukpowernetworks.co.uk](https://www.ukpowernetworks.co.uk/futuresmart) the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

3 | Who is UK Power Networks?

Delivering electricity to 18 million people

UK Power Networks owns, operates and manages three of the 14 regulated electricity distribution networks in Great Britain (GB) serving London, the South East and East of England. Our networks deliver electricity to 18 million people (8.2 million homes and businesses), representing 28% of the United Kingdom's population.

Today, our regulated businesses are purely network operators, providing connectivity to customers. We do not generate or buy electricity, nor do we sell it to customers, but our networks are vital to ensuring the reliable supply of electricity.

Our responsibility is to 'keep the lights on' for the customers and communities connected to our network, and to do this as cost effectively as possible.

Where we operate

The area we serve covers more than 29,250 square kilometres from Cromer in the east to Brighton on the south coast.

London (LPN)

London Power Networks

We look after the electricity network for inner London, with responsibility for delivering power to iconic buildings and businesses as well as high profile international events through the year.

South East (SPN)

South Eastern Power Networks

We serve South London, Surrey, Kent, East Sussex and part of West Sussex, covering a rich variety of customers and locations.

East (EPN)

Eastern Power Networks

We deliver power to North London and East Anglia, encompassing a diverse range of urban and rural areas as well as a huge coastline.



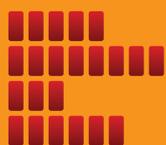
Energy Distributed per year
79,577 GWh



Length of overhead network
46,133km



Length of underground network
140,878km



Total length of network
187,011km



Peak Demand
14,878MW



Number of people served
18 million

Our Vision

At UK Power Networks, we have a clear vision to be the best performing Distribution Network Operator (DNO) in the UK over the 2015 to 2018 period, the first four years of RII0 ED1. We will achieve this by demonstrating industry leadership in the three areas below:

An employee
of choice

- > The safest
- > The best employer

A respected
corporate citizen

- > The most reliable
- > The best service
- > The most innovative
- > The most socially responsible

Sustainably
cost efficient

- > The lowest cost

...and consistently best performing DNO 2015 – 2018/19

Our *Future Smart* strategy and the transition to a 'smart grid for all' is pivotal to ensuring we continue to realise our vision. It will enable us to continue to:



Keep the lights on

- Maintaining the safety and reliability of our electricity networks whilst managing the increased complexity driven by the increasing number of Distributed Energy Resources (DERs) connected to our networks.



Provide great customer service

- Providing fast and cost-effective access to our distribution networks.
- Extending and upgrading the network to meet our customers' future needs as they engage and become active in the energy market through Electric Vehicles (EVs), smart appliances, smart meters, storage and distributed and on-site generation.
- Innovating to continually improve the customer service we provide to our customers.



Lower our costs

- Harnessing the successful innovations and customer flexibility to optimise network investment decisions.
- Collaborating with National Grid, the GB System Operator (GBSO), to reduce total systems costs through coordinating distributed and flexible energy connected to our networks.

4 | Changing Energy Landscape

The nation's journey to a low carbon economy is revolutionising the way we produce, distribute and consume electricity.

UK Power Networks has witnessed this first hand through the rapid connection of mainly renewable generation to our networks, which now totals 8.5 GW of capacity – a third of GB distribution-connected generation. A number of technical, environmental, political and economic factors are driving these changes and our customers' evolving needs and expectations.

4.1 How energy is delivered is changing

The world is changing fast and UK Power Networks, and other DNOs, are already playing a central role in delivering this change.

The transition to a low carbon future is changing the nature of the electricity system rapidly. The types of generation are changing, there is greater decentralisation of energy production, and consumers are beginning to engage proactively in the market in ways they have not done before. This will require a more flexible electricity system, with greater reliance on digital technology.

A good example of the rapid changes being experienced on the electricity system is the growth of solar. Since 2010 almost 12 GW of solar capacity has been installed in Great Britain from a base of almost zero⁵ resulting in record instantaneous generation from solar contributing around 24.3% of demand on May 26 2017⁶. A large proportion of this solar generation is coming from large grid-scale solar farms and a small proportion from roof top mounted panels of domestic customers who are increasingly becoming producers as well as consumers of energy. At the same time, Great Britain has recently experienced its first coal free day since the 1880s.⁷

The changes in the ways that electricity is being produced and consumed are having profound implications for our networks and the energy markets that support the system. Power flows that were traditionally unidirectional – from the transmission system, through the distribution networks to end consumers – are now increasingly two way. The rise in distributed generation is leading to periods during which power is being exported from distribution networks onto the transmission system. Much of this new distributed generation produces output that is variable in nature (or intermittent i.e. not producing when it is dark or when there is no wind), and this is leading to variability in power flows, with short duration peaks in output coinciding with sunny and/or windy days, and local voltage issues.

Electric Vehicles (EVs) are rapidly becoming common, including private vehicles and commercial fleets, as well as buses and taxis, and the advent of vehicle sharing and driverless vehicles. Charging points are popping up in our towns and cities. The same technologies behind EVs are driving propositions combining battery storage with renewable generation, at the domestic level and for larger industrial and commercial consumers. Stand-alone battery projects are also being developed in response to new opportunities to provide ultra-fast response required to balance the system on a second-by-second basis in the face of the changing nature of generation on the system.

In the future, the amount of domestic heating using electric heat pumps is expected to increase, imposing further demand on the electricity system. Some customers or communities will adopt hybrid schemes combining heat pumps and more traditional gas boilers. This would result in more complex flows on the supporting electricity networks, and also create more interactions with the local gas and heat networks, but it could also increase the ability of these customers to be flexible about how they meet their energy service needs. The increasing complexities and interactions require new relationships between gas, heat and electricity networks to coordinate and manage the impact on the whole energy system.

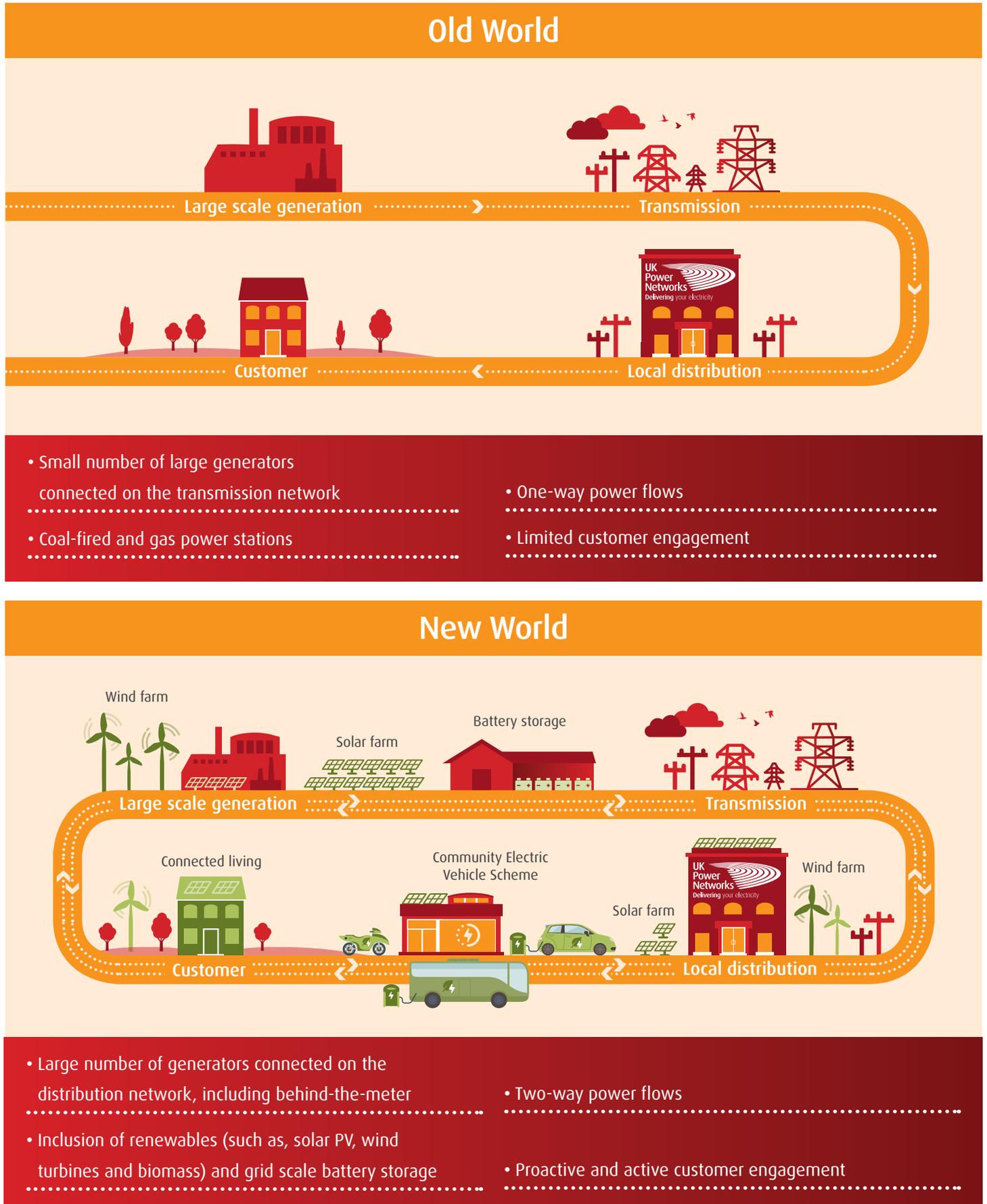


⁵ <https://www.gov.uk/government/statistics/solar-photovoltaics-deployment>

⁶ <http://www.bbc.co.uk/news/business-40058074>

⁷ <http://www.bbc.co.uk/news/uk-39675418>

Figure 1: Changing world of electricity



Overall the impact of these changes is expected to be a significant increase in the electricity demand in GB driven by the decarbonisation by electrification of the heat and transport sectors. Figure 2 shows the annual electricity demand projections based on the analysis of the Committee on Climate Change scenarios conducted by Imperial College London⁸, with heat and EV load the main drivers of growth.

These technologies will have a substantial effect on peak electricity demand, as shown in Figure 3, as their peak loads potentially coincide with the UK peak demand periods.

Figure 2: Great Britain electricity demand growth

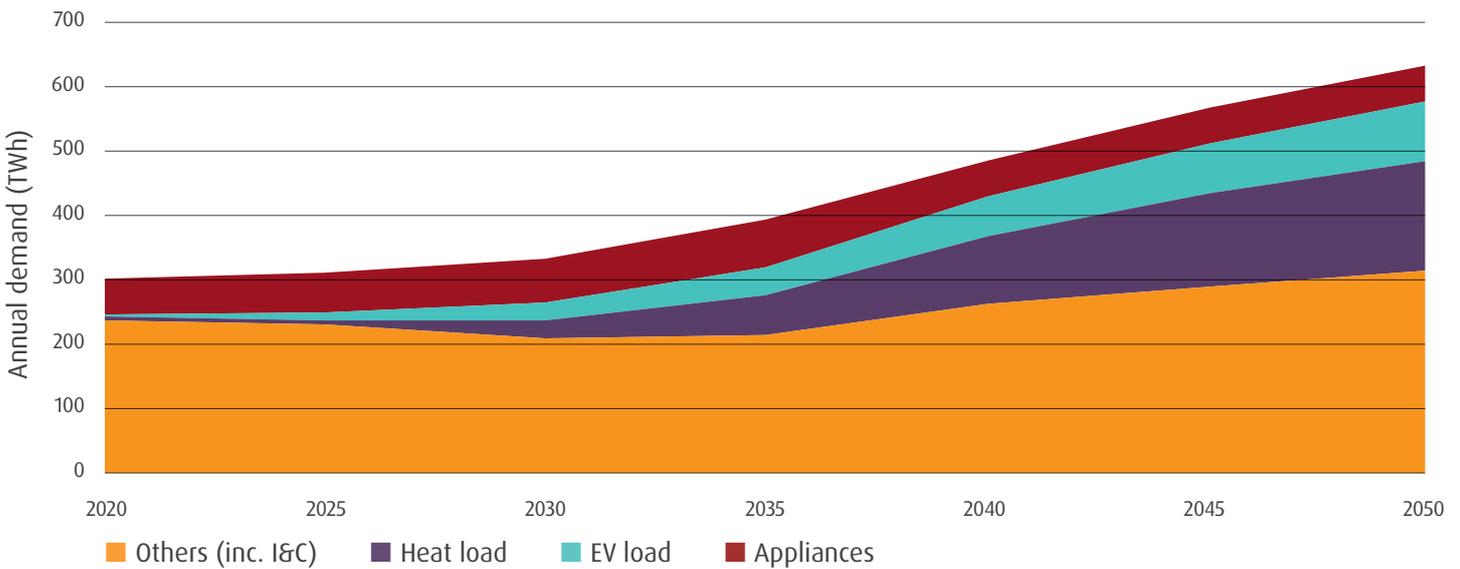
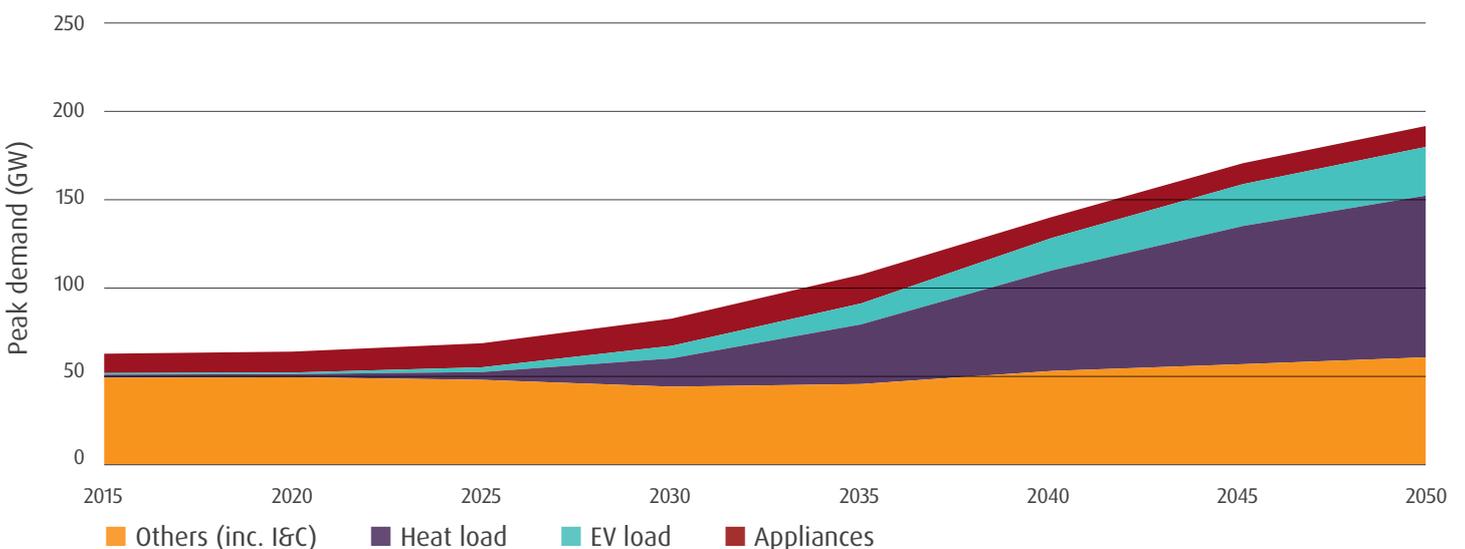


Figure 3: Great Britain increased peak of electricity demand (without DSR)

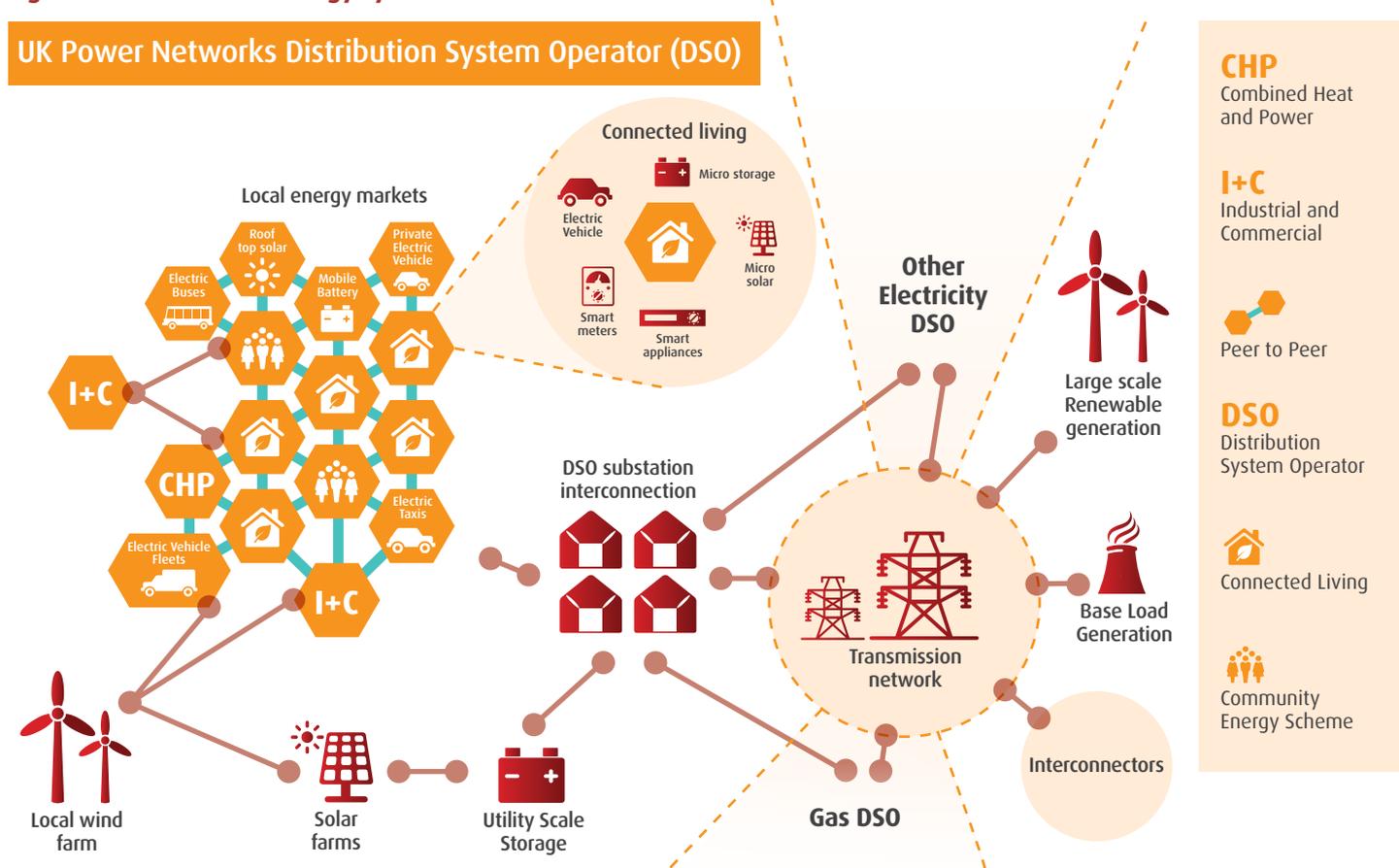


⁸ <https://www.theccc.org.uk/wp-content/uploads/2017/06/Roadmap-for-flexibility-services-to-2030-Poyry-and-Imperial-College-London.pdf>

To cost efficiently manage decarbonisation of the energy system, a smarter, flexible approach needs to be developed. This could lead to a very different distributed energy world in 2030. Many homes will evolve to support 'connected living', equipped with smart appliances, smart heating and lighting systems and with access to smart electric meters. Some homes will also have microgeneration and micro storage. The combination of domestic storage with self-generation allows customers to store surplus power, and then use it at peak times in order to reduce bills. They will also have the choice to use EVs to get around.

Finally, peer-to-peer trading, which allows consumers to trade with each other and share energy at a local level, will enable local community energy schemes and smart cities. These local energy networks can serve their own energy needs and provide surplus power to DSOs to enable whole system optimisation. Gas, heat and electricity DSOs will collaborate and coordinate to meet overall energy system needs. This is illustrated in Figure 4.

Figure 4: Future of the energy system



UK Power Networks is already experiencing these changes first hand, for example:

- We have connected 8.5 GW of distributed generation to our networks with another 3.6 GW waiting to connect.
- We already facilitated 25,884 EVs by the end of 2016 and anticipate the widespread adoption of private EVs during the 2020s with forecasts of up to 2 million in the areas that we serve by 2030.
- We have received close to 16 GW of applications for battery storage with 1 GW of connections offers accepted by May 2016, having been one of the pioneers of grid connected storage through our Smarter Network Storage project.
- We have connected the UK's largest electric bus garage in London's Waterloo, serving 51 all-electric buses.



The UK's largest electrical energy storage system – Smarter Network Storage

Smarter Network Storage one of Britain's largest batteries, in Leighton Buzzard, Bedfordshire. It is the size of three tennis courts and can store enough electricity to power 6,000 homes for 1.5 hours at peak times.

The project has proved it can potentially transform the energy grid and play a major role in the transition towards a low-carbon economy. It has provided critical insight to support network operators in the management of a more variable and dynamic system.

What is driving change?

As illustrated in Table 1 below, the changes are being driven by a combination of factors including:

- Government decarbonisation policies and wider environmental objectives
- Advances in generation and battery technologies, and rapid cost decreases
- Advances in digital technologies
- Innovation funding

Table 1: Change Drivers

<h3>Government policy</h3> 	<p>Climate Change Act 2008. To reduce the UK’s emissions by at least 80% from 1990 levels by 2050</p> <p>Financial support for low carbon generation and heat through the Renewables Obligation, Contracts for Differences, Feed-in Tariffs and the Renewable Heat Incentive</p> <p>Vehicle emissions standards, and local air quality regulations</p> <p>Financial support for low carbon transport through grants for new EVs, the Plug-in Taxi Grant programme, and exceptions for road taxes and congestion charges</p> <p>The UK signed the Paris Agreement in 2015 to limit global temperature rises to below 2°C</p>
<h3>Advances in generation technology</h3> 	<p>Rapid reductions in the costs of solar generation</p> <p>Advances in lithium ion and other battery technologies, and rapid cost reduction</p> <p>Improved thermal efficiencies for gas reciprocating engines</p>
<h3>Advances in digital technology</h3> 	<p>In-home technologies</p> <p>Smart metering</p> <p>Active network management and advances in network management systems</p> <p>Advanced measurement and monitoring equipment</p> <p>Application of machine learning and advanced data analytics</p>
<h3>Innovation funding</h3> 	<p>Innovation allowances within price controls</p> <p>Ofgem’s Low Carbon Networks Fund and Network Innovation Competition</p> <p>Government funded research</p>

4.2 What could the future look like for customers?

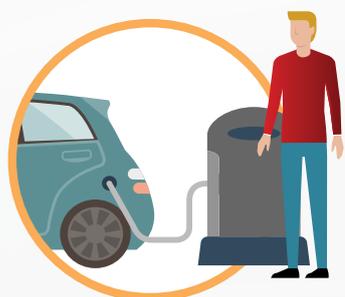
End customers will be using more electricity in the future; they will expect reliable and affordable supplies and some will be much more engaged through new technologies. Developers of DERs will want to know where they can connect their assets most cost effectively, and will want easy access to markets for the flexibility they can provide to system operators.

Customers of the distribution network come in two forms: end consumers, ranging from residential customers to large industrial and commercial users, and operators of DERs such as generation or storage. The needs and expectations of these different types of network customers are evolving with the changing energy landscape.

Residential customers

As we have discussed, with the growth of EVs and greater use of electricity in heating (and cooling) in the future, residential customers will be increasingly reliant on electricity to meet their future energy needs. Maintaining reliable and affordable supplies, whilst decarbonising the system, will be paramount.

For some customers, new technology is transforming how they use energy, and many are now producing their own electricity. Homes and buildings are becoming fully digitally connected and enabled for smart appliances, smart meters, storage and control leading to 'connected living'. The ability to manage energy in the home remotely and through voice activation exists now through advanced app-based products and personal assistant systems. Empowering customers to take control and make choices about when to produce and consume energy, and possibly engaging in local peer-to-peer electricity trading with neighbours and local businesses, are exciting developments.



At the same time, we need to recognise that not all residential customers will have the desire or ability to become so-called active 'prosumers', and it will be important that less engaged customers, particularly vulnerable customers, are able to benefit from the wider smarter energy system.

Industrial and commercial customers

For industrial and commercial users of electricity, reliable and cost competitive supplies of electricity are also a high priority. Like their domestic counterparts, these customers are also becoming increasingly sophisticated consumers and producers of electricity. Over recent years, considerable investment has gone into energy efficiency and energy management systems to reduce consumption and optimise usage to benefit from periods of lower prices. These same techniques are allowing some larger customers, working with aggregators, to offer commercial Demand Side Response (DSR) into the Capacity Market and National Grid's Balancing Services markets.

Many larger companies now have their own ambitious decarbonisation objectives, and are increasingly looking to develop on-site renewable generation projects to meet their own needs and export surplus onto the grid. We are also seeing energy management centres, sometimes linked to the development of new business parks or university campuses, which connect a range of DERs, such as renewable generation and storage, with loads over a private network.

Smaller commercial customers may be less engaged in the energy market than their larger Industrial and Commercial counterparts, but this may change in the future as technologies deployed in the domestic sector scale up, and technologies employed by larger users can be adapted to smaller sites. The adoption of EVs could drive innovative and new business models. By installing a smart charger, for example, a small delivery company may be able not only to power its vehicle fleet more efficiently, but may also be able to provide charging access to third parties, as well as providing flexibility services to the electricity system.



Operators of DERs

There has been an explosion in the number of connection requests from developers of distributed generation and storage over recent years. These customers are looking for timely and cost effective connections to the network and, for some technologies, easy access to markets for their flexibility, and good forward visibility of the future needs of system operators.

As we have demonstrated on our innovation project, Flexible Plug and Play, developers of renewable generation projects are in some cases willing to accept a level of curtailment of their output, controlled via Active Network Management (ANM), if that means a faster and cheaper connection.

For the developers of dispatchable generation, such as gas reciprocating engines and storage, fast and cost effective connections are also important. They need to be able to access a range of markets and have good visibility of the future revenue 'stack' to make their project economics work. For example, the DER operator may be looking to sell (and buy) power in the wholesale market, participate in the Capacity Market, bid into National Grid's Balancing Services tenders such as Frequency Response and Short Term Operating Reserve and potentially offer local network management services, such as 'peak shaving', to the DSOs.

These developers are increasingly looking to the DSOs and the GBSO to set out their future needs for flexibility services, and to describe how these will be procured, in order to underpin their business cases.

A rapidly changing energy landscape, motivated by a number of technical, environmental and economic factors, is driving an evolution in our customers' needs and expectations. Having discussed how our customers' needs have developed, we need to consider the corresponding evolution in the energy market required to successfully meet their expectations.



Delivering cleaner, greener, cheaper electricity – Flexible Distributed Generation

Our flagship Flexible Plug and Play innovation project has become a business as usual Flexible Distributed Generation (FDG) service. Flexible Distributed Generation makes it faster and cheaper for new customers to connect distributed generation to our network.

It means that we can connect new generation to our network without the need for building new assets. We offer this service in return for cheaper flexible connections, when the generators respond to automatic signals that curtail their electricity output for short periods when the network is busy, keeping power flows within safe and reliable limits.

So far, we have connected more than 20 generation sites with a total operational capacity of 110MW to the distribution network (with 134MW contracted). We have saved our customers more than £70 million in spending on upgrading the network.

We continue to roll out the service, extending it throughout East Anglia by 2021, and will launch it for the first time in the South East this summer. This is an example of DSO in action, with UK Power Networks making it as easy and cost-efficient as possible for customers to connect low carbon technologies to our network.



A day in the Life of a domestic prosumer

The domestic customer experience could look very different from today and expectations will continue to increase.

At the heart of the transformation to the low carbon future is the interaction customers, companies and communities will have with their energy use and the energy market. Looking to the low carbon future, we explore how a day in the life will be different for a domestic 'prosumer' – an active domestic customer who both consumes and produces electricity.



6:00am



At 6am **Jim** wakes up and hops into the shower, still amazed that the hot water is being supplied by the local CHP plant down the road. He's now been in his house for a month, part of a new wider development with a specially designed community energy scheme, linking the plant, households and their solar panels, offices and battery storage together.

CHP - Combined Heat and Power

A CHP plant produces both electricity and heat from a single fuel source resulting in a highly efficient process.

7:00am



After breakfast, **Jim** loads the washing machine and sets the cycle to complete by 5pm. This information is relayed to his 'Home Smart Hub' which can communicate and control the smart electrical devices in the household. The Hub checks the forecast and, seeing that it's going to be a sunny afternoon, schedules the washing machine run for 2pm, when the solar panels on the roof will be generating at their maximum. Based on the forecast, he is expecting that the panels will generate excess electricity, which is good since he earns money from the local scheme for the electricity he can sell.



Home Smart Hub

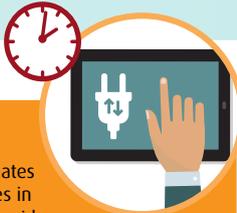
An automated controller which interfaces with multiple smart devices.

7:25am



Jim unplugs his electric vehicle which has reached 90% charge. As he sets it to a medium charge priority (guaranteeing 70% charge and using the spare capacity to offer flexibility to the community energy scheme) the spare capacity must have been utilised for flexibility services. **Jim** leaves for work, smiling at the thought of the extra money earned.

2:00pm



The Hub recognises the house is now empty and co-ordinates the smart appliances in the household to provide flexible demand services to the community energy scheme, with the fridge and freezer temperatures allowed to vary by +/-1°C.



Flexibility Services

A range of services provided using controllable electricity generation and/or consumption sources.

EV Charge Priority

A high priority ensures the EV charges to full capacity as quickly as possible. Lower settings allow for more flexible, variable charging.

5:12pm



Jim arrives home from work, plugs in his EV and sets the charge priority to high which guarantees him a full charge by the morning. He's off on holiday tomorrow and has a long drive in the morning so needs the car battery to be at full capacity. The Hub detects the car being plugged in and removes the offer of flexibility from the community energy scheme.

Many of the technology options described in the domestic prosumer's story are available today. As the demand for these technologies increases, we need to ensure that our networks are ready to accommodate them. Where those technologies allow consumers to be more flexible in their energy usage, we also need to make sure that we can access that flexibility to plan and manage our networks more efficiently and support whole system efficiencies.



How to respond to this consultation – please find on our microsite [FutureSmart.ukpowernetworks.co.uk](https://www.future-smart.ukpowernetworks.co.uk) the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

Consultation questions



1. Are there drivers that we have not considered that could change the pace and scale of the transition?

5 | Energy Market Evolution

In the previous section we discussed how our energy system is changing, and what is driving the change. In this section we explore how the market arrangements may need to adapt, and the implications for the roles of different market participants. In Section 6, we go into more detail on the potential future role for the DSO.

5.1 The need for change

The changing energy landscape will have profound implications for distribution networks. Market arrangements will need to evolve, and market participants, including DSOs, will need to adapt to ensure that customers are able to benefit from a future smarter energy system.

With the growth of new consumer technologies, most notably EVs and potentially electric heat pumps, assumptions on how much electricity customers will use, and when, will have to change. These changes will be combined with continued significant growth in the connection of generation and storage. Our approach to planning and managing the network will have to adapt to deal with considerable uncertainty regarding how much new load and generation (and storage) will connect and where.

Increasing network capacity through traditional reinforcement will be just one solution for accommodating increased power flows. But this can be costly and take time, and not always easily achievable. Other smarter solutions that can embrace new and existing network customers' flexibility such as DSR, managed charging of EVs, controllable generation and battery storage, should provide timely and cost effective alternative approaches. Furthermore, in the face of future uncertainty these approaches can provide options, allowing decisions on reinforcement to be deferred until there is better information on the enduring needs, and where and how much

to invest. Properly coordinated within and across system operators, these techniques can improve the utilisation of electricity grids, delivering more electricity with less network infrastructure, thus saving the end-consumer money. Given the potential future demand from electrification of the heat and transport sectors this becomes even more important.

In order to release the full benefits of these new techniques, an evolution of current energy market structures will be required. New arrangements will need to support a more distributed system, and facilitate new interactions between flexible DER and local and system wide markets. This will allow for the efficient operation of increasingly variable and unpredictable distribution networks and ensure that customers are able to benefit from a future smarter energy system.

The National Infrastructure Commission reported on Smart Power in March 2016, drawing on work from the Committee on Climate Change, stating that a smart, flexible energy system could reduce the cost of decarbonising the electricity system to consumers in the order of £3-8bn a year in 2030.⁹

Furthermore, a Government-commissioned study carried out by Imperial College London and the Carbon Trust, published in 2016, estimated that a combination of flexible solutions and a whole systems approach could deliver the decarbonisation targets between £17bn and £40bn cheaper than the traditional model.¹⁰

A common feature of how value will be unlocked includes optimisation of connected DERs and avoidance of some of the additional generation and infrastructure costs required. Delivering a 'smart' system that makes full use of the flexibility on the distribution network, for the distribution network itself and for wider network stakeholders can deliver significant financial benefits.



⁹ <https://www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report>

¹⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf

5.2 Context: the energy market today

The GB electricity market is characterised by a national wholesale market with locational aspects managed through the use of Balancing Services, with Use of System charges and connection charges providing longer-term locational signals.

Figure 5:
The GB electricity
market today

	Transmission Connected Customer	Distribution Connected Customer
Wholesale Pricing	<ul style="list-style-type: none"> The electricity market is characterised by a national wholesale market with a single price within each half-hour period Market participants are 'balance responsible' and trade bilaterally over-the-counter and on exchanges, with contracts ranging from within-day to a number of years ahead of delivery There is a Capacity Market which provides an additional revenue stream for reliable capacity, and some low carbon generators benefit from subsidies The GB System Operator, National Grid, plays the role of residual balancer, and manages sub-half hourly and locational imbalances on the national transmission system using the Balancing Mechanism and other Balancing Services Balancing costs are socialised across system users 	
Use of System Charging	<ul style="list-style-type: none"> Network charges are made over periods of peak energy consumption Peak consumption is calculated over a small number of half hour 'Triad' periods There are elements of locational charges 	<ul style="list-style-type: none"> Each time period is assigned a charging 'band' Customers are charged either based on a representative profile or, for larger customers, using their actual consumption patterns Locational charges used for EHV customers, but not for smaller network customers
Connections	<ul style="list-style-type: none"> Connection charges are 'shallow' - customer required to pay for cost of connection only Customer pays for its local connection to the Transmission System Customer receives financially firm access to the wholesale market Generators are compensated if they provide curtailment to manage transmission constraints 	<ul style="list-style-type: none"> Connection charges are 'deeper' - customer required to pay for cost of connection and any necessary reinforcements to the grid Customer pays for reinforcements up to one voltage level above its connection point Generators may opt for flexible connections, allowing them a faster and cheaper connection, in exchange for accepting a level of curtailment

5.3 What might future market design look like?

New arrangements in market design to support a more distributed energy system, including new market platforms and more sophisticated price signals, will set the framework in which DSOs can facilitate and drive benefits of smarter, flexible networks.

The existing GB market structure is suited to a world in which the majority of generation and providers of flexibility are connected to the transmission network, and the locational constraints are few in number, fairly static and well understood. The changes we are seeing to the structure of the energy market, however, are moving us rapidly away from this world. As DERs become more prevalent, and as actively managed constraints become the norm, there is a need to evolve the market design so that it better reflects the value of energy and flexibility.

There are a range of options for changing the market design, but these can be broadly captured under the following two approaches:

- **Wholesale market change.** Changing the wholesale market to include greater locational resolution, thus requiring market participants to balance their positions at multiple nodes (or zones), and creating locational marginal pricing signals; or
- **Strengthening price signals through use of system charging and local flexibility platforms and energy markets.** Retaining the current single node wholesale market, but providing stronger locational pricing signals and local system balancing capabilities through other means. These may include changes to use of system charging that include elements of dynamic locational and time-of-use charging, and introducing local flexibility platforms which allow System Operators (GBSO and DSOs) to manage local constraints by procuring constraint management services from local flexibility providers. Local energy schemes that allow peer-to-peer trading of electricity between market participants may also emerge under this approach, and could potentially be integrated with local flexibility platforms.

The approaches do not necessarily have to be mutually exclusive, since it is possible to have nodal pricing down to a certain voltage level, and then deploy flexibility platforms to ensure overall system reliability and management of the networks at lower voltage levels. It is also a possibility that local or regional solutions could be precursors to more fundamental wholesale market changes.

We explore these different approaches in more detail below;

Wholesale market change

The nodal pricing approach relies on the price of energy varying with forecast consumption at many points or nodes on the system, to encourage the balancing of supply (including the network capacity) and demand at each of these nodes. This type of market requires detailed information about the network's ability to meet demand and accommodate generation. This approach, typically based on a pool market, is deployed in a number of US markets and New Zealand. The nodal pricing approach provides the following signals:

- **A low nodal price** might reflect an excess of generation, with the network constraint limiting how much can be exported into other nodes. This low price should encourage more local consumption, and discourage dispatchable plant from generating. In the long run, this low price signal should encourage new demand connections, and potentially storage.
- **A high nodal price** might reflect a generation shortfall, or an import constraint limiting how much power can be brought in from other nodes. This high price should discourage consumption, and encourage local generation. The increase in price can be steep in order to achieve the required reduction in consumption. In the long run, the high price should encourage new sources of generation to connect, or again storage.

The price signals created by nodal pricing allows for network constraints to be resolved through the market since participants are incentivised to adjust their positions where constraints exist. However, there is still an ongoing role for the GBSO and DSO to manage the overall system in real time, ensuring that the market delivers the constraint management it is designed to do, and resolving network constraints that occur below the voltage level of nodal pricing.

Strengthening price signals through use of system charging, and local flexibility platforms and energy markets

The alternative to more fundamental wholesale market change could come through a combination of reformed use of system charging and local flexibility platforms, together with local energy markets. This would represent a more evolutionary approach.



Reformed use of system charging

Use of system charging currently provides long term signals that encourage efficient connection outcomes in terms of utilising available capacity on the network. It provides few short term signals, however, that can assist in operating the system in real-time. To achieve this would require the introduction of dynamic Distribution Use of System (DUoS) charges that change with time and location.

The effectiveness of network charges in influencing behaviour in any market depends on their magnitude relative to other costs and the value of the energy supply to the end user. The unrestricted network charges needed to change behaviours could be substantial, but the revenues network operators can collect from market participants are capped by regulation and it remains to be seen how this would affect the implementation and operation of dynamic network charges.

Experience in our Low Carbon London innovation project¹¹ and other studies indicates that substantial increases in prices are needed to influence behaviour in response to time of use charges, and evidence from current Extra High Voltage (EHV) distribution charges indicate that customers are not always able to change their behaviour in response to changes in locational price signals. However, there may be specific cases, such as EV charging, where consumers may be more price sensitive and, with the help of the appropriate information and control technology, might be willing to delay their energy consumption (e.g. charging overnight) or consume it in a different location (e.g. seeking out lower-priced charging stations).

There are other issues with more dynamic locational charges that need to be considered, including:

- Higher demands resulting from increased EV uptake, for example, could lead to higher charges for existing non-EV users in those locations, creating issues around fairness and cost reflectivity; and
- Dynamic charges are less transparent and predictable for suppliers.

Local flexibility platforms

Whilst nodal pricing and dynamic DUoS can influence behaviour, these price-based mechanisms cannot guarantee the real-time response to operate the system within safe limits. The GBSO and DSOs will always need to procure flexibility services to ensure real time balancing of supply and demand (for both local constraints, ancillary service and for frequency response) of the system to ensure continuity of supply. Buying services directly gives the GBSO and DSO greater certainty that the flexibility will be available and dispatched when and where needed, and also provides more certainty of capturing the value for providers of flexibility.

Flexible DERs are able to vary their generation or consumption in order to help to alleviate network constraints. For example, if a local network is export-constrained, and if the local generators are not otherwise discouraged from producing power, demand, storage or flexible generation can be paid to reduce the net export on the network. Equally in an import-constrained region, resources such as DSR or storage can be used to alleviate the constraint.

Initially discrete flexibility platforms may be implemented in specific constrained zones. These will allow DERs on flexible connections to trade their curtailment in a market environment (this is the approach we are developing for Flexible Distributed Generation). The price signals revealed may attract additional flexible DERs such as storage, and demand response. The DSO could also use this platform to procure services it needs to manage network constraints that it is responsible for, such as peak load shaving.

Over time, as DER penetration increases, these local flexibility platforms could merge into a broader DSO flexibility platform, which might interface with the GBSO's Balancing Mechanisms and potentially the flexibility platforms of neighbouring DSOs. The ability for system operators to share flexible resources is very much part of our vision, and will play an important part in optimising the whole electricity system for the benefit of customers.

¹¹ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL))

There are different ways to recover the costs incurred in resolving network constraints using flexibility platforms. One approach is to socialise the cost across all electricity system users (which is the approach taken on the transmission system). Alternatively, the cost can be targeted to those network users in the local region affected by the constraint, and who are thus benefitting most from the flexible solutions provided by DERs.

Local energy schemes¹²

Local energy schemes could evolve from the current GB markets where companies, communities and even individuals strike bilateral deals, facilitated by some form of market platform, to provide each other with energy, with only the aggregate 'balance' requiring to be traded out in the wholesale market. The GBSO and DSOs could participate in these markets buying the additional flexibility required to operate the system in real time. Equally local energy schemes could operate closely alongside, or even integrate with, local flexibility platforms operated by DSOs.

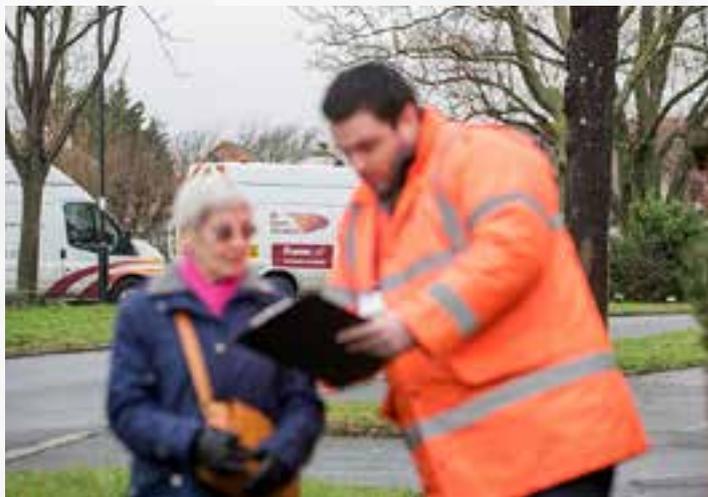
As the magnitude of interactions at a local level grows there will be an increasing need to ensure that the positions created in these markets are reconciled with the national markets (see also Section 6 on the DSOs role in enabling markets).

A new energy market model

As the networks become more constrained, and accommodate increasing amounts of flexible generation, storage and demand, it becomes increasingly important to reflect the local value of energy. As we have outlined, there are various ways to achieve this. A full nodal pricing model would represent a fundamental change to the wholesale market, requiring participants' energy positions to be traded, balanced and

settled at multiple nodes rather than at the single National Balancing Point, as is the case today. There will be a limit on how many nodes can practically be managed – international examples do not extend nodal pricing to the level of the distribution networks – and the duration of the price windows, so even under this fundamental market reform, there would still be a need for additional balancing and constraint management actions to keep the system secure.

A similar outcome may be achievable through a combination of DUoS changes to improve the locational and time of use signals¹³ and local flexibility markets to manage constraints efficiently and ensure the security of the network. This would represent a least-regret approach to managing these constraints, as the scale of the challenge remains uncertain. It may also be possible to introduce nodal pricing into a local energy scheme without requiring a fundamental change to the wider market design. Table 2 explores how these markets and flexibility mechanisms could work together to provide the combination of short and long term price signals that would encourage both efficient connections (by avoiding constrained areas and ensuring flexible assets can offer their flexibility to the market), and efficient operations (by reflecting the value of energy as a function of time and place, and the cost of getting that energy to the market).



¹² Centrica's Cornwall LEM project (<https://www.centrica.com/about-us/what-we-do/distributed-energy-and-power/building-new-energy-future>) and Open Utility's Piclo project (<https://piclo.uk/is> an example of a local energy scheme) are examples of local energy schemes.

¹³ From Ofgem's Targeted Charging Review it seems likely that there will be a levelling of the playing field between transmission and distribution charging, and new methodologies that more accurately reflect the costs and benefits that different technologies, including DERs, impose on the networks.

5 | Energy Market Evolution

Table 2: Combining different short- and long-term price signals

	Market	Market description	Nature of price signal
Short term	Wholesale market	Half-hourly national market for energy (encompassing forward, day-ahead and intra-day markets)	Half-hourly price for energy
	Community energy scheme/local energy market	Local market linked to the wholesale market that allows consumers and local DERs to trade energy between themselves	Participants trade energy based on a local price, from their perspective outside of the wholesale market, but the participating wholesale market participants remain responsible for balancing the scheme in the national markets and will charge the scheme participants for providing this service
	National Balancing Mechanism	Residual balancing market used by the GBSO to resolve aggregate system balance, locational constraints and sub-half hourly imbalances	Balancing Services such as Frequency Response, Fast Reserve and Short Term Operating Reserve and Reactive Power signal the value of flexibility for the national system. Used for national balancing costs and to signal national value of local flexibility. Imbalance prices signal the value of achieving energy balance
	Local Flexibility Platform	Platform used by the DSO to resolve distribution level network constraints	Services primarily around active power flexibility, including generator curtailment and DSR. Signals value of locational flexibility, independent of the wholesale energy market; i.e. the participant's energy position is settled independently in the wholesale market. It could also provide a route to market to the GBSO's Balancing Services
	Dynamic DUoS (Distribution Use of System)	Network charges that vary by location and time depending on state of local distribution system	Signals the value of network access at the half-hourly level in real-time in different locations
Long term	Balancing Services tenders	Forward tenders by the GBSO to procure Balancing Services, e.g. Fast Frequency Response, that cannot be procured economically in the real-time Balancing Mechanism	Signals the medium/long term value of flexibility in different locations for avoiding/deferring reinforcement
	Network services tenders	Forward tenders by the DSO to buy services to manage peak capacity on the network, e.g. DSR	Signals the medium/long term value of flexibility in different locations for avoiding/deferring reinforcement
	DUoS charges (non-dynamic)	Network charges that reflect the long run costs of investing to expand the network	Signals the medium/long term cost/value of generation and demand in different network locations

The effect of market changes, whether through nodal pricing or the procurement of flexibility at the local level, will be to create smaller geographic sub-markets. With fewer and fewer resources competing in these more localised markets, there is a risk that participants could exercise locational market power. There may be a trade-off between reflecting the local value of energy and the need to maintain sufficient levels of competition. This may be a factor in the selection of the ultimate market design.



5.4 How the roles of different market participants may evolve

How customers buy and sell energy will change, leading to the emergence of new market models and new market entrants – existing players, including the regulated monopolies, will need to adapt.

There are now over 100 electricity suppliers, and the market share of the traditional Big 6 energy suppliers has fallen to 85% from 99% in 2012.¹⁴ New entrants are offering customers new propositions and technology choices, and the established suppliers are responding with new offerings of their own, in some cases through acquisition of technology firms. The market share of these companies in generation has also fallen dramatically in recent years, to 70% in 2016, as renewables and new peaking generators have displaced older coal and gas fired generation.

Suppliers are increasingly seeing electricity as less of a commodity (“selling megawatts”), and more of a service (“providing warmth, illumination and energy-related appliances”), partly in an effort to differentiate themselves and to develop a closer relationship with their customers. Energy Service Companies (ESCOs) have entered the market targeting those customers who are looking for a broader set of services from their energy supplier.

In the future, some customers may not have a supplier in the traditional sense at all, instead participating in local or community energy schemes, potentially trading their energy through peer to peer trading platforms, or working through smart ‘Internet of Things’ services that can manage their flexibility for them.

The trend towards decentralisation in generation is mirroring a greater focus on localism more generally in society. Local Authorities are becoming increasingly engaged in the energy

system, looking to promote holistic ‘cross-vector’ approaches to meeting local energy needs. Combined with peer to peer trading this may support the development of local energy ‘islands’ with connections to the electricity and gas grids primarily to provide back-up and a conduit for any excess energy production.

Renewable generators, who have traditionally contracted with established offtakers (frequently larger suppliers), now have the option of contracting directly with large end-users looking to reduce their own carbon footprint and willing to procure some energy on a longer term fixed price. Some of this renewable generation is being developed ‘behind-the-meter’ to reduce network charges.

Whilst scale can be a barrier to market participation, aggregators have emerged, playing a very important role in innovating through new technology, and providing a route to market for flexibility services. Their roles will continue to evolve and they will play an important part in facilitating participation of DERs in DSO services.

We are beginning to see convergence in the roles of different market participants, for example with aggregators taking on supply licences, and suppliers and ESCOs increasingly offering aggregation services to their customers.

National Grid is going through a period of change, having been required to separate its system operator (GBSO) business from its Transmission Operator (TO) business. The GBSO role itself is also changing. Large thermal generators connected to the transmission system are being replaced with renewables and distributed generation that the GBSO has less visibility over, making its task of balancing the system and the service it procures increasingly complex. Through initiatives such as Power Responsive it is looking for new sources of flexibility, and through its System Needs and Product Strategy consultation¹⁵ it is reviewing how it procures Balancing Services, buying different mixes of services or buying capability that can provide multiple services.

Through its Regional Development Programmes, National Grid has recognised the need to coordinate with DSOs in order to draw on DERs to help manage challenges on the transmission system created by the changing nature and location of generation.

The possible future roles of the different market participants¹⁶ are summarised in Table 3.

¹⁴ <https://www.ofgem.gov.uk/chart/electricity-supply-market-shares-company-domestic-gb>

¹⁵ <http://www2.nationalgrid.com/UK/Services/Balancing-services/Future-of-balancing-services/>

¹⁶ This table is focused on market roles. For this reason, we have not included the Transmission Owner. The TO is responsible for building and maintaining transmission networks.

Table 3: Roles of market players in a DSO world

Participant	Current Market Role	Future Market Role (in addition to current role)
GBSO	<ul style="list-style-type: none"> Responsible for balancing the National Transmission System in real-time and on a locational basis using the Balancing Mechanism and other Balancing Services 	<ul style="list-style-type: none"> Utilising new sources of flexibility, especially DER, accessed through platforms including DSO's local flexibility platforms Identifying areas where actions with DSOs' can reduce whole system operating costs
DSO	<ul style="list-style-type: none"> Responsible for maintaining distribution networks within operational limits through network reinforcement and load management Providing fair and cost effective network access Ensuring efficient and economic network development by procuring innovative alternatives to traditional network reinforcement 	<ul style="list-style-type: none"> Maintaining network integrity using a range of market and non-market based tools and platforms Providing fair and cost effective network access using a range of connection options Ensuring efficient and economic network development Engaging, educating and advising customers on connection options (technology, connection type and location) that benefit them and the overall system Ensuring efficient and economic network development by procuring flexibility services to traditional network reinforcement. Supporting whole system optimisation by sharing information with the GBSO and making coordinated operational and planning decisions Enabling markets by facilitating access for flexibility on the distribution network and potentially offering spare flexibility from DERs participating in its local flexibility platforms to the GBSO for efficient whole system management
Renewable DER	<ul style="list-style-type: none"> Selling output direct to wholesale market, or via an offtaker 	<ul style="list-style-type: none"> Offering services to the DSO in local flexibility platforms (including active and reactive power management)
Flexible DER	<ul style="list-style-type: none"> Selling output or buying energy direct from wholesale market or via supplier /aggregator Offering flexibility to GBSO into Balancing Mechanism or Balancing Services tenders 	<ul style="list-style-type: none"> Offering flexibility to the DSO, directly or via an aggregator Flexible DER may have separate agreements with GBSO and DSO, or be party to a three way shared services agreement
Aggregator	<ul style="list-style-type: none"> Providing a route to market for flexible DERs to the GBSO balancing platform 	<ul style="list-style-type: none"> Providing a route to market for flexible DERs to the DSO flexibility platform and GBSO Balancing Services markets
Supplier	<ul style="list-style-type: none"> Supplying power to end consumers 	<ul style="list-style-type: none"> Providing energy services and facilitating local energy markets
Offtaker	<ul style="list-style-type: none"> Providing route to wholesale market for DERs 	<ul style="list-style-type: none"> Providing route to wholesale market for DERs
Energy Service Company (ESCO)	<ul style="list-style-type: none"> Offering services to end consumers to optimise own energy consumption 	<ul style="list-style-type: none"> Acting as a supplier and aggregator for flexibility
Domestic Consumer	<ul style="list-style-type: none"> Passive consumer of electricity Domestic generation feeding into distribution network 	<ul style="list-style-type: none"> Some may become prosumers, both producing and consuming electricity Potentially providing flexibility services e.g. through in-home battery storage or EV vehicle to grid
Local Energy Schemes	<ul style="list-style-type: none"> Facilitation of local energy needs 	<ul style="list-style-type: none"> Peer to peer trading between customers Provide excess flexibility services to local or system wide balancing platforms
IT Platform providers	<ul style="list-style-type: none"> Facilitation of aggregators and some peer to peer services 	<ul style="list-style-type: none"> Enabling technologies for DSOs' flexibility markets, local energy schemes and interfaces to national wholesale and balancing markets

Figure 6: Market participant roles and interaction under local flexibility and dynamic DUOs

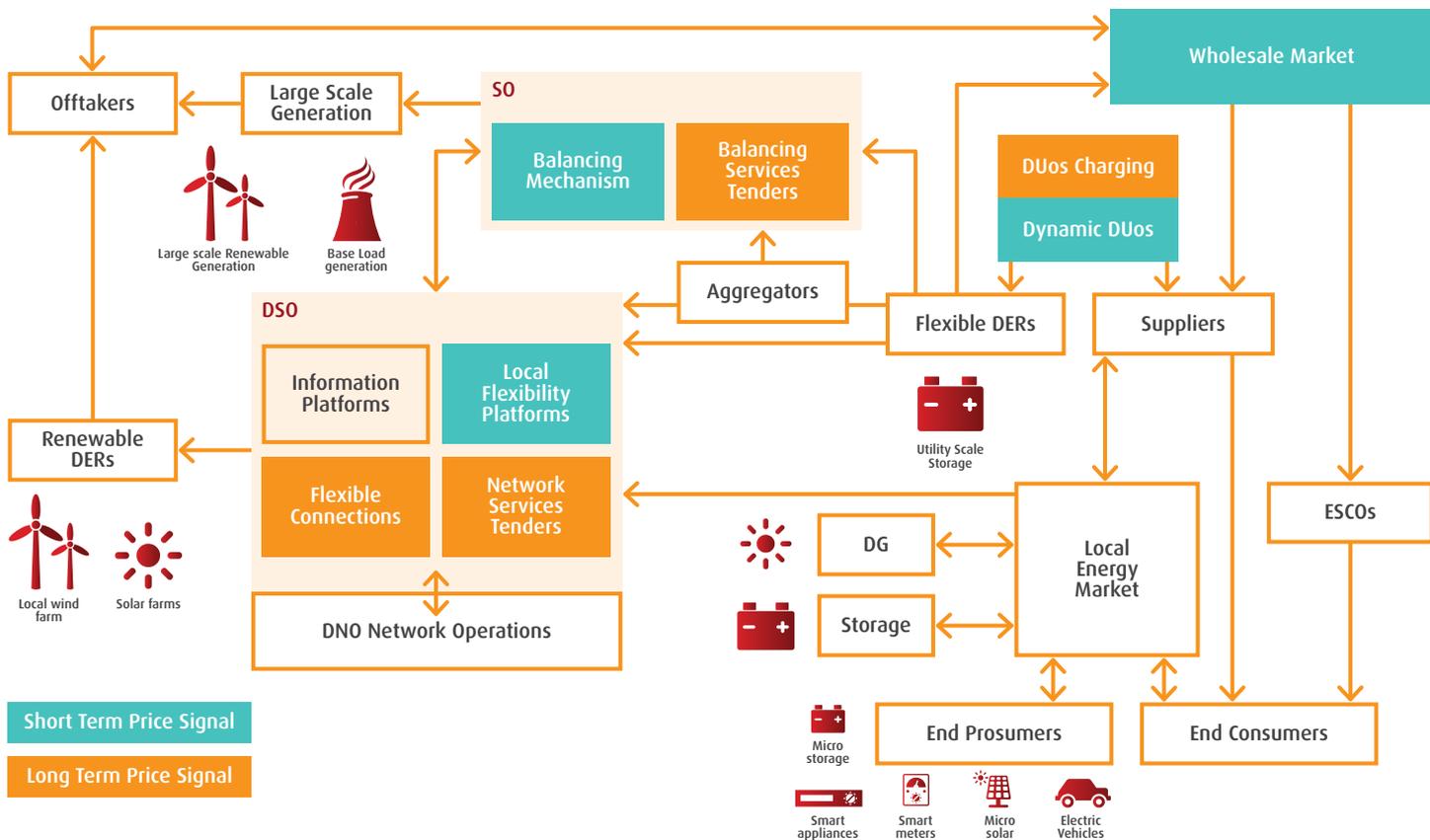


Figure 6 shows the possible interactions between the different market participants that might occur.

As we transition to a DSO, it is important for us to recognise that the businesses of our customers, suppliers, and fellow network and system operators are also changing. We believe that it is important that we are seen as a facilitator of market change, and not a barrier to it, and in the next section we explore in more detail the role of the DSO. With advances in technology, automation is going to become increasingly prevalent in the operation of networks. This may result in some of our customers performing complex interactions with the distribution network in a completely automated manner. We need to facilitate this transition by ensuring our own technology is compatible with our customers. Doing so will allow us to realise the benefits of network technology advancements and will help deliver a safe, efficient and reliable network.

How to respond to this consultation – please find on our microsite [FutureSmart.ukpowernetworks.co.uk](https://www.future-smart.ukpowernetworks.co.uk) the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

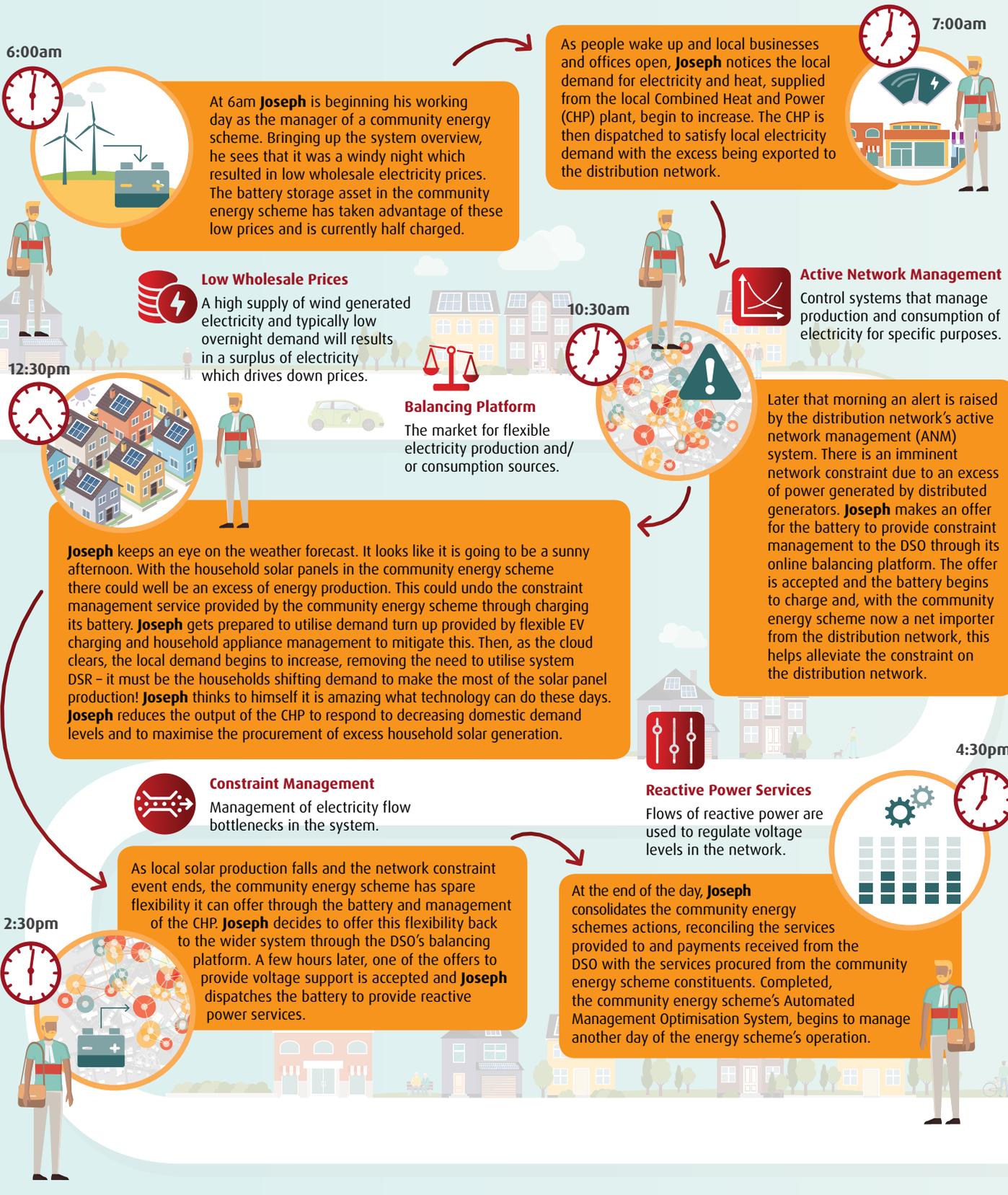
Consultation questions

 2. To what extent will the mechanisms that we have described form part of the future market design?

A day in the Life of a community energy scheme manager

New market models will require new relationships between the DNO and customers

Market changes are necessary to facilitate the move to a low carbon future. This day in the Life of explores how a community energy scheme might allow a group of people to come together to generate, own, manage, or reduce consumption of energy.



6 | The DSO Role

We are transforming our business into a DSO so that we can respond to the needs of our customers, both now and in the future, and work with the wider industry to help deliver decarbonisation of the electricity system at the least cost. In this section we explore what we mean by the term DSO and what we think the objectives of the DSO are, and examine in more detail its roles and responsibilities.

6.1 What we mean by DSO

The DSO will be integral to creating a smarter, flexible energy system to achieve decarbonisation at least cost.

In moving to a DSO, we have actively contributed and collaborated with peers in the Energy Networks Association (ENA) 'Open Networks' project to design a common industry definition that sets out an industry vision for a DSO:

A Distribution System Operator (DSO) securely operates and develops an active distribution system comprising networks, demand, generation and other flexible distributed energy resources (DERs). As a neutral facilitator of an open and accessible market it will enable competitive access to markets and the optimal use of DER on distribution networks to deliver security, sustainability and affordability in the support of whole system optimisation. A DSO enables customers to be both producers and consumers; enabling customer access to networks and markets, customer choice and great customer service.



Collaborating and sharing with industry – Energy Networks Association

UK Power Networks is a member of the Energy Networks Association (ENA), which brings together all seven of Great Britain's electricity network operators and transmission operator, National Grid.

The ENA commenced a major industry project in December 2016, 'Open Networks' that includes involvement from energy regulator Ofgem that will progress the transition to a DSO to enable a smart, flexible energy system. It fosters an industry view of the DSO business capabilities to be designed and an environment in which insights on innovation projects and who how to embed them can be shared.

At UK Power Networks we envisage two broad phases of the DSO transition:

- The first phase, and one we are already in, is what we might term the 'emergent DSO' in which new roles emerge as a natural consequence of meeting our core objectives in a changing energy landscape, making efficient use of flexibility to achieve positive outcomes for our consumers, such as reducing connection and reinforcement costs.
- The second phase, the 'full DSO', involves a more expanded role in whole system optimisation and enabling markets for DERs.

We describe each of these phases in more detail and then in Section 7 we discuss the business capabilities that we are investing in to deliver our objectives for the emergent DSO role and in preparation for a full DSO role.

6.2 The emergent DSO roles and responsibilities

The core objectives of a DNO will remain as it develops smart functions and capabilities in response to a changing energy landscape. We are already taking on capabilities associated with the emergent DSO, with many of our enhanced smart functions becoming business as usual.

Whatever changes occur in the energy landscape, we believe that the core objectives of UK Power Networks' vision – keeping the lights on, providing great customer service, and lowering our costs – will remain central to any future DSO role. However, the way in which we meet those objectives will have to adapt in a number of ways:

- **Keeping the lights on** will become more challenging as network usage increases and becomes more complex, but there is an opportunity for the DSO to maintain network integrity in innovative ways.
- **Providing great customer service** is fundamental to any DNO, but the relationship with customers will become richer and more long-term, and the range of customers we engage with will likely increase.
- **Lowering our costs** and the costs our customers ultimately face will always be a priority. As increased demands are placed on our networks, we need to use all the tools available to do things efficiently, and to think more broadly about how our actions impose costs on, or provide benefits to, the wider system.

We have been developing our emergent DSO capabilities since 2010 when we launched our Low Carbon London project. Since then we have delivered a large and successful portfolio of innovation projects, investing £88.2 million between 2010 and 2015, enabled by Ofgem's Low Carbon Network Fund to build and develop DSO capabilities.



Delivering pioneering insights on smart grid developments – Low Carbon London

Low Carbon London constituted the second largest Smart Grid trial in the UK. It was a pioneering project that piloted and demonstrated a broad range of smart grid systems to manage increasing demand and generation on tomorrow's electricity networks. This included:

- **Electric Vehicles** – Studying the habits of electric vehicle drivers, we found their charging times peaked two hours later than anticipated at 9pm (instead of 7pm). The impact of charging at home on a mass scale remained substantial, at around 0.3kW per household, but was more manageable than feared. We saw at least 36% less charging within the peak period by customers on a time-of-use tariff, that encouraged them to charge after 9pm than those who were not, and reductions of over 70% in many of the months we observed.
- **Smart Meters** – This was, at the time, the largest smart meter trial in Britain, monitoring and analysing power consumption in thousands of homes. We installed 5,500 meters with EDF Energy and secured concurrent data from a further 10,000 British Gas smart meter customers. Using this information, we have updated our planning assumptions to improve network investment decisions.
- **Demand Side Response** – DSR contracts – which pay large customers to reduce their electricity consumption on demand – were tested and proved effective. The learnings from this trial are now informing our latest flexibility programme.

We will continue our focus on emergent DSO capabilities within RII0-ED1, whilst investigating and trialling requirements for a full DSO role. Our RII0-ED1 business plan included ambitious smart grid and innovation strategies, in which we committed to deliver £111 million of network reinforcement savings based on our innovation portfolio and approximately £30 million of on-going and continued savings from practices which are already 'smart'. The final RII0-ED1 price control challenged us to make an additional £100 million of smart grid savings.

This approach has enabled us to continue to meet our core objectives in the face of a changing energy landscape through the following roles and responsibilities:

- **Maintaining network integrity:** using Active Network Management systems (ANM) to control variable power flows on the network, ensuring we can keep the lights on as we connect more DERs to our networks.
- **Providing fair and cost effective network access:** using innovative connection arrangements to connect more of our customers to constrained areas of our network, ensuring we can deliver great customer service and facilitating the low carbon future.
- **Engaging, educating and advising customers:** adopting proactive stakeholder engagement to identify and offer connection options (technology, connection type and location) that benefit our customers and the overall system

- **Ensuring efficient and economic network development:** procuring innovative alternatives to more costly traditional network reinforcement, lowering our costs for the benefit of all our customers.

We are therefore already delivering the emergent DSO roles and responsibilities. Table 4 maps a selection of our smart practices to the key roles that are fundamental for us to continue to fulfil our objectives.



Table 4: Emergent DSO functions

Smart practices	Maintain Network Integrity	Providing fair and cost effective network access	Engaging, educating and advising customers	Ensuring efficient and economic network development
<p>DER capacity management</p> <p>Taking a proactive approach to the customer connection process</p>	A more targeted approach to connections makes better use of the network and enables us to increase the value of flexibility services for network management	Capacity heat maps indicate to developers where spare capacity exists on the system Simplified DER connections process for the South Eastern network reduces connection time	Engaging and advising customers through surgeries, workshops, and information packs (including network heat maps) are part of our increasingly proactive approach	Facilitating the connection of DER to areas of the network with spare capacity results in greater network utilisation
<p>Flexible Distributed Generation</p> <p>Connecting DER to constrained areas of our network without high reinforcement costs</p>	Network constraints are actively managed via an ANM system which curtails flexibly connected DERs	Flexible connections can avoid the need of costly and time consuming network reinforcement This speeds up and reduces the cost of the connection process for our DER customers	Potential connectees are being provided with the information and advice needed to understand the merits and risks of flexible connections	Flexible connections allow us to increase the utilisation of the network while reducing the need for network reinforcement
<p>Procurement of Flexibility</p> <p>Using customer flexibility as an alternative to network upgrades</p>	Customer flexibility can be used to actively manage network flows and constraints	Flexibility can be procured to mitigate the need for reinforcement	More of an enduring relationship with customers reveals mutually beneficial opportunities from flexibility services	Customer flexibility provides an economic alternative to conventional network expenditure
<p>Facilitate uptake of Electric Vehicles</p> <p>Prepare for EV growth to ensure electricity system enables uptake</p>	Engagement with key customer groups improves our knowledge and capabilities around EVs and is key to managing their uptake	Our support of Transport for London's plan to deliver 300 rapid EV charging points across London by 2020 will encourage uptake of EVs	Early engagement in EVs gives us the opportunity to avoid adverse impacts on our networks and potentially reap flexibility benefits	Improved visibility of EV uptake will enable us to optimally deploy network reinforcement

6.3 The full DSO role

In the future the DSO will take on additional roles to support the wider system and enable markets for DERs.

In addition to fulfilling the core DSO objectives using new tools and techniques, the full DSO of the future will play an increasingly important role in delivering value for customers in the wider electricity system. The roles of the full DSO will include:

- **Supporting whole system optimisation**
- **Enabling markets**

We discuss each of these new roles in turn. The exact scale and scope of the full DSO role will depend on how markets and market actors respond to the needs of a more flexible system. We are actively engaged in programmes (summarised at the end of this section) with other market participants to explore different concepts, both technical and commercial, as well as following closely parallel initiatives being undertaken by others. These will form a vital part of the knowledge base to inform future market arrangements and the roles and responsibilities of different players.

Supporting whole system optimisation

The increasingly active relationship between the DSO, distribution network customers and the GBSO requires additional coordination between the GBSO and DSO to ensure a beneficial whole system approach to managing the local and national electricity networks. This coordinated approach should reveal the locational value of DER, help to optimise losses, and provide the means to keep the system secure, doing so in a cost-effective manner.

Studies undertaken as part of the Low Carbon London innovation project¹⁷ determined that there was a significant risk of service conflicts between the GBSO and the DSO, with the impact particularly affecting the DSO. The study revealed that coordinating service dispatch, whether by joint procurement on a flexibility platform or with the DSO acting as the interface, could significantly reduce the occurrence of these conflicts – improving system security and lowering costs.

The GBSO needs to balance the system on a second-by-second basis to manage system frequency. A significant proportion of DER is both intermittent in output and is not directly visible to the GBSO, making this balancing more difficult and more costly. Many of these DERs are themselves capable of providing balancing services, but doing so can conflict with the management of distribution constraints. As the distribution network itself becomes more heavily utilised and actively managed there is a need for a coordinated approach.

This needs to ensure that constraints are not violated, that contracted services can be delivered, and that all network customers are treated fairly and equitably.

Coordination is also required at the connection and planning stage. In some parts of the network, the volume of DER is such that for parts of the year generation can exceed local demand, resulting in ‘reverse’ power flows onto the transmission network. If these reverse flows become sufficiently large, this can lead to technical constraints on the transmission network and, ultimately, the need to reinforce the transmission network.



Managing network losses using advanced analysis and data sharing – Losses Strategy

Transitioning to a DSO environment will inevitably lead to higher network utilisation. Without mitigation this will likely lead to increased network losses. Our current losses focus is developing an understanding of how to optimise our network during this transition.

Importing data from previous Innovation projects into our Load Related Expenditure modelling tool is enabling us to begin to understand the impact on losses that the DSO transition may have. Increasing bi-directional power flows and changing consumption patterns will affect Britain’s electricity networks in different ways. We have incorporated a losses algorithm into our Kent Active System Management (KASM) software to develop a holistic understanding of how changing dynamics, relationships and dependencies between across transmission and distribution networks will affect network losses.



¹⁷ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A5%20-%20Conflicts%20and%20synergies%20of%20Demand%20Side%20Response.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A5%20-%20Conflicts%20and%20synergies%20of%20Demand%20Side%20Response.pdf)

A reinforcement decision by the DSO can impose costs on the GBSO and TO that, if considered on a “whole system” basis, could have resulted in a different course of action. Similarly, the need for transmission reinforcement can in some cases be alleviated by using DERs or reconfiguring the distribution network itself. It may also be that transmission actions can be taken by the GBSO or TO to resolve distribution constraints. As the DSO role evolves it will be important that this interface between DSO and GBSO develops further. There a number of activities that the full DSO will need to do to support the optimisation of the wider electricity system, both on an operational and planning timescale. These include:

- Procuring services from flexible DERs to manage the operation of the distribution networks.
- Facilitating access for DERs to the GBSO’s balancing markets.
- Co-ordinating balancing actions with the GBSO, and providing visibility of available flexibility from DERs.
- Providing enhanced forecasting and analytics regarding available network capacity, as well as real-time information on the operations of the distribution system.
- Co-ordinating network planning with the GBSO and TO to determine the most economic solutions for managing the transmission and distribution systems, considering both network reinforcement and smart solutions.
- Learning from others including innovation projects led by others.



Learning from others – innovation projects led by peers

As we move towards full DSO, it is important that our DSO capabilities are informed by the innovation activities led by other DNOs;

- The My Electric Avenue (Scottish Southern Energy Power Distribution) project which was the first project to look at smart domestic EV charging;
- The Flexible Approaches to Low Carbon Optimised Networks (FALCON) (Western Power Distribution) and Flexible Networks for a Low Carbon Future (Scottish Power Energy Networks) projects which demonstrated tools and techniques including dynamic ratings and network modelling and monitoring to optimise the use of networks; and
- The Customer Load Active System Services (CLASS) (Electricity North West) project which has proven that distribution network management can provide cost effective solutions to wider system management.

Some of these activities we have already started to do, for example, through our participation in National Grid’s Regional Development Programmes.



Collaboration with National Grid to realise additional generation capacity in the highly utilised South East network – Regional Development Programme

The South East electricity system is one of the most complex areas of network in Europe, with several interconnections to continental Europe, a nuclear power station and a significant volume of renewable energy resources. Just in this area over 1.8GW embedded generation and 3.6GW of transmission capacity has been connected (2GW of additional HVDC interconnector capacity contracted and coming online in next 3-4 years). This requires both National Grid and UK Power Networks to consider a whole system approach to manage and optimise network capacity. Through close collaboration with National Grid we have co-developed new network models and improved the level of granularity in data exchanges. This has already revealed the potential for a significant increase in available capacity on the South East Network.

We have also developed a process for updating and managing new connections onto the system, which will give future customers all the relevant technical and commercial requirements without the need for a prolonged network assessment. We have work collaboratively with other network operators to develop this new process and anticipate this work will be the bedrock of the forthcoming changes to the Statement of Works process.

Enabling Markets

At UK Power Networks, we believe it is critical that markets flourish to drive competition and lowest costs to consumers.

With respect to enabling market for DERs, the DSO will initially need to provide visibility surrounding the operations of the distribution system to inform the GBSO and DERs of available capacity and procure flexibility to meet its own needs to manage the distribution system.

However, as we have discussed, an increase in the volume of DER capacity, including EVs, will drive demand variability, complexity, and the number of local network constraints. This will inevitably result in the operation of the distribution network becoming a more complex and challenging task, with increasing operational risk for the DSO.

To manage and relieve network constraints, DSOs will require greater access to DER flexibility in order to actively manage the network, and optimise the amount of network reinforcement needed. In addition, increasing DER capacity will displace the large thermal plant on the transmission network on which the SO relies for the majority of today's frequency and constraint balancing requirements, creating more need for the SO to access to DER flexibility services in order to replace this lost service.

It will become increasingly difficult for the SO to access unconstrained services from DERs and the role the DSO must play will become larger and more complex.

UK Power Networks' view is that the DSO will be required to operate local flexibility platforms to meet its own flexibility requirements, and to enable customers on flexible connections to optimise their own output or consumption with others in the same constrained zone through trading. As we discussed in Section 5, we expect that as DER penetration increases discrete flexibility platforms will merge and form a wider DSO platform. We expect that the GBSO (and potentially neighbouring DSOs) will want access to this platform, which will also allow DERs on our system to access wider markets.

The interface between the DSO flexibility platform and the GBSO's Balancing Mechanism, and broader Balancing Services, is an important area for consideration. The DSO must ensure that flexibility being offered on its platform and procured by the GBSO (and other DSOs) must be capable of being delivered to the transmission system without compromising the reliable operation of its own network.

In the short term, we see the emergence of a hybrid model where DER services are directly managed by the GBSO and some DER services are accessed by the GBSO via the DSO and aggregators. We also see an increasing role for DSO as the level of DER on the distribution network increases. How this will work in practice is yet to be defined, but initiatives such as the Power Potential project will provide valuable insights on the best way to achieve this.

Longer-term operational coordination models are being explored by a number of industry initiatives and high-level options were consulted as part of BEIS / Ofgem Call for Evidence in December 2016.

Under any model there is a need to define protocols to maintain network integrity, including robust data exchanges between the DSO, GBSO, third party operators of local energy markets and DERs.



Future Electricity System Market Models – Industry work

The question of the most efficient future whole system market model is currently being considered by industry participants. We are working as part of the ENA project 'Open Networks' where GB network operators are currently working on producing a consolidated view of the GBSO of the potential future market model options.

We are also informing our thinking from work undertaken by other network operators. DNOs SP Energy Networks (SPEN), see www.spenergynetworks.co.uk, and Western Power Distribution (WPD), see www.westernpower.co.uk, have released their visions for the DSO transition including their view on future market model options.

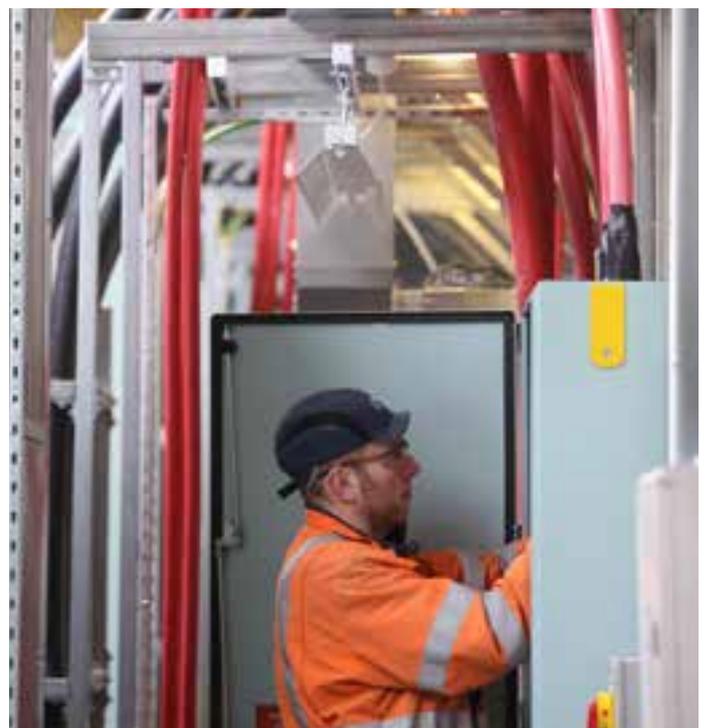
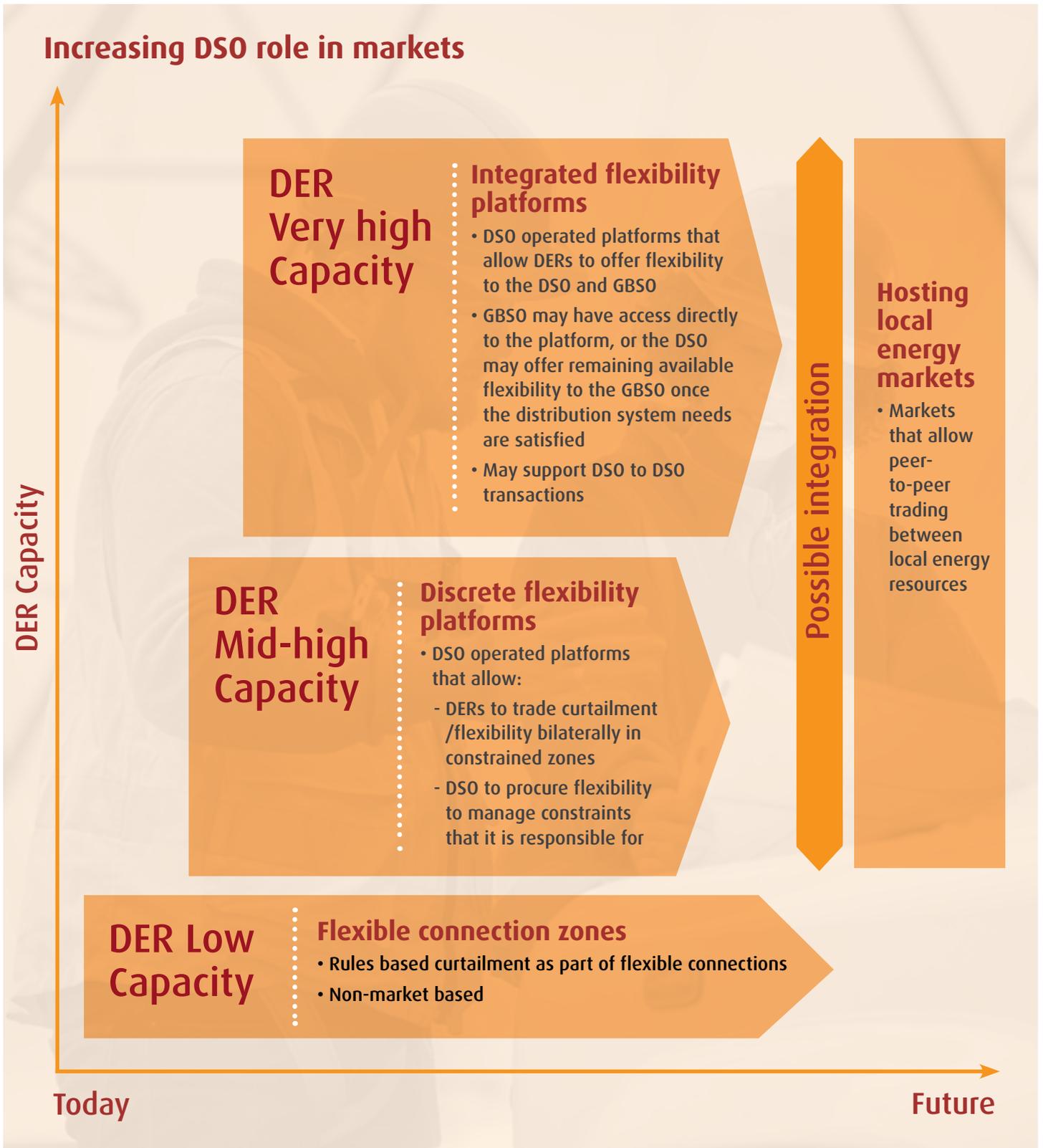


Figure 7 explores how local flexibility platforms may evolve as DER penetration increases, from today's world of rules based curtailment for those on flexible connections using Active Network Management, to a world of more integrated market based flexibility platforms.

Figure 7: Potential evolution of local flexibility platforms



We do not believe that DSOs necessarily need to be the party hosting local energy markets, but where there is a requirement for a flexibility platform to manage network constraints in the local area, we believe there could be a benefit in common platforms covering both local energy and flexibility.

In procuring flexibility from DERs, the DSO is taking actions that impact on energy balances. There remains an open question on how this will be accounted for in the future market design. There are essentially three options:

- 1) the DER's offtaker or supplier has to manage the resulting imbalance;
- 2) the impact on energy balances of DSO action is 'recognised' in central settlements; or,
- 3) the DSO takes control of energy and is itself a participant in the wholesale market. The choice of a suitable option will depend on how the market structures and design evolves.

Improving network visibility, monitoring and control

Enabling markets will need a significant expansion in the DSO's roles regarding network visibility, monitoring and control. Existing ANM systems are currently able to monitor the state of a specific constrained network and take curtailment actions as required. In order to achieve optimal whole system outcomes, however, this role will need to become more sophisticated in a number of dimensions:

- **Multiple constraints and DERs** will need to be monitored and analysed simultaneously in order to provide the system operators with a view of the ability of DERs to provide system services.

The volume and complexity of data that will be exchanged may create the need for innovative approaches to data visualisation, synthesis and sharing to interpret and act on the wealth of information that will be available to the DSO and GBSO.

- **Forecasting** network utilisation and DER behaviours over various timescales will become critical in order to allow the GBSO to procure and utilise DER flexibility efficiently and without endangering the distribution network.
- **Contingency analysis** will need to become more sophisticated, considering more network configurations and accounting for TO and GBSO behaviour, in order to achieve efficient whole system planning.

The transition to a full DSO will require a transformative shift in the way that we, and the electricity system as a whole, operate. The eventual design of energy and flexibility markets is yet to be determined, and the roles of DERs and the network operators have yet to be fully defined.

We strongly believe that we need an evidence-based approach to answer these questions, and that we can only develop a robust approach through "learning by doing".

We are involved in two innovation projects with National Grid, Kent Active System Management (KASM) and Power Potential, which explore the concepts behind the full DSO role. These are summarised in Table 5 below. We are also engaged with National Grid's Regional Development Programme for the South East which is exploring how to coordinate connections of DERs in areas of transmission and distribution constraints.

Table 5: Innovation projects informing the full DSO model

Innovation Project	Supporting Whole System Optimisation	Enabling Markets
<p>Kent Active System Management Enhanced analysis and monitoring of East Kent network to improve network operation</p>	<p>New communication link between UK Power Networks control room and GBSO's control room will increase whole system visibility, a vital step for whole system optimisation</p>	<p>Providing and maintaining systems, processes and data to enable DER to offer services to the wider market</p> <p>Advancements in network visibility, monitoring and control provide the tools required to set-up and operate market platforms</p> <p>Explores the technical and regulatory issues associated with data transfers across the Transmission-Distribution boundary</p>
<p>Power Potential Optimise South East network by providing market for DER to provide flexibility service</p>	<p>Reactive and active power services provided by DER presents the GBSO with an alternative to costly transmission network reinforcement</p>	<p>UK Power Networks will create and operate a regional active and reactive market for DER in the South East, providing DER access to wider constraint management markets</p>



The learning from these initiatives will contribute to the growing evidence base required to understand how best to coordinate the actions of DERs, DSOs and the GBSO in a way that allows us to plan and operate the increasingly complex electricity system in a safe, secure and efficient manner.

As well as providing the evidence needed to understand what a full DSO can and should look like, it also allows us to identify, understand and develop the new capabilities associated with a full DSO. This enables us to anticipate and plan for the new systems, processes, data and skills that will be required in the future. The transition to the DSO role, and the capabilities required to achieve it are explored in the next section.



Enabling real-time interfaces between the GBSO and DSO – Kent Active System Management (KASM)

The project developed the necessary business processes and capabilities to allow the exchange of real-time data between the UK Power Networks and National Grid control rooms to support coordinated planning between the parties. The deployment of an advanced analytics solution will allow increased network visibility through real-time modelling and contingency analysis to manage the security of the network, which is becoming increasingly complex as new distributed generation comes online. The forecasting capabilities within the solution will also enhance the capability of outage planners to minimise constraints placed on the output from distributed generators during the summer maintenance season, and during major construction and reconfiguration activities required to complete the new NEMO interconnector between Kent and Belgium.

How to respond to this consultation – please find on our microsite [FutureSmart.ukpowernetworks.co.uk](https://www.future-smart.ukpowernetworks.co.uk) the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

Consultation questions



3. How does your view on the definition of DSO marry up or vary to what we have set out?
4. How does our description of the transition to DSO in two broad phases - the 'emergent DSO' and the 'full DSO' - align with your view of how network operators will transform?
5. Are there any other roles and responsibilities you expect a DSO to perform under the 'emergent DSO' or 'full DSO' model?

A day in the Life of a DSO

We have explored a typical day in the life of a domestic prosumer in the low carbon future.
 We now consider how a DSO must operate on a daily basis to accommodate variable power flows and utilise flexible DER to efficiently manage the distribution network as well as the wider system.



7 | Transition to DSO

In this section we describe the capabilities we believe are required to support the DSO roles. By capability we mean the systems, processes, data and people required to deliver a high quality service for our customers.

7.1 Capability Requirements

The transition from DNO to DSO requires new capabilities and the evolution of existing capabilities.

Developing a DSO Capability

UK Power Networks has already invested significantly in the capabilities to deliver the first stage of the transition to the DSO, the emergent DSO.

To complete the transition to a full DSO will require further investment in transforming existing capabilities, as well as creating new capabilities. We believe that successful fulfilment of the DSO role is best achieved through building on what has made our business successful to date. As a result, our capability development plan takes our current business capabilities and turns them into a full DSO.

Implications of our DSO Capability Model

We have determined the new capabilities that are required in addition to our current role as an emergent DSO. We have also identified which existing capabilities require further development and investment to deliver the full DSO role. A key conclusion of our DSO capability model development is that our existing business provides a robust and valuable basis from which to progress our DSO transition.



Below we discuss the new and transformed capabilities, and how they enable the transition from the emergent DSO role to a full DSO role.

The capability model is organised into three groupings:

- 1. Customer, Markets and Regulation:** These provide the ability to deliver the enhanced customer service we anticipate being required under the DSO model, the need to procure flexibility services from a range of providers, and ability to run market platforms.
- 2. Distribution System Planning and Operations:** This addresses the ability to plan, manage, develop and maintain the distribution system in coordination with other system operators, asset owners and aggregators in a safe and efficient way.
- 3. Enablers and Security:** These provide the ability to explore, evaluate and deploy technology and innovation in a timely, secure and efficient manner, and to have the systems required to bring these new capabilities together in a coherent way.

Within each group the detailed capabilities have been logically arranged in sub-groups. The capability model is not intended to imply a relationship to a physical organisation structure. Rather it aims to articulate all of the capabilities that a business will need to fulfil to fully deliver the DSO role.

Customer, Markets and Regulation

The most significant investment in new capability will be in the commercial areas, which we have grouped as Commercial Operations and Customer Strategy and Operations.

As a DSO, UK Power Networks will need to understand, engage with and manage customers who provide flexibility services. We will need to understand what they need to be able to provide flexibility services, and design flexibility products accordingly. Doing this will require investment in key roles that provide commercial, market and risk analysis, forecast and plan resource needs, and establish flexibility contracts, whether bilaterally, tendered or via market based flexibility platforms. This presents us with an opportunity to bring in experience and learning from other industries and geographies who are familiar with the commercial, legal and regulatory complexity, and are experienced in the technologies that will support the engagement, management and settlement of flexibility markets.

We will need to build systems that can accommodate enhanced DER-related customer information to provide a valuable knowledge base for developing customer insight to support our DSO commercial strategy. This will allow us to analyse and segment customers according to their capabilities, so that we can design flexibility services that attract customers to participate and allow us to get the right services to ensure customers' energy needs continue to be met.

It will also be important to ensure that we design a great customer experience for those accessing flexibility services. UK Power Networks is already recognised as a leader in engaging with its customers through digital channels. The additional requirements of a DSO role, and the expected increase in DER customers will require us to have dedicated teams to manage these relationships.

Figure 8 below shows the capabilities we have identified in this area, including those that already exist, those that need to transform to accommodate a DSO role, and those that will need to be newly developed. Our existing Charging Methodology and Regulation capabilities will remain, but will need to evolve to support the DSO role and the new commercial relationships and structures that emerge. In particular, we anticipate there being changes to charging methodologies, a greater focus on market design issues at the distribution level, and changes to the incentive regimes, all of which will need to be managed through these functions.

Figure 8: Customer, Markets and Regulation Capabilities



Distribution System Planning and Operations

A number of the Distribution System Planning and Operations capabilities shown in Figure 9 are familiar to UK Power Networks in its role as an emergent DSO, namely those of modelling network growth, planning investment, delivering work, and the power systems and engineering expertise to manage our network.

Figure 9: Distribution System Operations Capabilities



Our DSO capability model maintains these concepts but adds new capabilities that reflect a number of key differences between the full DSO and emergent DSO role:

- The need to plan and operate networks with increasing number of DERs on the system
- The volumes of data being exchanged by network assets and the DSO will increase significantly. More time-critical operational data will be needed to ensure that system assets are operating within network capabilities, and to identify where flexibility is needed to manage the network. This information will need to be exchanged with the GBSO, potential neighbouring DSOs, operators of local energy

markets, DERs, aggregators and other market participants in order to anticipate and plan for future system needs.

- The importance of analytics will increase as the management of an active network results in more reliance on complex processes and systems. Modelling and analytics are also key to developing a whole system view of where alternative solutions to network reinforcement would be of benefit to the system.

We have grouped a number of key new forecasting and planning capabilities, needed in order to fulfil the DSO role, under the heading of Integrated System Planning.

The required maturity of this capability is closely linked to the volumes of DER connecting to the distribution system. A key new capability will be the ability to more accurately model and forecast DER load and generation growth, so that we can select the right combination of flexibility solutions and reinforcement needed for our networks and the wider system. An example of this is the Scenario Planning for DER growth that we have completed for our EPN region, and are now starting in the SPN region.

Our investment planning processes will be refined so that the relative merits of all options – including DER flexibility and conventional reinforcement – are considered and evaluated. Taking into account the upfront and ongoing cost of each option, and uncertainty over future network loading, the process should aim to achieve the optimal outcome for the end consumer. We have initiated work on this as part of our flexibility procurement this year.

Planning processes will need to involve much greater interaction with the GBSO to ensure that the impacts on the wider system are considered as part of our decision making process. This will need investment in new decision support tools and analytics to integrate the commercial and engineering impacts of proposed investments for our asset management experts, and enable collaboration with the other participants in the electricity system. The technology trends in process automation and data visualisation will be of particular value to the development of the Integrated System Planning capability.

We have defined a System Management capability that brings the visibility of network assets together with information regarding asset health, and the availability of DERs. This capability supports the real-time operation of the DSO system, and provides the visibility of our network to other participants. This will require investment in telecommunications and telemetry technology to enable greater visibility of our own network, as well as the network boundaries of the GBSO and DERs.

Our existing Network Management systems will need further investment to provide the secure data exchanges that a full DSO role will require. Acting as a full DSO will require UK Power Networks to develop platforms that allow customers greater visibility of capacity availability on the system, for example through heat maps and generation indices, and real-time state of the system and how this may affect DERs' abilities to access wholesale, flexibility and balancing markets. To achieve this we will develop online tool-sets with the support of our customers.

Active Network Operations and Control capabilities will require us to develop real time simulation and playback functionality over and above our requirements for similar functions within our enhanced DSO role. We also see a need to invest in predictive analytics solutions that will identify when system reliability, power quality or energy losses related issues may occur.

The Active Network Operations and Control capability will need investment to increase the maturity of contingency analysis, energy flow forecasting and DER dispatch systems. The more complex tools will require development of enhanced power systems and power engineering skills.

We will also develop the necessary solutions to provide engineers operating the system with real-time comparison of products and services to enable them to select the optimal commercial solution or network intervention. This will require an evolution of our control engineer role to one that incorporates the necessary commercial skills to ensure the optimal dispatch of resources. The real-time dispatch of DERs using ANM is a new technology capability that we will continue to invest in.



Figure 10: Enablers & Security Capabilities



Enablers & Security

To realise the capabilities described above will require us to invest in enabling innovation and business change in a safe and secure way.

A key characteristic of the new capabilities is the increased sharing of information and interaction with parties outside of UK Power Networks. This means that we have to develop our existing cyber security capabilities so that our cyber defences are continually resilient to the changing risks and threats that could be targeted at a much more open and interactive power system.

We will need to develop our existing expertise to ensure we have the appropriate breadth of skills to support the close integration of information technology and operational technology that can deliver the coherent and efficient technology platform we would need to carry out a full DSO role.



7.2 Approach to investing in DSO capabilities

The expenditure required to achieve the DSO transition is substantial, but we have identified a set of investment principles that allow the first steps to be taken with minimal regret, and let us use these to make sure we as an industry make the right investments in the future.

Making the transition from a DNO to a DSO is expected to bring substantial benefits for our consumers, wider network stakeholders and society more broadly. Realising this transition, however, is likely to require investment in our networks, systems, processes and people.

In the East of England we are investing £15.4 million to deliver 500 MW of additional generation capacity by delivering a number of smart interventions such as better network visibility at the 132kV and 33kV networks, innovative protection schemes and the use of updated capacity ratings informed by Light Detection and Ranging (LiDAR) techniques.

In the South East, we will be undertaking a similar programme where we will be investing £6 million to deliver 330MW of additional generation capacity using similar techniques. As with any investment, we need to be sure that further expenditure is justified, and that the benefits outweigh the costs.

In Table 6 we show where investment in our capabilities is required to support each of the DSO roles outlined in Section 6. In the case of the emergent DSO roles, some of this development is already underway.

Table 6: Mapping DSO functions to our Capability Requirements

Capabilities		Customers, Markets & Regulation				Distribution System Operations					Enablers & Security		
Roles	Customer Strategy & Operations	Commercial Operations	Market Development	Regulation & Markets	Active Network Operations & Control	System Management	Integrated System Planning	Asset Management	Standards	Plan Manage, Execute Work	Technology & Innovation	Security & Risk Management	IT/OT
Emergent DSO	Maintaining network integrity		✓			✓	✓	✓	✓		✓	✓	✓
	Providing fair and cost effective network access	✓	✓		✓						✓		
	Engaging, educating and advising customers	✓	✓										
	Ensuring efficient & economic network development		✓		✓	✓		✓	✓		✓		
Full DSO	Supporting whole system optimisation		✓		✓	✓					✓	✓	✓
	Enabling markets	✓	✓	✓	✓						✓	✓	✓

The scale of the transformation required, combined with significant uncertainty around the timing of key external drivers, such as the rate of EV uptake and the pace of technology change, further contribute to the investment challenge. Heading too far in the wrong direction could lead to stranded investments, which impose unnecessary costs on our business and our customers. Investing in technologies early can be expensive, and carries the risk of it being superseded, whereas investing later could mean that we struggle to meet our customers’ needs.

It is difficult at this stage to estimate accurately the full cost for the transition to DSO. We first want to listen and understand our customers and stakeholders current and future needs to inform our prioritisation of organisational change and investment. We are collaborating with industry through the ENA to develop a coordinated framework to evaluate the cost and benefits of the transition.

In the meantime, we believe that we can move forward by following these investment principles:

1. Make sure our planned investments are consistent with the emergent DSO role, and can support the full DSO role if this can be done for minimal additional cost;
2. Identify no regret investments that make sense whatever the future DSO model looks like, where the benefits accrue in the current price control period;
3. Identify innovation projects that can move our understanding forward, particularly where the benefit is uncertain or is expected to materialise in a future price control period;
4. Use business as usual funds to embed DSO capabilities if a business case can be made; and

5. Apply for Innovation Roll-out Mechanism funding for cases where there is clear customer benefit but the current incentive regime cannot justify investment within the current price control.

When policy-makers, regulators, industry and wider stakeholders have a clearer view of the best way forward, it may be appropriate to include additional allowances for the DSOs that recognise the added value that DSOs can provide, and the additional risks involved in operating a more complex system. In the meantime, we see the innovation and incremental investment strategy as being key components in trying to understand what that future model should look like.

7.3 Roadmap and strategic priorities

A short- medium and long-term plan is needed to reach the full DSO model, and we have identified five key priorities for the short-term.

We have developed a roadmap that sets out our priority areas for development of DSO capabilities across three stages to drive the necessary business change. These stages are Phase 1 (2017) focusing on short term goals, Stage 2 (2018 -2023) focusing on medium term goals and Stage 3 (2023 -2030) focusing on long term goals.



Figure 11: DSO Roadmap 2017 – 2030

	Short	Medium
	RIIO – ED1	RIIO – ED1
	2017-18	2019-23
Keeping the lights on	Maintain safe reliable operation and minimise constraints as more intermittent DERs connect	Managing the impact of network constraints on customers through the use of flexible DER and ensuring the take up of EVs does not impact reliable services to all customers
Fair and cost effective distribution network access	Roll out of Active Network Management Systems (ANM) allows increased DER to connect using cheaper flexible connections	Roll out of ANM completed across the East of England and the South East to provide more DER connection opportunities Develop commercial mechanisms for flexible connections constraint management and test market based arrangements to allow customers to have more control over curtailment
Efficient and economic network development	Run flexibility tenders to explore alternatives to network reinforcement reducing network costs and stimulating market for flexibility	Extend flexibility tenders and develop new flexibility products Build portfolio of flexibility to inform ED2 investment plans Improve demand forecasting, planning and operational control using enhanced data to minimise the cost of developing networks to meet the demands of the low carbon transition
Support Whole System Optimisation	Regional Development Plans produced with National Grid allow more DER to connect where transmission network is constrained	Implement revised regional planning framework with National Grid to maximise ability of DER to connect in face of transmission constraints Identify opportunities for whole system cost reduction through DSO actions and investment in ED2
Enable Markets and Competition	Test a market for reactive and active power in partnership with National Grid improving access to transmission and distribution services	Scale up commercial platforms for reactive and active power services Design flexibility products and service strategy to support network development and whole system services Create fair and open markets to service providers to enable & facilitate competition in services to lower whole system costs
Network Visibility and Control	Design of a programme to increase monitoring of low voltage network in areas where the drivers for EV take up are high	Roll out of network visibility and control on Low Voltage networks Integrate data into management systems to identify areas where investment or flexibility will be needed to manage EV take up and provide more information for improved demand forecasting, planning and operational control, to reduce the costs of accommodating DERs

Figure 11: DSO Roadmap 2017 – 2030



7 | Transition to DSO

Focusing on the short-term period, we have set out our DSO strategy for 2017-2018 that identifies five key priorities, which are summarised in Figure 12.

Our DSO Strategy for 2017–2018



1. Facilitate cheaper and quicker connections using proven innovation

Continue rollout of Flexible DG that uses Active Network Management



2. Use customer flexibility as an alternative to network upgrades

Run market tenders for flexibility services such as Demand Side Response



3. Develop enhanced System Operator capabilities

Develop TSO – DSO Commercial Framework, DER Dispatch capability and readiness for smart meters



4. Collaborate with industry to enable GB wide benefits

Actively participate in industry forums to make this transition a reality



5. Prepare and facilitate the uptake of Electric Vehicles

Enable connections using smart solutions and ensure business readiness

For an in-depth discussion of our five key DSO strategy priorities please refer to Appendix A: DSO Strategy Priorities where we layout what we have achieved so far, what we have planned for 2017, and what the near future holds.

How to respond to this consultation – please find on our microsite FutureSmart.ukpowernetworks.co.uk the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

Consultation questions



6. We have organised the capability model into three groupings. Do these in your opinion accurately describe the main DSO capability requirements?
7. Are there other DSO capabilities we should consider?
8. How does your view of the capabilities that the DSO will need vary to what we have set out?
9. Which capabilities most supports your needs and why?
10. Do you broadly agree with the content of our roadmap?
Are there steps you think that should be added?
11. Are the timings in our roadmap appropriate?
Should any be advanced or pushed back?
12. Do you agree with our DSO strategy for the next 2 years? Are there any other priorities you would wish us to consider focusing on?
13. Which of the priorities is most important to you?

A day in the Life of a commercial operator

New processes are required to accommodate the increase in demand for timely and cost effective network connections for DER along with easy access to markets for their flexibility.

Renewable generation is essential to the low carbon future. In order to facilitate the projected increase in distributed renewable generation, which is already creating challenges, innovative solutions must be employed. We therefore explore a day in the life of a commercial DER operator.



9:00am

At 9am **Sarah**, a solar PV plant developer/operator, arrives at her offices. These are interesting times for solar PV developers as the installed capacity of solar PV has increased rapidly over the past decade driven by falling technology costs, reduced distribution network connection costs and easy access to flexibility service markets. **Sarah's** portfolio consists of several operational plants as well as three under development.

9:15am

Sarah is currently going through the process to gain connection agreements from the local DSO for the three plants under development. She thinks to herself how much easier the connection process has become in the past few years. Today the DSO takes a more proactive approach to the process with a number of connection options offered.

Site 1
10:00am

Sarah accesses the DSO's website, navigates to the connection process page, and opens up the network heat maps. This maps out the levels of network utilisation and spare capacity for connections. **Sarah** searches for the areas which relate to the three under-development sites. She finds that the network around the **first site** is currently underutilised. Great, she should be able to apply for a fixed connection agreement without any costly reinforcement costs.

Site 2
11:30am

The **second site** she finds shows that the network is currently over-utilised but there are existing DER sites which have flexible connections. Great, she looks at the networks heat map that includes information on the estimated curtailment level range for the network area to see if she should apply for a flexible connection agreement. She assesses the impact on the business case that in exchange for reduced connection costs, to have the solar PV plant curtailed in times of network constraints.

Flexibility Indices
Indicate how well placed a DER is for providing various constraint management services.

Site 3
1:00pm

Flexible Connection
A flexible connection allows the DNO to temporarily reduce the plant export to manage network constraints.

The **final site** she finds has network capacity at its limit but the map indicates that there is a consortium interested in sharing reinforcement costs in exchange for fixed connections. **Sarah** follows the link which shows the consortium is still looking for further sites to join. Great, she considers joining the consortium to share the reinforcement costs to receive a fixed connection at a reasonable connection cost.

Inverters
Convert DC power, produced by solar PV plant, to AC power which meets the network specifications.

2:30pm

Sarah opens a further network map, this one displaying "flexibility indices". The map shows that the three sites all have high indices for voltage support services. **Sarah** decides that with the money saved through reduced connection costs, that they should consider upgrading their plant inverters. These upgraded inverters allow for dynamic reactive power control, essential for providing voltage support services. Being able to provide an effective service will allow **Sarah** to command a higher price. She'll be able to easily offer this service through the DSO's local balancing market.

4:00pm

This reminds her to check on her operational sites. It's forecasted to be a sunny day and the DSO Active Network Management System (ANM) is warning that a network export constraint is highly likely. One of the sites has a flexible connection agreement and will therefore face curtailment. Through the local balancing market **Sarah** sees an offer from a DER to increase their demand which will reduce the solar plant's curtailment obligation. **Sarah** accepts the DER's offer down the road, a battery in a community energy scheme begins to charge.

The demand to connect increasing volumes of renewable generation on the distribution network, as seen in the commercial operator's story, is already here. We are able to offer generators a range of connection options, allowing these network customers to connect faster and more cheaply in exchange to be flexible. Furthermore, guiding them with network analysis which identifies spare network capacity, and potentially helping them to form consortia, can help us utilise the network in a more efficient and cost effective manner.

8 | Further Key Issues for Development

In this section, we discuss the key wider issues that we believe require development in order to deliver the transition to DSO.

8.1 What Enhanced regulatory approaches are needed to drive the full benefits of a DSO?

Government and regulators need to provide greater clarity of the future policy and regulatory framework.

We believe that the strengths of the current regulatory framework (total expenditure benchmarking; outputs led with strong incentives) can be enhanced to encourage DSOs to enable the successful delivery of whole system benefits and achieve decarbonisation at least cost.

Incentives for DSOs to invest for whole system benefits

As highlighted by research undertaken by Imperial College London and the Carbon Trust, there could be £17-£40 billion of benefits from optimal system operation by 2050¹⁸. The vast majority of these benefits are obtained through optimising the use of resources at distribution level and therefore enabled by the development of the DSO.

Under the current RII0 framework, the total expenditure incentive mechanism (TIM) encourages us to make investments where they reduce costs on our network and is supported by a number of delivery incentives on quality of supply, investment delivery (asset condition), customer service, and stakeholder engagement.

The incentives for RII02 framework will need to build on this foundation to address two key areas:

- The development of mechanisms that address the increased risk and uncertainty associated with the development of low carbon technology demands, balancing the need to manage costs with the need to ensure the system can meet the low carbon technology (LCT) demands as they arise; and
- The development of mechanisms to incentivise actions at the distribution level that reduce the whole system costs. An example of the latter could be incentives that recognise the benefit of removing distribution level constraints to allow more DERs to participate in the Capacity Market, increasing competition and reducing costs for consumers. There is no current mechanism for DSOs to share in wider system benefits enabled by the smart operation of distribution systems, or to compensate for the additional operational risks that the DSO might be taking on.

We expect that the regulatory framework for future RII0 price controls will need to evolve to provide a suite of incentives that ensure that whole system cost reduction is equally important as local system efficiency and that provide the right balance of support for investment in time to meet customers' future needs.

Alignment of incentives between Transmission and Distribution

A whole system planning framework requires a more joined up approach to assessing the costs and risks (and associated benefits) across transmission and distribution. DSOs could access services on behalf of National Grid, or provide services to others, to maximise whole system efficiencies. The current distribution (ED1) and transmission (T1) price controls were not set with the delivery of whole system solutions in mind.

Connection queues are emerging in some parts of our network, slowing the rate of connection for some DERs. Managing these queues is also a challenge for the DSO. New capacity on the distribution system is funded today by connecting customers or through general reinforcement costs, charged to all demand customers through use of system charges¹⁹. Encouraging collaboration through the forming of consortia to address connections capacity is being trialled in certain areas. Allowing the DSO to invest, in flexibility capability or assets ahead of need, anticipating the requirements of its customers, may provide an approach for speeding up connections. We are also seeing constraints on transmission networks affect our ability to offer connections on the distribution system. A more sophisticated approach to funding and allocating capacity from a whole system perspective seems increasingly likely to be needed.

It will also be necessary to determine what the output measures are that represent whole system efficiency. Measures such as whole system capacity, balancing services / flexibility capacity, its utilisation and the costs of these will be challenging to link to specific interventions and investments, particularly across the separate transmission and distribution price controls.

The regulatory framework will need to evolve to provide incentives and/or funding for the services required and provided by the DSO. We consider that there is merit in setting out a programme for this work as part of the RII02 framework development to provide certainty that these issues will be considered and appropriate assessment mechanisms put in place to enable the formulation of high quality business plans for the RII02 price controls.

¹⁸ https://www.researchgate.net/profile/Marko_Aunedj/publication/310400521_An_analysis_of_electricity_system_flexibility_for_Great_Britain/links/582c61ab08ae138f1bfd376f.pdf?origin=publication_list

¹⁹ Some additional capacity can be released following the replacement of assets.

Facilitating cross-energy vector collaboration and managing dependencies

Policy and regulatory decisions taken in other sectors will affect the need for and availability of flexibility. This is particularly the case for EVs. Personal transport energy usage from hydrocarbon resources is equivalent to the current energy supplied by electricity²⁰ and we have already discussed how the decarbonisation of transport could have a significant impact during the 2020's. Transport policy will shape the way personal transport develops, how quickly autonomous transport is developed and adopted, the incentives for sharing compared to owning (especially in urban areas) as well as the incentives to switch to hybrid/EVs.

It will be important that DSOs have good visibility of where EVs are connecting to their networks in order to manage charging capacity. It will also be important that transportation providers are encouraged to work with the energy system operators to design a customer proposition that supports both the successful electrification of personal and public transport and will deliver the flexibility needed by the energy system. For example, if vehicle charging systems do not develop to encourage flexible vehicle charging when there is surplus production capacity and network capacity, typically in the daytime, additional local storage and network capacity would be needed to meet the increased evening demands. Government and regulators should consider how network innovation funding can be made compatible with other matched funding opportunities in areas such as smart vehicle charging.

The policy on the decarbonisation of heat could also have a profound impact on the development of the electricity system and the role of the DSO. Heat demand is much larger than today's electricity demand, up to five times the energy consumption, with peak demand occurring at the same time in the early evening. The gas system also has vast amounts of inherent energy storage achieved by pressuring the gas in the pipe network, together with plenty of flexibility in supplies available from the North Sea, through interconnectors and from liquefied natural gas (LNG). The solution to heat is unlikely to be through a single solution. Electric heat pumps, electric water heating, renewable biogas, hydrogen and hybrid systems²¹ that can use multiple energy sources to produce and store heat are all options being considered and trialled today. The proportion of this that is decarbonised through electric solutions will have a profound impact on the demands faced by the electricity system and the design and investment needed to upgrade existing infrastructure to a



new smarter system. A long term policy is needed to allow the development of the energy system to optimise between energy vectors (electricity, gas and potentially hydrogen), between smart solutions (including home heat and energy storage) versus network reinforcement, and the development of suitable local and national energy production.

The questions surrounding the decarbonisation of heat also raise the challenge, ensuring the financial, social and environmental costs in all sectors are factored into policy making and ultimately optimising and aligning the incentives in and across the different energy systems and their regulatory frameworks.

Long-term investment, uncertainty and affordability

There will be a challenge to find the right balance between the incentives to invest in flexibility to address future uncertainties in supply and demand with the equally important efficiency incentives that keep costs down for customers today. The regulatory framework will need to take in to account and balance the long-term certainty for investors in flexibility with shorter term decisions intended to protect customers in an increasingly uncertain world.

The critical nature of electricity supplies in the modern world will increasingly drive the system operators to minimise the risk of the system not being able to meet demands. Upgrading the capacity of a significant proportion of the electricity networks (over 1 million km across the UK²², over 187,000km in UK Power Networks) would be an enormous task even over a 20 year period. Electricity cables can operate reliably for over 70 years and whilst flexibility provides a means of making best use of our existing networks, policy certainty, particularly around heat, would help ensure that investments made today can serve customers well into the future.

²⁰ Dukes energy statistics <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes>

²¹ <http://www.wuutilities.co.uk/media/2405/on-the-road-to-a-green-energy-uk.pdf>

²² Energy Networks Association http://www.energynetworks.org/assets/files/news/publications/GTTN/1400111_ENA_UKguideToTheNetworks_AW_18May15.pdf

8.2 What areas does the industry need to focus on?

The industry is best placed to develop the future vision but we need to work together to achieve this.

It is important that industry works together in order to ensure great service to its customers and stakeholders.

We consider the immediate focus areas for industry to be:

- Start the work needed to build on the RIIO regulatory framework to develop aligned incentives for transmission and distribution in time for the RIIO-T2 and RIIO-ED2 price controls, to support the delivery whole system benefits and decarbonisation at the least cost.
- Continue innovation trials to learn by doing and to inform the transition to DSO.
- Support the development of standards to ensure the visibility and control of smart EV charging in conjunction with the Department of Transport and their work on the Modern Transport Bill.
- Develop flexible market arrangements to manage constraints and optimise resources connected on the distribution network; and
- Collaborate with wider industry to design cross-energy vector practices to support lowest whole energy system costs.

We believe that the ENA provides a vital platform through which to drive these focus areas, share learning on how businesses are transforming and agree how best to continue the coordination required. There will still be some areas where it will be helpful for individual network operators to work bilaterally with National Grid and others to explore the options to help inform the wider policy debate.

We are actively contributing to the ENA 'Open Networks' project that will progress the transition of DNOs to DSOs. It enables an industry view of the DSO business capabilities to be designed and an environment in which insights on innovation projects and their embedment are shared. We are also working together with other industry peers including the FPSA project and the Energy Systems Catapult (ESC).



Thought leadership – Energy Systems Catapult (ESC) and Future Power System Architecture (FPSA)

The Energy Systems Catapult is a leading technology and innovation centre set up to help the UK navigate the transformation of our whole energy system. The ESC's research and publications are vital at informing stakeholders and driving an industry consensus on the direction of the energy system transformation.

In particular, the Future Power System Architecture (FPSA) project is a collaborative effort involving industry professionals, academics, policymakers and stakeholders to assess the challenges to be faced in the electricity system by 2030 and to identify new functionality required.

It is crucial to the transformation of the energy system that we progress together as an industry. As such we will fully engage with the ESC and the FPSA project by drawing practical insights on the impact on our business of the recommendations and conclusions made in their publications.



How to respond to this consultation – please find on our microsite [FutureSmart.ukpowernetworks.co.uk](https://www.future-smart.ukpowernetworks.co.uk) the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

Consultation questions



14. Are there any other key issues that need to be addressed to support the transition to DSO?

15. Which key issues do you think industry should prioritise?

9 | Responding to this consultation

What this will deliver

The transition to Distribution System Operator will enable UK Power Networks to continue to facilitate the low carbon future, whilst delivering value to our customers and local communities who rely on our networks for a secure supply of electricity.

The core objectives of UK Power Networks' – keeping the lights on, providing great customer service, and lowering our costs – will remain central to any future DSO role. However, the way in which we meet those objectives will adapt as our customers' needs and expectations change and the energy landscape evolves around us.

Transformation through collaboration

At a time of unprecedented change and a rapidly evolving market where closer collaboration and partnerships are going to become more prevalent, the industry needs to collaborate like never before. We are putting collaboration at the heart of our strategy.

Help us Shape 'A Smart Grid for all'

The world is changing fast, and so is our role. At UK Power Networks we have already begun our transition to a

Distribution System Operator. We want to help our customers to realise the value of the low carbon transition and we need your feedback on our plans to make this vision a reality.

What we need from you

We invite partners, customers, innovators, businesses, policy makers and the wider industry to share their views on our future strategy. We have posed a number of questions throughout this document, and some overarching questions at the end of this section. We would be interested in your thoughts on these questions, and any feedback you have for us more generally on how we create 'a smart grid for all'.

We will also need you to continue to challenge us as we progress on this journey to full DSO status.

Our consultation will run until 15 September 2017, and we urge you to take part.

Please respond to our consultation questions to FutureSmart@ukpowernetworks.co.uk

How to respond to this consultation – please find on our microsite FutureSmart.ukpowernetworks.co.uk the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

Consultation questions



16. We have presented a number of potential participant experiences as 'A day in the life of' stories. We would be interested to hear about other participant experiences you would like us to consider to inform how we transition.
17. Has this document increased your understanding of what a Distribution System Operator is? If not, please let us know the areas in which you are looking for more clarity.
18. Do you think UK Power Networks is doing enough to facilitate the low carbon transition, and connect DERs to the distribution system? If not please let us know what we could do.
19. Has this paper presented new industry information on the topic of DSO? If not, please let us know further areas you would expect us to explore.
20. Are we being bold enough in our vision for the future electricity system? If not, which areas do you think our vision could be enhanced?

10 | Appendix A: DSO Strategy Priorities

10.1

DSO Priority 1 - Facilitate cheaper and quicker connections using proven innovation

Delivering cleaner, greener, cheaper electricity – Flexible Distributed Generation (FDG).

Flexible DG is our connection offer that makes it easier and cheaper for customers to connect distributed generation to our network. We estimate it's saved our customers more than £70 million in connection costs through reducing the need for building electricity network infrastructure.

We offer this connection service in return for customers accepting a 'flexible' connection, where the electricity output is curtailed for short periods when the network is highly utilised to keep power flows within safe and reliable limits. Active Network Management (ANM) technology is used to automatically manage the electricity generators' output.

What have we delivered so far?

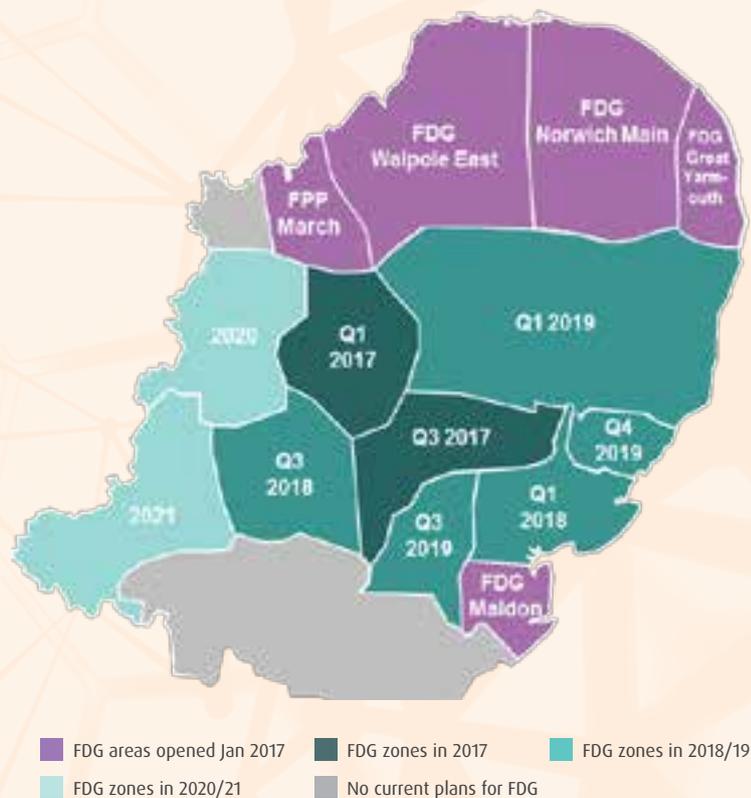
As of March 2017, we have connected more than 20 generation sites with a total connected capacity of 110MW to the distribution network.

What do we have planned for 2017?

We continue to roll out the Flexible DG service in response to customers' needs and the uptake of DERs across our network.

- We have announced five zones in East Anglia that are open as of the January 31 2017 for Flexible DG applications
- We have opened the region of Cambridgeshire in East Anglia for Flexible DG applications in June 2017 and we have a further region planned for the third quarter 2017.
- We launched FDG across our South Eastern region's Kent and Sussex in June 2017 in collaboration with National Grid.

Figure 13: Flexible DG Roll out Plan in East Anglia to 2021



Looking forward

Evolution of the connections process to a market where connectees will not only seek a connection but they will also advertise their flexibility services. Potential market changes could see connection queues transforming to include a fast track process based on the connectees flexibility value to support network resilience.

10.2

DSO Priority 2 - Use customer flexibility as an alternative to network upgrades

Maximising connected network resource to reduce network investment and drive lower costs in customer energy bills.

Flexibility is the ability to change generation and demand to the benefit of the system. Hence, DERs like generation, consumers, and storage have inherent flexibility. If we can control DER we can use it to benefit the distribution network, support whole system optimisation and drive cost-efficiencies in network investment.

When demand is greater than the secure substation capacity, we can tell DER to either increase exports (generate) or reduce imports (consume less). This has the effect of reducing net demand at the substation when required.

The DNO normally upgrades its network assets to accommodate the peaks of demand. The capability to reduce the peaks allows us to delay the investment until it becomes clear that reinforcement is required. We can also use it to manage outages as well as to increase network security.

What have we delivered so far?

We have learnt from our Low Carbon London innovation project, the various benefits to the distribution network of DSR and how it can be deployed.

What do we have planned for 2017?

We plan to procure contracts for flexibility services at 10 sites across our network, through competitive tender events.

Looking forward

Flexibility tenders will be part of business optioneering when preparing network investment plans and during network investment delivery to ensure optimal network solutions are selected. Potential to compare flexibility tender clearances between regional and national markets to determine optimal network solution between System Operator and the DSOs to ensure whole system efficiencies.



10.3

DSO Priority 3 – Develop enhanced system operator capabilities

Collaboration with the System Operator (SO) to realise additional generation capacity in the highly utilised South East network.

UK Power Networks is working in collaboration with National Grid on three initiatives to improve transmission and distribution coordination with each other so that we can understand the impacts services can have on each other's networks.

The Power Potential project

The project will help us make the best use of existing and new DER resources in our network. It will support the growth of low carbon technologies, such as wind and solar power, and help us to manage the operational challenges that the intermittent generation of renewable energy presents.

By creating a reactive power market in the South East, we believe Power Potential can deliver over 3.7GW of additional generation capacity in the area by 2050 and reduce the need to build additional electricity infrastructure. If the approach we are trialling could be introduced nationwide, it could save consumers more than £400 million by 2050.

We want to create new opportunities for our customers and by setting up a market, we can ensure that the Power Potential approach helps manage the whole electricity system while delivering the most cost effective solution to the consumer.

What have we delivered so far?

The project Potential Power successfully kicked off in January 2017.

What do we have planned for 2017?

- We will produce the service contract between us and the DER customer for their reactive and active power services
- We will put in place a contract between us and National Grid for service provision at our interface to support the management of transmission constraints using resources connected to our distribution network
- We will have designed the commercial framework for the reactive and active power services from customers to advertise the potential value of providing services that will stimulate a local reactive power market



The Regional Development Programme

The South East electricity system is one of the most complex areas of network in Europe, with several interconnections to continental Europe, a nuclear power station and a significant volume of renewable energy resources. The network supplies electricity over an area of approximately 8,200km², incorporating all of Kent, East Sussex, and much of West Sussex and Surrey.

The continuing evolution to a de-centralised generation landscape and incentives to deliver clean energy onto the system have strained an already heavily loaded part of the system.

Just in this area over 1.8GW of embedded generation and 3.6GW of transmission connected generation exists (2GW of HVDC interconnector contracted and coming online in next 3-4 years).

This requires both National Grid and UK Power Networks to consider a whole system approach to manage and optimise network capacity.

The scope of works undertaken has considered collaborative development across a number of areas:

- Enhanced modelling and data sharing
- Development of a technical and commercial frameworks for Active Network Management
- Facilitating storage and commercial services in actively managed areas
- Addressing Loss of Mains protection challenges
- Whole system planning

This collaborative approach will reduce the need to build costly transmission infrastructure, meaning customers will continue to benefit from cheaper and quicker connections.

What have we delivered so far?

Through close collaboration with National Grid we have co-developed new network models and improved the level of granularity in data exchanges. This has already revealed the potential for a significant increase in available capacity on the South East Network.

We have also developed a process for updating and managing new connections onto the system, which will give future customers all the relevant technical and commercial requirements without the need for a prolonged network assessment. We anticipate this work will be the bedrock of the forthcoming changes to the Statement of Works process.

10.3

Continued

What do we have planned for 2017?

- Offer of Flexible Distributed Generation connections in the East Kent area.
- New bi-lateral connection agreements between UK Power Networks and National Grid.
- New connection arrangements and commercial frameworks for DERs.
- Further development of control functionality to manage transmission constraints through DERs.
- Development of whole system planning methodology to realise further cost savings from whole system network solutions.

The Kent Active System Management (KASM) Project

KASM seeks to explore how the DSO can use real-time power flow modelling and potential post-fault analysis capabilities, combined with generation and load forecasting, to:

- Operate the network closer to its limits in a secure and reliable manner, enabling the connection of additional low carbon generation by reducing capital-intensive connections costs;
- Reduce constraints placed on generators during maintenance and other planned outages; and
- Improve operational processes and reduce the overall risk on the network.

What have we delivered so far?

The project has successfully delivered an Inter-Control Centre Protocol (ICCP) link, which allows real-time data exchange between National Grid's control centre and UK Power Networks' control centre. This enhanced visibility will allow for improved operation and planning of transmission and distribution networks.

We have successfully demonstrated the use of real time contingency analysis in the control room and will be trialling the benefits of this capability over a trial period, which will be completed by December 2017. Furthermore, the project has developed advanced short term (0-5 day ahead) load and generation forecasting modules which will facilitate more accurate look ahead modelling capabilities used by UK Power Networks' Outage Planners. This capability aims to reduce the levels of generation curtailment during planned network outages, by utilising forecast data rather than 'worst case' scenario assumptions.

What do we have planned for 2017?

During 2017 we plan to demonstrate the benefits of the following capabilities:

- Improved real-time data exchange with National Grid;
- Real-time contingency analysis; and
- Short term load and generation forecasting modules.

The benefits will be quantified by measuring the reduced generation curtailment and additional generation capacity available by utilising the capabilities highlighted above.

Develop our network visibility, monitoring and control capabilities to enable our transition to a DSO.

Network visibility and control is an important capability. It is currently required most at our Extra-High Voltage and High Voltage networks and we have been investing on the networks and developing our standards to make them fit for the DSO needs.

We know that in the future we will also need control and visibility at our Low Voltage (LV) networks. Historically these networks did not require monitoring and ANM was not considered cost-effective as load growth was more predictable. However, this is changing given the uncertainty that is currently associated with the magnitude and timing of the connection of DER and with the increasingly active participation of consumers within the energy market. This is particularly relevant considering the expected clustering effect in areas with high demand for DER connections. There is a risk that the rapid increase in DER will not be seen with sufficient time to enable an optimal programme of network investment.

Greater network visibility and control will enable targeted and efficient network investment. This will, in turn, support customers' access to flexibility markets and is a critical enabler of distribution-level markets.

What have we delivered so far?

- We have assessed how all of our DSO capabilities are dependent upon network visibility - across all of our assets and voltage levels - and we have published a new, holistic network standard: **System Monitoring Policy**.
- We are investing to increase network visibility at our currently congested areas in EPN and SPN, these investments will release capacity for additional DER connections.
- We have **expanded the smart grid capability of our distribution management system** - at HV and EHV for example, we have developed and introduced advanced capabilities such as an Automated Power Restoration System (APRS) that algorithmically determines and executes a plan for re-routing power to keep our customers on supply when a fault occurs.

What do we have planned for 2017?

- In 2017 we have completed detailed planning of the optimum rollout strategy for LV visibility and control on our network, carefully assessed the benefits of such a rollout for

our customers, and have submitted an application to Ofgem under the Innovation Rollout Mechanism to approve our investment in this critical enabling system. This rollout would commit over £33 million in the remaining years of RII0-ED1 in order to make fully smart grid ready the 7% of our network most likely to be impacted by the low carbon transition.

- We are continuing to develop new and advanced smart grid techniques – for example through developing a new integrated combination of power electronics, automation, and optimisation systems that will increase network capacity and enable new levels of network meshing. We are preparing this solution in our Active Response submission for the 2017 Network Innovation Competition.
- As well as furthering the readiness of our already proven smart grid techniques – for example by developing and testing new technical capabilities and more cost effective monitoring systems, and by refining and re-issuing our internal technical standards for the solutions demonstrated in our Flexible Urban Networks at Low Voltage (FUN-LV) and Smart Urban Low Voltage Networks (SULVN) projects.

Helping customers get the most from their smart meters

The UK is upgrading its residential and Small and medium-sized enterprises (SME) metering infrastructure so that smart meters are available across the country. With the UK's central Data Communications Company (DCC) providing a data coordination role, UK Power Networks is able to draw upon the data from smart meters to provide insights into our Low Voltage networks. Access to this data will significantly improve our ability to manage network status (and outages) and plan investment as we will have MPAN level data detailing energisation status, voltage, power and energy consumption.

What have we delivered so far?

In line with the national smart meter Implementation Programme, UK Power Networks is in the final test phases that will result in deploying our DCC Adaptor before the end of 2017. This solution will coordinate the exchange of Smart Meter data between our business and the DCC. We are also supporting energy suppliers in their efforts to install Smart Meters within our license areas.

A number of our innovation projects have explored the functionality and benefits of smart meters, with Low Carbon London (LCL) being one of the most significant explorations of smart meter functionality UK Power Networks has undertaken. Through our work on LCL over 5000 meters were installed across London, one of the key outcomes from the project was determining improved diversity and granularity in consumption profiles that have better informed our investment planning and connection design process. In addition a subset of those customer with smart meters

installed were involved in Time-of-Use trials where UK Power Networks was able to assess the extent to which customers demonstrated a demand response triggered by prices signals delivered via the In Home Display (IHD).

We have also secured funding in support of our energywise project, which will explore how DNOs can support the fuel poor community to manage their electricity usage and energy bills. Whilst also identifying how UK Power Networks can work with energy suppliers and locally trusted intermediaries (e.g. social landlords and community centres) to deliver energy saving campaigns and smart meter installations to the fuel poor.

What do we have planned for 2017?

During the second half of 2017 UK Power Networks will complete the process of becoming a live DCC user which will enable smart meter data to be available to our business. From this point all SMETS2 meters installed in our geography will be registered within our DCC adaptor enabling UK Power Network to utilise all relevant functionality.

Through our support of smart meter installations (around 5% of all installs require support from the DNO) and through updates to our digital, print and voice channels we are focussed on educating and engaging our customers as to the functionality and benefit of smart meters and the role they will play in the our future energy system.

Once the initial volumes of data are received from SMETS2 meters within our license area we will have a dedicated team to perform analysis of the smart meter data so that we are well placed to be continually developing additional insights into the characteristics and behaviours of our network at the customer level. We will also be able to deliver incremental benefits to existing data sets, such as improving our customer-network connectivity model which can be refined following each instance of an outage that impacts a customer with a smart meter. This work be begin in late 2017.

Looking forward

Regional and national markets will exist where DSOs will advertise network service requirement and customers will bid in flexibility services to support distribution and whole system operations. There will be two key market resolution activities – (i) conflict management resolved to ensure that the DSO and GBSO are not driving different behaviours from the service provider and (ii) optimisation run to ensure that the best solution is selected for the whole system, identifying where regional markets can deliver GBSO needs. This management and optimisation will be enabled through increased network visibility data coupled with smart meter data.

10.4

DSO Priority 4 - Working closely with the industry

Industry has been working together to develop the thinking needed to facilitate the DNO to DSO transition. This has resulted in the 'Open Networks' project, launched in December 2016 by the ENA. This project will lay the foundations of a smart energy grid in the UK by defining how our electricity networks will need to change the way they work to help the UK's energy market become more competitive, more efficient and more cost effective.

The project brings together the leading minds in the UK energy industry to transform the way our networks work - all eight of UK's electricity network operators (including National Grid), respected academics, Non-Governmental Organisations (NGOs). The Department for Business, Energy & Industrial Strategy (BEIS) and the energy regulator Ofgem are also part of the project and are members of its steering group.

It will enable the UK's energy networks to move from their traditional role of delivering electricity from centralised power plants to one where they act as a platform and enabler for a whole range of new smart energy technologies that operate in a distributed and decentralised way.

These technologies will deliver benefits to households, businesses and network operators that will:

1. Provide greater control of energy and lower costs
2. Promote greater competition in energy markets and;
3. Ensure that the operations and maintenance of energy networks is done as intelligently and efficiently as possible.

UK Power Networks holds the chair of one of the project's four work-streams which will set out how the traditional role of DNO in our electricity network will change to become the DSO that deliver these benefits.

What have we delivered so far?

The project has defined how the role of the DSO will be that of a neutral market facilitator. This will allow flexibility services such as DSR to connect to the network and provide their services to whoever requires them.

So far this year, the project has identified four key principles that underpin the transition to that role:

1. That a DSO is non-discriminatory and technology neutral: favouring solutions that provide the most optimal solutions rather than particular technologies;
2. That it uses market mechanisms that are fair, transparent and competitive, providing a level playing field for providers of

network services and providers of energy products/services in order to deploy the most efficient and effective solutions;

3. That it supports flexibility and innovation in responding to customer future requirements and in developing the network services they require, including enabling and facilitating innovation by others; and
4. That it delivers value and service to a range of customers and communities.

What do we have planned for 2017?

In December 2016 ENA member companies, including UK Power Networks, gave their commitment to a major new long-term project that will enable the UK's electricity networks to:

- Address the challenges caused by the continued uptake of distributed generation.
- Become a platform and enabler for a whole range of new energy technologies.

Members companies must meet these challenges whilst:

1. Continuing to deliver safe and secure operation of distribution networks.
2. Ensuring efficient and timely access to the network for customer.
3. Providing value for money.

The project is based around four work streams, which are based on the objectives of the project. The four work streams are:

1. **DNO to DSO transition:** defining the DSO transition.
2. **T-D Process:** exploring challenges at the interface between transmission and distribution networks as roles and responsibilities evolve.
3. **Charging:** reviewing the charging requirements of enduring electricity transmission and distribution systems.
4. **Customer Experience:** considering the customer experience as we move towards a more flexible energy system.

The first phase of work will take place over the course of 2017. It will undertake a complete assessment of the parts of the electricity grid that need to change, providing options for delivering that change at the end of the year. After a period of assessment in 2018, regulations will be drafted and introduced to put them into effect.

Looking forward

We will continue to work with the ENA 'Open Networks' project, other industry partners and new entrants as the transition to DSO progresses.

10.5

DSO Priority 5 - Prepare and facilitate the uptake of electric vehicles

UK Power Networks must make sure that it has the skills, processes and systems in place to enable the low carbon transition. Electric Vehicles (EVs) are a key element of this transition. We have therefore established a cross department EV Working Group to identify the key initiatives that we must deliver in the next two years.

What have we delivered so far?

We have engaged extensively with all three categories of customers. Some of key successes include:

- **Commercial Fleets:** Engagement with bus operators in London: we have successfully energised the first fully electric bus garage in Waterloo, holding 51 electric buses in the heart of London. We have also been working closely with UPS on increasing their electric fleet in the Camden garage. Both of these initiatives have served to inform our timed connections offer.
- **Public charging:** We have been talking to different vehicle manufactures such as Tesla and BMW to inform our approach to plan the uptake of public charging. We have also worked closely with TfL to inform their approach to deliver 300 rapid EV charge points across London by 2020. Finally, we have published an EV guide for councils providing clear and fundamental information that explains the benefits and requirements of electric transport.

- **Residential:** We have led the industry through the ENA low carbon technologies working group to establish a notification process for us to have improved visibility of where residential EV uptake is taking place.

What do we have planned for 2017?

- Define a communication strategy to engage with stakeholders and provide clear information to customers on our website
- Engage with local authorities across our networks to understand their electrification plans and see how we can best support them
- Establish a market intelligence framework to closely monitor uptake and EV tendencies to inform our network planning assumptions
- Conduct an assessment of taxi uptake in London to understand the impact on the network
- Define the roadmap for enabling smart EV charging across our networks

Looking forward

We will ensure that EV infrastructure is located to meet customer requirements and smart charging capabilities are enabled across our network license areas.



11 | Glossary of Abbreviated Terms

ANM	Active Network Management
BEIS	The Department for Business, Energy & Industrial Strategy
CHP	Combined Heat and Power
DER	Distributed Energy Resource
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
DUoS	Distribution Use of System
Emergent DSO	Emergent Distribution System Operator
ENA	Energy Networks Association
EPN	Eastern Power Networks
ESC	Energy Systems Catapult
ESCO	Energy Service Company
EV	Electric Vehicle
FDG	Flexible Distributed Generation
FPSA	Future Power System Architecture
Full DSO	Full Distribution System Operator
GBSO	Great Britain System Operator
LCT	Low Carbon Technology
LiDAR	Light Detection and Ranging
LPN	London Power Networks
NGO	Non-Governmental Organisations
RIIO	Ofgem's framework for setting price controls for network companies (Revenues= Incentives+ Innovation+Outputs)
RIIO ED1	Price controls for DNOs running from 1st April 2015 to 31st March 2023
RIIO ED2	Price controls for DNOs beginning 1st April 2023
RIIO T1/2	Price control periods for Transmission Network Operators
SME	Small and medium-sized enterprises
SPN	South Eastern Power Networks
SO	System Operator
TO	Transmission Operator
Triad	The three half-hour settlement periods with highest system demand that are used by National Grid to determine charges for demand customers

What this will deliver

These roles will allow UK Power Networks to deliver benefits directly to our customers, as well as benefit the wider electricity system:



Keep the lights on

- Maintaining the safety and reliability of our electricity networks whilst managing the increased complexity driven by the increasing number of Distributed Energy Resources (DERs) connected to our networks.



Provide great customer service

- Providing fast and cost-effective access to our distribution networks.
- Extending and upgrading the network to meet our customers' future needs as they engage and become active in the energy market through Electric Vehicles (EVs), smart appliances, smart meters, storage and distributed and on-site generation.
- Innovating to continually improve the customer service we provide to our customers.



Lower our costs

- Harnessing the successful innovations and customer flexibility to optimise network investment decisions.
- Collaborating with National Grid, the GB System Operator (GBSO), to reduce total systems costs through coordinating distributed and flexible energy connected to our networks.

Help us Shape 'A Smart Grid for all'

The world is changing fast, and so is our role. UK Power Networks has already begun to change our role and transition the business into a Distribution System Operator (DSO) to continue to support the low carbon transition. We want to facilitate your low carbon plans, and we need your feedback on our plans to make this vision a reality.

What we need from you

At a time of unprecedented change, the industry needs to collaborate like never before. We now need your feedback on our Future Smart strategy. We also need you to continue to challenge us as we progress on this journey to full DSO status. We want to facilitate your low-carbon plans. Hold us to it.

How to respond to this consultation

Please find on our microsite FutureSmart.ukpowernetworks.co.uk the consultation response form that can be filled out digitally or printed out. We ask that you please send your feedback to: our DSO email: futuresmart@ukpowernetworks.co.uk or by post to: UK Power Networks, Futuresmart response, Newington House, 237 Southwark Bridge Road, London, SE1 6NP

Our DSO Strategy

Five key areas for 2017 - 2018



1. Facilitate cheaper and quicker connections using proven innovation

Continue rollout of Flexible DG that uses Active Network Management



2. Use customer flexibility as an alternative to network upgrades

Run market tenders for flexibility services such as Demand Side Response



3. Develop enhanced System Operator capabilities

Develop TSO – DSO Commercial Framework, DER Dispatch capability and readiness for smart meters



4. Collaborate with industry to enable GB wide benefits

Actively participate in industry forums to make this transition a reality



5. Prepare and facilitate the uptake of Electric Vehicles

Enable connections using smart solutions and ensure business readiness