UK Power Networks
Delivering your electricity

Our DSO strategy – a summary for stakeholders

RIIO-ED2 Business Plan 2023 – 2028

Contents

1 Executive Summary

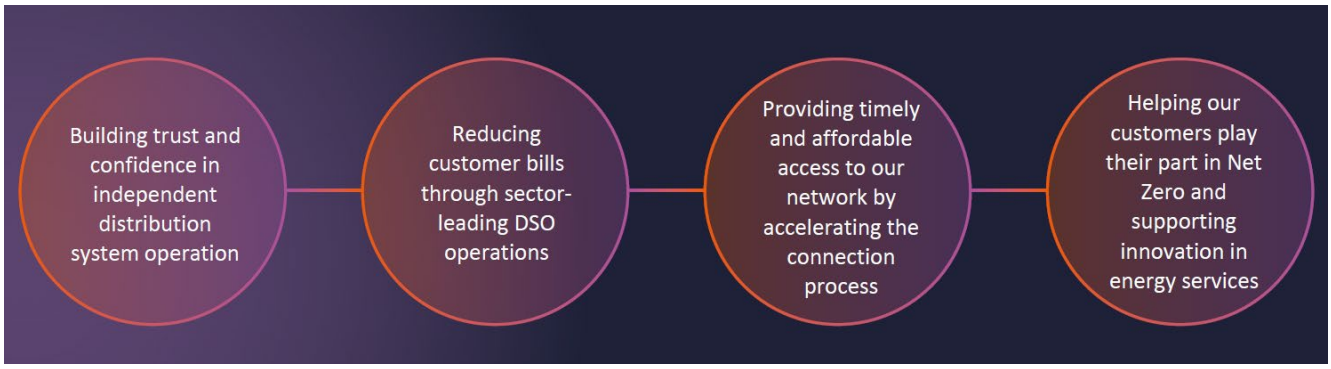
Facilitating the transition to Net Zero and supporting clean economic growth, at lowest cost

Government climate targets require a radical shift in the way that everyone in Britain consumes energy. In turn, this will require a significant increase in the volume of Distributed Energy Resources (renewables, storage, electric vehicles, heat pumps) connected to our networks.

Our vision is of a dynamic distribution system, with electricity demand and supply flexing in response to distibution-level conditions and wider market signals. We will see market based solutions incentivising customers to utilise available network capactiy efficiently, being supplemented with traditional network investment that results in the lowest costs for consumers overall. This will lead to a smarter and more highly utilised distribution network, with faster and cheaper access for the DERs we will need to achieve Net Zero.

This is a radical departure from the traditional thinking that has guided networks over the last 100 years, which has been to build new network as the default solution. We will need to continue to innovate, thinking in new ways, being more dynamic and agile in line with changing customer requirements and new technology, and working in much stronger collaboration with others to deliver whole system outcomes.

We see our Distribution System Operator (DSO) being at the heart of facilitating the transition to Net Zero at lowest cost, whilst supporting clean economic growth. In our business plan, we set out the four pillars of our DSO Strategy, and our commitments under each. Those pillars are:



Our DSO will also support the delivery of wider strategies, and so this document should be considered in conjunction with wider published appendices to our business plan – Appendix 19a: Whole systems strategy, Appendix 8: Vulnerability strategy, Appendix 9: Our major connections strategy, and Appendix 15: Competition.

A DSO that delivers value for money for consumers

The Government's recent Energy White Paper has signalled that smart systems and distribution-level flexibility markets will be pivotal to ensuring the Net Zero target is achieved by 2050 at lowest cost.

Our DSO strategy represents an ambitious programme to facilitate the delivery of Net Zero at lowest cost. It will deliver savings into our RIIO-ED2 plan and in future price control periods, and hence we have undertaken cost benefit analysis out to 2040. Through coordination with the ESO and other industry players it will also facilitate the delivery of wider system savings, and play a vital role in helping to reduce costs across the energy system from optimal use of flexibility on our networks.

In RIIO-ED2, our DSO investments will allow us to defer or avoid the following expenditure from our business plan, reducing costs to our customers accordingly:

1. £410m of capital investment on the primary and secondary network, enabled by making greater use of flexibility.
2. £185m of capital investment to facilitate distributed, enabled through the use of innovative flexible connections.
3. £6m of additional secondary reinforcement through the use of enhanced modelling and data analytics to inform our investment decisions.

The DSO investments we are making now and in ED2 will allow us to continue to defer and avoid network expenditure beyond the ED2 period. As load growth increases over that time-period, the cost savings delivered by our DSO investments will increase.

In addition to our investment savings, our DSO programme will help deliver whole system benefits. The ESO has identified around £2bn of savings from its RIIO2 business plan. We have calculated, and validated with the ESO, that £170m of ESO-related benefits are expected to flow from our DSO strategy, through expanding the Regional Development Programmes,

providing timely network access for DER, and coordinating system operations across the T-D boundary. We have ensured that our DSO investments not only deliver these benefits within the RIIO-ED2 period but continue to do so in the future. Working with the ESO[1], we have calculated that these deliver between £470m and £580m of benefits out to 2040.

Based on the savings in our RIIO-ED2 business plan and the wider system savings we are helping the ESO deliver, we have high confidence that **our DSO will deliver a net benefit** (benefits generated less the DSO costs) **of £560-670m out to 2040** on a NPV basis**.**

In addition, through optimal use of flexibility on the distribution network we can help avoid wider system costs, such as reducing the amount of generation (and storage) capacity needed to meet peak demand. We have worked with the Carbon Trust and Imperial College to leverage the analysis in their recent study "Flexibility in GB"[2] to understand what quantum of the £9.6-16.7bn of flexibility benefits in 2050 could be attributed to UK Power Networks' DSO. We estimate this to be **between £230m and £2.0bn out to 2040**. Including these wider system benefits within our CBA increases the overall positive **NPV of our DSO strategy to between £780m and £2.6bn out to 2040.**

DSO Net benefits (to 2040):

High confidence NPV benefits:

£560-670m

Total including wider system PV benefits:

Building trust through transparency

The DSO will be responsible for planning our Net Zero future system and establishing markets for flexibility and access products that can create more network capacity at lower cost, whilst meeting the evolving needs of our customers. To create trust in our ability to operate market functions independently of our network business our customers expect a high degree of transparency in how our DSO will operate.

At present, our DSO-related activities are conducted from several areas in our business. This approach has served us well to date, enabling a clear focus internally for innovation in flexibility services and new connection products, whilst also gaining good feedback from stakeholders, customers, and flexibility service providers. However, in development of our DSO Strategy for RIIO-ED2 we have undertaken further extensive stakeholder engagement and worked through an operating model design process. Our conclusion from undertaking this work is that there are several challenges in continuing with the current model in which DSO functionality is embedded in the DNO business.

Whilst transparency delivered through clear processes and data publication will go some way to providing confidence, it will not address the perceived conflict of interest inherent in any model in which the DSO is ultimately governed by the DNO. It will also result in Directors who hold accountabilities for both DSO and DNO outcomes, leading to reduced transparency in decision making, and potentially raising questions over how the best outcomes for customers have been achieved if all decision makers in the process have dual responsibilities.

Our experience pushing ahead with our DSO development has shown us that delivering a fully-fledged DSO operation will be a transformative change challenge, and we believe that any model based on incremental evolution 'in the line' will not create the focus, commercial mind-set, customer centricity, and step change in ambition required to succeed. **It will also fail to confront instances where processes are not clear and grey areas in decision making exist.**

Having considered the costs and benefits of a range of operating model options, and informed our thinking through a rigorous design process, we have concluded that to be successful a DSO must be established **at least as a fully ring-fenced entity**. Given that stakeholders are telling us that delivering transparency is critical to achieving the benefits of the DSO, it is clear that the minimal incremental costs of **full legal separation** are both warranted and appropriate, and the feedback we have received since the publication of our July submission has reinforced this view. **We know that our strategy has generated a lot of discussion in the industry with "traditionalists" suggesting that we are not serious or that "it can't be done." Our operating model work has not only helped us to understand specifically how a legally separate DSO could function; it has reinforced our confidence that it can be done, and we will set the bar for the industry.**

We are therefore setting out what we believe to be the UK's first clearly defined operating model of how a legally separate DSO could work in the best interests of customers. Our operating model for the beginning of RIIO-ED2 is based on the following key foundational actions:

1. Key organisational changes to create an agile, transparent, DSO business unit within UK Power Networks on day 1 of RIIO-ED2 with clear accountabilities, set-up as a separate legal entity within UK Power Networks Group with appropriate governance and controls.
2. Development and publication of a **DSO:DNO Operational Agreement** (modelled on the SO-TO Code) setting out key interactions and encompassing our transparent process across all roles and how they are governed.
3. An **independent DSO Supervisory Board**, which will provide assurance of our compliance with the DSO:DNO Operational Agreement, represent the views of our customers and stakeholders, and ensure that customers get the

[1] ESO RIIO-2 CBA report (nationalgrideso.com)

[2] Flexibility_in_GB_report.pdf (storage.googleapis.com)

best-value solutions. The independent DSO Supervisory Board will review and approve key DSO investment decisions to provide extra assurance that the best-value solutions for all customers are taken forward.

This clear separation between DSO and DNO business units **significantly exceeds Ofgem's baseline expectations for transparency**. We believe that establishing a legally separate DSO will foster confidence in our decision making, thus stimulating greater engagement and competition, and the clear accountabilities and incentives on individuals will lead us to maximise the benefits of our investments in DSO capabilities.

This separation has enabled us to develop clear accountabilities for the DSO and DNO across all DSO roles – for instance in how decisions are made for network development (with the DSO accountable for the cost of network expansion, and the DNO accountable for reliability and delivery efficiency), how flexibility service dispatch decisions are made in operational timeframes, and how Distribution Market Operations functions can be carried out via a partnership with an independently owned platform provider.

Commitment DSO1: We will build trust and confidence by establishing a legally separate DSO business unit by 2023, creating an independent DSO Supervisory Board, and through our annual DSO forward plan of action. We will measure our compliance against the DSO:DNO Operational Agreement, targeting 100% compliance during RIIO-ED2 and reporting on this annually for transparency.

Alongside operational measures, our engagement showed the importance of being transparent on our progress in delivering for our customers. We have therefore committed to developing an annual DSO forward plan, and a stakeholder satisfaction measure focused on the performance of the DSO function.

Commitment DSO6: We will develop a new DSO stakeholder satisfaction survey. Once we establish a baseline at the start of RIIO-ED2 we commit to improving our score by at least 10% over the period and publishing an annual DSO forward plan that will explain how we are responding to stakeholders' priorities.

Our customers and stakeholders are also telling us that they want access to as much data as we can possibly share with them. UK Power Networks wants to be recognised as the driving force enabling the market to develop the tools they want, by providing the data required to support their development[3].

Commitment DSO8: We will be the UK's leading DSO in network data provision through a best practice service that opens data according to user priorities and customer value-add. Our ability to meet users' data needs will be measured as part of an annual stakeholder survey from the start of RIIO-ED2.

Role 1: Planning & Network Development

Our primary challenge in the next decade will be enabling the rapid uptake of DER to facilitate delivery of the UK's Net Zero ambitions, through maximising the use of existing capacity, wherever possible, and the timely release of additional capacity. This will need to be achieved whilst delivering network safety, security, and reliability and at best value for consumers.

Our goal is to deliver an open, transparent, and competitive network development approach, building strong partnerships to anticipate needs and to deliver them quickly. To enable this, we will need greater visibility of the network; an enhanced suite of planning and forecasting tools, data, and outputs; and whole system planning framework that considers all solution options on a level playing field.

Network Visibility

We will deliver **100% coverage of the LV network through a combination of LV monitoring, and advanced analytics using smart meter data** for the remainder of the network. Armed with this greater visibility, we will utilise smart solutions and flexibility to increase network utilisation and only reinforce the network when there is evidence of no other economic alternative.

Commitment DSO5: We will collect real time data through monitoring in all LV networks where we are forecasting constraints over RIIO-ED2 and will target 100% coverage of the rest of the network through advanced analytics using smart meter data. This will give us better insight to run the network at higher utilisation and to defer reinforcement actions for as long as possible.

[3] Our data best practice strategy (Appendix 17b) sets out the foundational investments we are planning to deliver in order to ensure reliable, accessible and interoperable data for our targeted smart-grid capabilities. Our Digitalisation strategy (Appendix 17a) will also support our DSO in improving the way that we share data, whilst also ensuring that we meet international best practice standards.

Our ambitious programme is using state-of-the-art analytics to maximise use of data and targets physical monitoring at the locations that are forecast for LCT clustering under our highest modelled scenario. This combination of actions provides the visibility required to effectively deploy flexibility and actively manage the network during RIIO-ED2 at an efficient cost. Under our proposals, by the end of RIIO-ED2, 30% of our underground low voltage transformers will be monitored in real-time, and we will have visibility of modelled demand across 100% of the underground and overhead networks through predictive analytics. This allows a significant proportion of LV open data to be shared with stakeholders to stimulate flexibility and innovation.

Our approach is designed to stay ahead of the LCT load growth curve through fully embedding the processes, culture, digital skills, capabilities and tools that DSOs need to make use of data. We believe that this approach drives short-term benefits in requiring less physical monitoring to be deployed ahead of need, but more importantly long-term efficiencies as similar approaches will be applicable to many other DSO challenges.

Open data

Alongside our suite of planning outputs, it is imperative that customers and stakeholders have access to data such as network topology, capacity heat maps, and asset data to assist them in planning their operations. Stakeholders told us that they want open, accessible and accurate information, and as much of it as possible, proactively shared in the format they want. In this strategy **we set out the planning data items that we intend to publish through our data portal and DSO Dashboard[4].**

Whole system planning

We will continue to enhance our suite of planning tools and outputs, evolving our Distribution Future Energy Scenarios (DFES) with stakeholders, and **establish a Distribution System Operability Framework (DSOF) as a core part of our planning outputs**, to enable greater visibility of our service needs to stakeholders, thus stimulating investment in future services.

We will establish a 20-strong Local Area Energy Planning (LAEP) team to provide expertise and data support to the 127 Local and Regional Authorities in our areas, and support them in developing the clarity and confidence required to incorporate their proposals for delivering Net Zero into our investment plan, as set out in **our** Whole Systems Strategy (appendix 19a to our business plan).

When it looks likely that we will exhaust the capacity in the existing network, **we will utilise market-based flexibility solutions to create capacity at lowest cost.** Our DSO will run an open **Distribution Network Options Assessment (DNOA) process**, consulting on scenarios for system needs and comparing flexibility and whole system solutions sourced from the market with asset-based solutions provided by the DNO (and in future also by third party network operators). We will do this all the way down to the low voltage network to maximise opportunity for domestic level participation and cost savings for consumers.

In our proposals, our **DSO will take accountability for the cost of delivering new network capacity (across both asset and service solutions) and the DNO will take accountability for reliability and delivery efficiency**. This clear distinction in objectives across the DSO and DNO should help reveal inherent trade-offs between cost and reliability, and in doing so deliver the right level of supply reliability to the customer at the right price.

We will drive competition everywhere we feasibly can. Our DSO's core role is to open new markets to competition to deliver best value for consumers. **For the benefit of consumers, this is not limited to introducing flexibility services, but we are now also proposing to the construction of DNO assets**. As we explain in Chapter 15: Competition in our RIIO-ED2 business plan, we have made a DNO-first commitment to tender construction of major load and connections-driven investment. Our independent DSO will run the procurement process for these works. Our DNO can bid for these projects, but will do so on a level playing field with other providers, and will only deliver the work if it is the successful bidder.

Through this process we are committing to deliver significant cost savings whilst enabling unprecedented DER growth.

Commitment DSO3: Our DSO function will deliver up to a £410m reduction in load related expenditure during RIIO-ED2 through increased competition and use of LV flexibility, including at the domestic level.

Role 2: Network Operation

Historically, DNO network operations have focused on maintaining network reliability and safety, managing planned outages, and responding to unplanned events and faults. This has been achieved primarily through network switching and smarter network technologies such as network automation.

[4] https://innovation.ukpowernetworks.co.uk/open-data/?tab=4

Going forward, our goal for DSO Network Operation is to **lead the way in the use of flexibility services to support all network and system needs** where they deliver value for consumers, leveraging **real-time optimisation** to deliver the highest levels of network utilisation and network access for users.

To support this, network operation will become a more dynamic activity, with a focus on coordinating the dispatch of DER to facilitate the efficient operation of the distribution system, whilst maintaining reliability, and avoiding the need for unnecessary reinforcement. To manage this new aspect of system operation **we will establish a separate DSO Control Room as part of our legally separate DSO**.

For the start of RIIO-ED2, the DSO will be responsible for operational planning and scheduling – creating a **short-term forecast of generation, demand and network conditions**; conducting **outage planning** and **contingency planning**; and **scheduling the service dispatch and curtailment** required to deliver network capacity and facilitate works on the network. We will **publish our operational plans and schedules across timeframes up to day-ahead**, in order to provide transparency as to our intended running arrangements and schedule of service dispatch.

We will develop a **clear dispatch decision making framework within our DSO:DNO Operational Agreement, in conjunction with stakeholders**, which will be used as the basis for operational planning and scheduling, as well as decisions taken in real time. We will **publish a monthly control room transparency report** to provide assurance that decisions are being taken in accordance with the Operational Agreement. Service options will be facilitated via our market platform, that will support 'coordinated access' (explored further under Role 3) for the ESO and other DSOs, in order to **enable whole electricity system coordination of service dispatch**.

Commitment DSO2: We will deliver operational transparency by publishing our day-ahead operational plan and schedule of flexibility services and curtailment, and a monthly control room dispatch decision report from the start of RIIO-ED2.

Role 3: Market Development

Our DER customers have told us that they want to see us creating new markets for networks flexibility services at the distribution level, **to procure more of our needs closer to real-time**, and to ensure integration of markets so that they can easily sell their flexibility where it is most valued in the whole system. The need for transparency is coming through loud and clear.

UK Power Networks aims to be a market leader in supporting and progressing the development of distribution flexibility markets and the associated market platforms, to allow DER access to new potential revenue streams and products and services, as well as to ensure we can meet the flexibility needs of the DSO. **We believe that a dynamic Distribution Market Platform will be integral to the effective operation of the distribution system during RIIO-ED2, and we intend to channel all of our system needs through such a platform** – including forward tenders for flexibility services and running day-ahead and within-day markets.

Flexibility and energy efficiency first

We are committed to a Flexibility First strategy through which we commit to market testing all future network needs for non-network asset solutions. As well as a very significant increase in the procurement of flexibility services, we need to plan for the potential for trading of access rights and service commitments amongst our customers during RIIO-ED2.

Through RIIO-ED1, we have had a strong track record of co-designing new products with our customers and stakeholders. For RIIO-ED2, we plan to give the DSO responsibility for all aspects of access product and distribution flexibility services design, investing further in our commercial skills, and looking to build on our agile delivery capability to develop our technology to support the procurement, trading and settlement of new products and services.

We will work closely with our customers and service providers, together with the ESO, to develop a portfolio of shorter- and longer-term products that promote participation in distribution flexibility services and give us access to competitively priced flexibility. We will extend our flex procurement to more low voltage areas and procure it for new applications such as outage management and restoration services.

More than half of the emissions cuts required under the Sixth Carbon budget rely on consumers and businesses taking up low carbon solutions. Our strategy is to nurture a rich ecosystem of service providers that we will collaborate with to develop and procure our DSO flexibility services, and we will co-develop services with our partners to capitalise on the opportunities created through energy efficiency. We will seek to understand consumer behaviour, inform, and adapt our propositions and bring them to market through third party intermediaries that have direct access to consumer and their homes.

We understand that whilst we are one step removed from the residential consumer (with the primary relationship between customers and supplier), we have a role in safeguarding consumer protection and the consumer experience. In addition, the DSO will also have a key role in delivering our Vulnerability strategy, in particular supporting our Social Delivery Programme.

Commitment DSO4: We will keep our costs down by taking a "flexibility and energy efficiency first" approach over RIIO-ED2 and will "market test" all network needs before considering reinforcement. These needs will be procured through a range of long-term and short-term markets and products, which are inclusive by design and ensure no customer is left behind in the energy transition.

Access products

UK Power Networks was the first DNO group to rollout flexible connections, and over half of all generation enquiries we now receive are for our flexible connections' products. The range of access products for large users, and tariffs for smaller users will depend on the outcome of Ofgem's Access and Forward Charging Significant Code Review (SCR). However, we plan to continue to trial new access products and tariffs, co-designed with our customers. We will set ourselves up to be able to launch new access products and tariffs within 6 months, and then seek to continually refine and improve them.

We will investigate the possibility of access products specifically designed to allow DER, otherwise on flexible connections, to participate in ESO Balancing Services – i.e. guaranteeing firm access to align to availability windows of the ESO services. We also plan to support secondary trading of access rights, to share capacity between users who may value it differently at different times of the day, or year, and will develop products that guarantee a maximum curtailment level.

Commitment DSO7: We will offer a range of firm and flexible connection products, from lowest cost through to highest access, with a maximum curtailment commitment from the start of RIIO-ED2, and will annually update our products based on stakeholder feedback

Establishing a Distribution Market Platform

It is our intention to partner with a third-party platform provider (or small number of third parties) to operate our Distribution Market Platform, rather than building a solution ourselves. This area is evolving fast, and we want to employ 'best of breed' market solutions wherever possible and avoid getting locked into a certain technology or provider over the long-term and so will seek industry standardisation of market data flows.

We envisage that **data flows between the Distribution Market Platform and DSO functions will be facilitated via Open API interfaces**, and by taking this approach we will be **establishing Market Operations functions which can scale and interface openly with multiple markets and platforms.** We believe that as the number of DER connecting to our network grows, so will market participation and liquidity.

The Distribution Market Platform may ultimately involve an ecosystem of providers, but we believe that partnering at the early stage of market development will allow us to help platform developers to grow their portfolio of services more quickly than if this had to be undertaken without partnerships, at the same time helping expedite the development of this crucial component of the future of procuring flexibility and DSO services.

Our strategy in market development is to ensure that we are enabling '**coordinated access**' and developing services which align to those of the ESO, such that the ESO can access resources that can help it to operate the transmission system. We do not envisage that the Distribution Market Platform will be the only route to market for DER into the ESO's Balancing Services markets, as our customers have told us they do not want that, but it would provide one solution for DER who do not have firm access onto the electricity network. Hence, we believe it will become an attractive option for DER looking to keep connection costs low, but not preclude themselves from additional revenue opportunities where the system can accommodate this.

We plan to **host secondary trading** of certain DSO products and services on the Distribution Market Platform, pending the outcome of the Ofgem's Access SCR and the feedback from our customers on their needs.

How we will ensure the resilience of the system

Operating as a DSO will mean that we are dynamically coordinating generation, storage and demand to run the network at higher utilisation, just as our customers become more dependent on the network as we seek to decarbonise transport and heat. With a non-smart network, the system is sized for peak, and as a result capacity is assured; going forward, with a smarter network, new risks emerge.

The DSO will need to secure operational availability for flexibility services that allow the DNO to achieve the network reliability standards that it will have responsibility for. Hence, our DSO will ensure aggregate dispatch performance of DER with 99.99% reliability (as with our DNO infrastructure), to maintain system resilience levels. This will be set out in the DSO:DNO Operational Agreement, and the DNO will have a route to challenge the DSO should service delivery fall short of that set out in the agreement. This is turn should create the right incentives on the DSO to strengthen delivery incentives in its flexibility contracts and/or include greater contingency in the volumes that it is procuring.

In our Cyber Resilience Strategy (a confidential document) we also set out our approach to 'Securing the transition to DSO' as one of the four key strategic pillars for RIIO-ED2 of the Cyber Resilience Strategy.

Our DSO transformation is underway and gathering pace

Since our July submission we have continued to evolve and add detail to our DSO strategy. We have developed a detailed DSO technology investment justification paper to underpin our investment plan; we have developed a programme milestone plan and prepared our approach to delivering and operating the DSO investments; we have developed further detail regarding our proposals for conflict mitigation, including clarifying the options considered, the Terms of Reference for the DSO Supervisory Board, and the outline of the DSO:DNO Operational Agreement; we have further developed our proposals for the role of the DSO in connections and competition in networks; we have clarified our Cost-Benefit Assessment working with the ESO and Imperial College; and we have developed further detailed design elements of the DSO operating model.

Our DSO programme is mobilised and gathering pace, and we are preparing to begin further investments in capabilities and organisational change in 2022 to ensure our DSO is ready for April 2023.

Delivering the DSO will require investments in new and enhanced capabilities, as well as building our workforce to deliver a more commercial and customer-focussed operation. Our track record demonstrates our ability to deliver a programme of this nature, such as our Business Transformation Programme which involved investment of £100m across DPCR5 and RIIO-ED1. By the end of RIIO-ED1 we will have set up the processes and structures of the DSO business unit, recruited around 40 new people into key roles, and continued to deliver key foundational capabilities such as increased network visibility, enhancements to network modelling tools, and the evolution of our Distributed Energy Resource Management (DERMS) platform and market operations capabilities.

Establishing a DSO represents a fundamental shift in our culture, moving away from traditional engineering solutions, adopting a service-based mentality, and becoming more agile to adapt quickly to the changing customer and technology landscape. Creating a legally separate DSO will enable us to foster the culture needed to be relevant for the next phase of decarbonisation as we embark on this fundamental transformation of our business.

2 The challenges and market context that have shaped our strategy

2.1 Our RIIO-ED1 track record

The UK's electricity distribution networks are undergoing the biggest period of change since privatisation, and UK Power Networks is leading the way.

Together DNOs have connected over 32GW of distributed generation, over 1GW of electricity storage and 300,000 plug-in Electric Vehicles (EVs), of which we have been responsible for more than a third.

As a result, the UK is cited as a global leader on the progress it has made towards DSO, which is benefiting customers and society by:

- Allowing low carbon generation to be easily integrated into our network, thus allowing individual customers and communities to engage in the energy transition.
- Providing new connections and access products (supported by Active Network Management solutions) enabling renewables to connect quickly and cheaply to the distribution networks.
- Providing new markets for flexibility service providers, thus stimulating the market in batteries and energising the market for demand side response and innovative EV smart charging tariffs.
- Promoting new solutions for operating the network, by supporting innovation trials and promoting competition in distribution flexibility services.
- Working in partnership with local authorities and the private sector in helping to plan low carbon solutions for new developments, towns, cities, and entire regions.
- And in doing all the above, reducing the need for costly and disruptive network upgrades.

Our leadership in flexibility was recognised in 2020 when we were ranked No 1 in the international Smart Grid Index[5]. Such recognition means our peers internationally are keen to learn from us, and we benefit from this interaction, learning from others, and challenging ourselves to remain No 1. We are following closely developments in Europe, Australia and in the US.

In 2017 we were the first UK DNO to tender for flexibility in the open market, and since then we have market-tested c. £300m of load related capex, translating into £70m of flexibility revenue potential that we have made available to participants for the RIIO-ED1 period, and awarded more than £45m of flexibility contracts through to 2028.

We have developed one of the world's first flexibility markets at the Low Voltage level, demonstrating the potential importance of smart charging of electric vehicles to the operation of the low carbon electricity system.

As we have been building our DSO related capabilities, we have been listening to what our providers and customers are saying, providing more information on future needs and potential value, offering different contract lengths, and increasing the frequency of tenders. It is in our interests, and those of our wider customers, to maximise participation in the tenders.

We have been actively engaged through the ENA in developing standardised products across DNOs, to facilitate participation by flexibility providers, and we fully endorse the ENA's Common Evaluation Methodology for assessing network options to promote transparency in decision making, and providing a common basis for how flexibility will be valued by DNOs.

Our Distribution Future Energy Scenarios (DFES) provide the most detailed picture yet on how our part of the energy system might evolve over the coming years. These scenarios, alongside our capacity heat maps, have provided stakeholders with a rich picture of our system and how it is changing, which helps connectees to decide for themselves where capacity is available to connect quickly and cheaply.

Our 'business as usual' Flexible Connection product was launched in October 2019. Since the launch, we have seen exceptional demand from customers for the product. More than 50% of all generation enquiries received are now for Flexible Connections, and we have seen a 60% increase in customers accepting flexible connection offers when compared to the acceptance rate for firm connection offers in the past three years. This highlights the viability of this product for customers in comparison to traditional connection offers with costly associated network reinforcement.

There is now over 4.2GW of accepted flexible connection capacity in UKPN. This figure continues to grow month on month. On average we have seen 135MW of flexible connection capacity accepted each month. Customers with existing flexible connections have already benefitted from cumulative savings of £155m in avoided wider reinforcement costs. Based on flexible connection acceptances to date, it is projected that flexible connections could provide further customer savings in the order of £326m to the end of RIIO-ED1. This can be extrapolated to infer similar volumes in RIIO-ED2.

We also believe we will be able to connect far more low carbon generation and reduce curtailment levels through implementing market-based approaches for allocating curtailment to generators with flexible connections, and we are planning to trial this through our Energy Exchange innovation project.

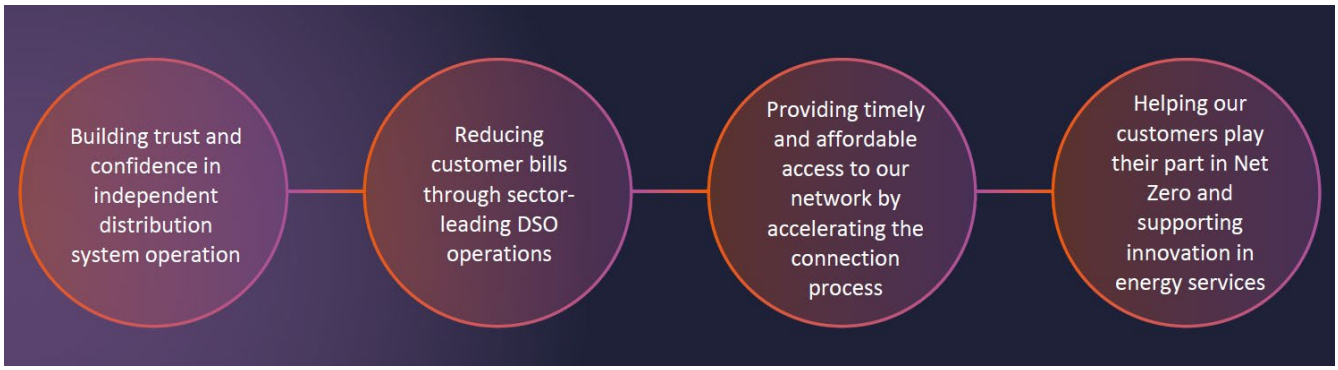
[5] https://www.spgroup.com.sg/what-we-do/smart-grid-index

Much of our DSO capability has been developed by transitioning successful innovation projects into business-as-usual. In such projects we have collaborated with a wide range of partners which has helped us to understand far more about how customers can engage with the DSO (for example, through our EV trials with Kaluza and Octopus Energy), and how we will need to collaborate with other parties (notably the ESO) to deliver whole system solutions, when operating a safe and secure low carbon electricity system.

But we recognise we need to go further to meet the challenging targets set by Government. Significant change is required by our customers both in terms of the way they travel and how they heat their homes. More than half of the emissions cuts required under the Sixth Carbon budget rely on people and businesses taking up low carbon solutions[6]. Our Whole Systems Strategy (appendix 19a to our business plan) discusses the important role we must play in encouraging customers to uptake such technologies, and how we will promote the use of whole system solutions.

2.2 The changing energy landscape

Our DSO strategy has been shaped by consideration of a range of drivers and viewpoints. We have considered the DSO challenges we face within our areas, and the impact they will have on our networks as we strive to facilitate delivery of our collective Net Zero ambitions. We have taken into account what we have learned through building our DSO foundations through RIIO-ED1, and have gained valuable insight from our customers and stakeholders through extensive engagement. This has led us to four key themes on which we have based the four pillars of our DSO strategy, which are:



Through the remainder of this section, we briefly summarise the insight that has shaped these themes. The issues we cover are explored in more detail in our Future Smart consultation and strategy document[7], and wider business plan documents including our Whole Systems Strategy (Appendix 19a to our business plan).

The changing energy system

The transition to a low carbon future is changing the nature of the electricity system rapidly. 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.

These changes 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. 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 the fast response required to balance the system on a second-by-second basis.

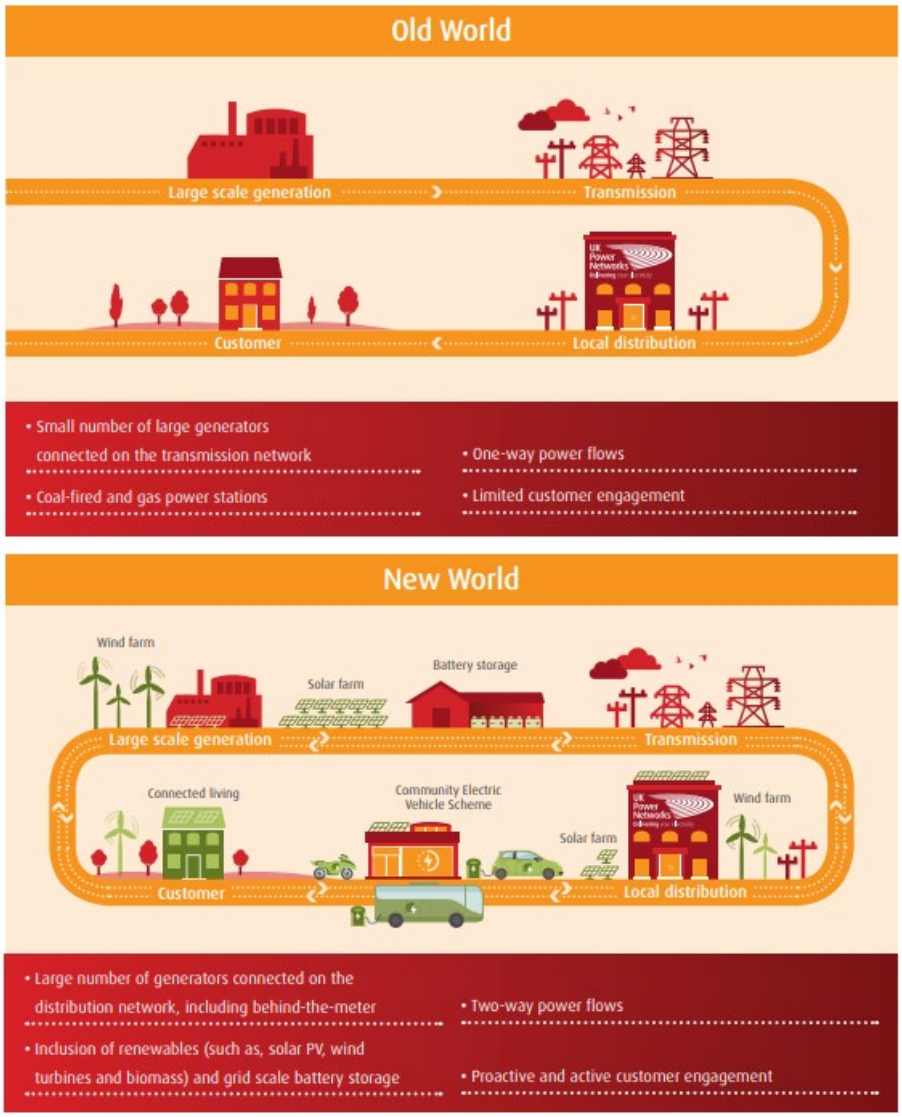
[6] See Climate Change Committee, https://www.theccc.org.uk/publication/sixth-carbon-budget/

[7] https://smartgrid.ukpowernetworks.co.uk/

The amount of domestic heating using electric heat pumps and hybrid schemes is expected to increase, imposing further demand on the electricity system. 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.

The roles of these networks will inevitably change as the way energy is produced, moved, and consumed evolves, and as other networks emerge – including those carrying heat, hydrogen, and data. The future whole energy system is likely to be cross-vector (electricity, heat and transport interdependently linked), more distributed (local, regional, national), flexible (on-demand, service driven) and smart (dynamic, and automatically controlled). Transformational change is happening at an ever-increasing pace, driven by the need to reduce carbon emissions in the most efficient, cost effective way. There are opportunities for collaboration and innovation in all elements of the whole system, including technologies, capabilities, services, people, policies, regulations, and commercial business models.

Figure 1: The changing energy system



What's driving change?

In 2019 the UK became the first major economy in the world to pledge Net Zero carbon emissions by 2050, as a necessary and fundamental measure to end its contribution to global warming and fight climate change. To reach Net Zero, major infrastructure decisions need to be made and quickly implemented to enable the uptake of low carbon technologies (LCTs).

At UK Power Networks, we operate and maintain the electricity distribution network for roughly a third of the country. We believe that the distribution network is at the core of facilitating the transition to a zero-carbon economy, as the uptake of low carbon technologies connected at the grid edge, such as heat pumps and electric vehicles, increases. In delivering against this challenge, we face pressures from a wide range of change drivers, as illustrated in Figure 2 below.

Figure 2: Drivers for change influencing the DSO transition

Political	Economic / Regulatory	Socio-cultural
• Increasing global focus on decarbonisation • UK leadership at COP26 • Levelling up agenda • Pressure on energy bills and returns • Local Climate Emergency plans • Drive for transparency in markets (e.g. ESO separation)	• Increasing government stimulus for Net Zero (e.g. Energy Efficiency funding £9.2bn, Rapid Charging EV Fund) • Ofgem's agenda for delivering a Smart, Flexible Energy System • Post-COVID 19 Green Recovery	• Increasing awareness of Net Zero • Lack of understanding of potential lifestyle changes required by Net Zero • Emergence of "prosumers" • Affordability concerns • Exclusion to new opportunities due to lack of skills, education, access • High customer expectations

Technological	Legal	Environmental
• Digitalisation • Internet of Things / Connected Homes • Electric vehicles / heat pumps / storage / distribute generation • Data – presumed open • AI and machine learning • Cloud computing – unlimited processing power	• Climate Change Act – Net Zero by 2050 / 78% reduction by 2030 • Ban on sales of ICE vehicles by 2035 • Future Homes Standard – low carbon heating by 2025 • NISD regulations related to Cyber • Data protection / GDPR • Competition (e.g. Penrose report, Dieter Helm Cost of Energy review)	• Uncertainty in decarbonisation pathway – timing, scale, location of generation and demand • UK commitment to 40GW of offshore wind by 2030 • Climate Change impacts on network resilience

How these changes are impacting our network

The carbon intensity of electricity has reduced dramatically in the last decade, aided by a substantial increase in renewable generation and storage connected to distribution networks. We now operate an electricity network with nearly 10GW of distributed generation including 220MW of storage (with 2.6GW of accepted offers for connecting storage in the pipeline). Our primary challenge in the next decade will be to continue to enable a rapid and accelerating uptake of Distribute Energy Resources (DER) to facilitate delivery of the UK's Net Zero ambitions and doing so at best value for consumers. These challenges will manifest in different ways in each of our licence areas, due to different customer demographics, the variation in uptake of DER due to regional factors, and the existing characteristics of the network infrastructure.

In LPN, and the south east in general, we expect to see the steepest adoption curve for electric vehicles and heat technologies, driven by the population density, demographics, and relative affluence. For instance, the south east currently contains 8% of the total vehicles in the country, but 13% of the total electric vehicles stock. Integrating this demand is particularly challenging in the LPN region which manages unique challenges such as containing the UK's only summer peaking areas, driven by air conditioning load, and requiring high levels of network resilience to support the criticality of load.

EPN is our largest region – and one of the largest in the UK – with the highest peak demand and DG capacity across our licence areas. Most of the growth in DG thus far has occurred in the EPN area, and each year we are seeing higher numbers of applications for connection than in any previous year. This volume has increased through COVID 19, reaching a record level of 300 per month. We are anticipating this to continue and we will also see a large amount of additional large-scale wind capacity added offshore along the east coast, increasing the level of coordination required with National Grid Electricity Transmission (NGET) and the ESO.

In SPN, we are now seeing generation peaks that are higher than demand peaks during the summer, resulting in a net export of power from our distribution network to the National Grid, and the pipeline of connection applications continues. This region is also the landing point for three interconnectors and connects with GSPs in a key constrained area for the transmission network. These conditions result in a highly dynamic Transmission/Distribution interface, and a need to collaborate closely with the ESO, as we are doing through our Regional Development Programmes and Power Potential programme.

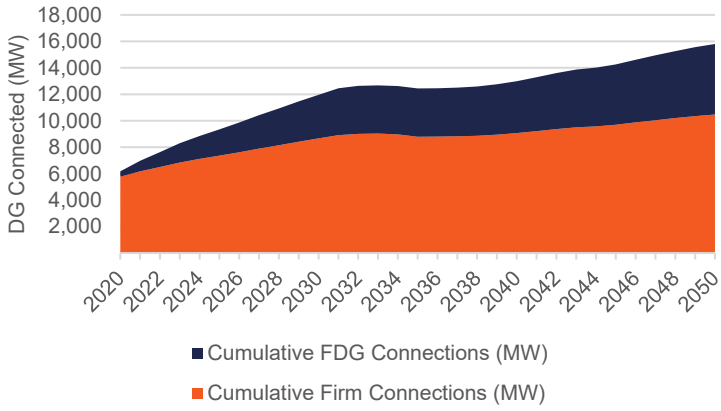
The potential for smart solutions

With more DG connections coming online, the ability to provide low cost and quick access to the network has become challenging using traditional solutions. Over the past years, UK Power Networks has been at the forefront of innovation focussing on facilitating cheaper and faster DG connections.

UK Power Networks was the first DNO group to rollout flexible connections. In 2019 a centralised ANM System was procured which facilitated the opening up of the rest of our distribution networks to flexible DG connections. This roll-out into a business-as-usual offering has seen our DG acceptance rate increase by 60% and we now have a pipeline in excess of 3GW of Flexible Connections.

Over half of all generation enquiries we now receive are for our flexible connections product, and projecting this forward would imply a significant increase in volumes of flexible connections to be commissioned and managed within network operations, as set out in Figure 3. In the event of a change to the connection boundary through the Access

Figure 3: DG Flexible Connections application forecast



SCR, we may expect to see a lower volume of flexible connections propositions being accepted by customers, as customers would no longer bear as much of the cost of a firm connection. However, a flexible offer will also speed up the timescale in which a connection can be delivered for the customer. Under a shallower connection boundary, we would therefore still expect a flexible connection to be an attractive offer, where it can deliver a faster connection.

2.3 The evolution of the energy market

In Section 3.5 (Role 3: Market Development) we set out our strategy for developing DSO market arrangements through RIIO-ED2, and the options and considerations that shaped our strategy. In this section, we recap on the forces we see shaping the market landscape, as set out in our Future Smart publication[8] and updated with recent developments.

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 smarter energy system. With the growth of new low carbon technologies (LCTs), most notably EVs and electric heat pumps, there is considerable uncertainty regarding how much new load and generation (and storage) will connect and where, and how that new load will behave.

Increasing network capacity to accommodate increased power flows can be costly and takes time. Other smarter solutions that embrace new and existing network customers' flexibility, such as DSR, managed charging of EVs, controllable generation and battery storage, can provide timely and cost-effective alternative approaches. Furthermore, in the face of future uncertainty these approaches can provide options, allowing decisions on network reinforcement to be deferred until there is better information on the enduring needs, and where and how much to invest.

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.

Numerous industry, academic, and government studies have investigated the potential benefits of flexibility in the electricity system. For instance, a 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 per year cheaper than the traditional model. Their updated report, Flexibility in Great Britain[9] – published in 2021, has again concluded that "Investing in flexibility is a no-regrets decision as it delivers material net savings of up to £16.7bn per year across all Net Zero scenarios analysed in 2050".

A common feature across these studies includes optimisation (at a whole system level) of connected DERs and avoidance of some of the additional generation and infrastructure costs required. The existing GB market structure is suited to a world in which most of the generation and providers of flexibility are connected to the transmission network, and the locational constraints are few, 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 two approaches of **wholesale market change** (i.e. 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 locational network price signals** (i.e. retaining the current single node wholesale market, but providing stronger locational pricing signals and local system balancing capabilities through other means, such as through changes to use of system charging and network access, or procuring constraint management services from local flexibility providers).

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.

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 several US markets and New Zealand.

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 SO and DSO to

[8] https://smartgrid.ukpowernetworks.co.uk/

[9] https://prod-drupal-files.storage.googleapis.com/documents/resource/public/Flexibility_in_GB_report.pdf

manage the overall system in real time, ensuring that the market delivers the constraint management is it designed to do, and resolving network constraints that occur below the voltage level of nodal pricing. The SO and DSO can use the emerging price signals to identify where there is a positive business case for expanding network capacity to reduce network constraints.

Strengthening locational network price signals – 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 more granular and/or dynamic Distribution Use of System (DUoS) charges, that change with time and location, and/or time varying access products.

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. Experience from numerous industry trials, including our recent Innovation Project Shift[10], suggests that consumers, with the help of the appropriate information and control technology, are willing to shift their energy consumption (e.g. charging overnight).

There are several issues with more dynamic locational charges that need to be considered, including fairness and cost reflectivity, transparency and predictability for suppliers, and the potential for exacerbating the network peaks by concentrating loads into attractive price windows. These issues are being considered by Ofgem in the Access & Charging review[11]. In their minded-to position, Ofgem has proposed changes to the connection boundary with respect to connection charging for generation and demand, and are consulting on taking forward a separate wide-ranging review of DUoS under a separate vehicle from the original Access SCR.

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 ESO and DSOs will always need to procure flexibility services, to a greater or lesser extent, 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 ESO and DSO greater certainty that the flexibility will be available and dispatched when and where needed and provides more certainty for providers of flexibility.

Several approaches have been taken forward by GB DNOs in trials. For our Energy Exchange[12] innovation project we are developing a platform to enable DERs on flexible connections to trade their curtailment obligations in a market environment. 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.

Over time, as DER penetration increases, these local flexibility platforms could merge into a broader DSO flexibility platform, which might interface with the ESO's Balancing Mechanism 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.

Local energy schemes

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 ESO 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.

[10] https://innovation.ukpowernetworks.co.uk/projects/shift/

[11] https://www.ofgem.gov.uk/electricity/transmission-networks/charging/reform-network-access-and-forward-looking-charges

[12] https://innovation.ukpowernetworks.co.uk/projects/energy-exchange/

2.4 Our vision for the DSO's role in the future energy system

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

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.

Renewable generators, who have traditionally contracted with established off-takers, 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.

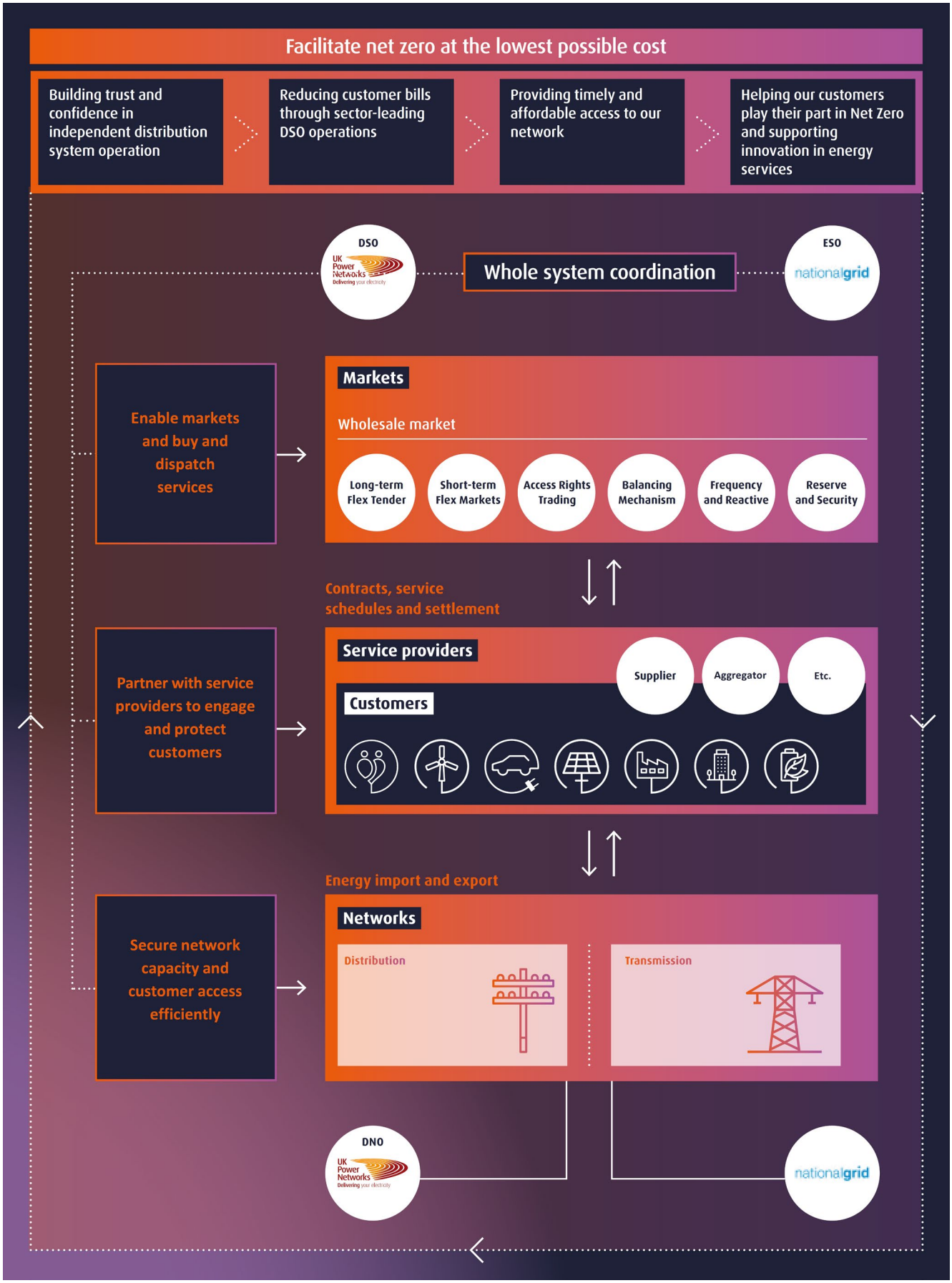
Whilst scale can be a barrier to market participation, aggregators have emerged, playing an important role in innovating through new technology, and providing a route to market for flexibility services. We are beginning to see convergence in the roles of different market participants, for example with aggregators offering supply services, and vice versa.

With the loss of flexibility on the supply (generation) side as we strive to integrate large-scale renewables onto the system, it is imperative that we awaken the demand side, and engage consumers and businesses to participate actively in delivering flexibility. The race is on to "own the home" and provide consumers (and businesses) with their transport and heat needs, enabled by propositions that frequently combine smart energy management with distributed generation and storage.

However, the DSO's role is not to "own the home", or to direct when and where electricity can be consumed; the DSO's role is to collaborate to stimulate the market and facilitate maximum opportunity and participation in flexibility. Our role is to make our flexibility and access products as inclusive as possible, and to work with providers to reduce barriers to participation. Whilst we will always procure services from consumers through intermediaries, we understand that although we are one step removed from the consumer, we have a role in safeguarding consumer protection and the consumer experience.

Figure 5 illustrates how we see the role of the DSO in enabling and facilitating the future energy system – ensuring that network capacity and customer access is managed efficiently; partnering with service providers to engage and protect customers; and developing transparent, coordinated markets for the procurement and dispatch of services provided by those customers.

Figure 4: Our vision of the DSO's role in the energy system and interactions with customers and stakeholders



Defining the DSO customers and stakeholders, and understanding their needs

In the development of our DSO strategy, we have continued to engage customers and stakeholders. This engagement has reached a broad range of groups, ranging from end-consumers through to market participants, service providers, wider utilities, local authorities, and policymakers. We will also establish a DSO Supervisory Board specifically to guide our RIIO-ED2 business plan development and conducted focus groups to inform our approach to each DSO role.

This engagement has given us rich insight to inform the options considered and the ultimate shape of our strategy. Our accompanying Whole Systems and DSO Engagement Summary and Line of Sight documents set out in detail our approach to engagement, the key findings, and the specific 'line of sight' to how this engagement has shaped our plan.

To anchor our proposals in the context of customer needs, we have defined customer and stakeholder personas for the different market participants with which the DSO will interact on a regular basis.

The seven different customer personas are shown in Figure 6.

Figure 5: Summarising the types of customers and stakeholders the DSO will interact with

Distributed Generator	Battery Storage	Large Commercial Energy User	Flex Aggregator	System Operator	Local Authority	Residential Customer
			FLEX Co	nationalgridESO		
• Ellie operates solar PV assets in Ipswich, with a total installed capacity of 20MW • She likes the ability to connect to the network quickly and easily – her flexible connection is efficient, with an acceptable level of curtailment • Her goal is to export as much renewable power as possible to maximise her revenue and reduce the carbon intensity of the local network	• Raj owns a 15MW Battery Storage asset in SPN located close to a GSP, and he is planning to connect a second asset • He wants to know how he can optimise his asset across both the ESO and DSO in a coordinated way • He is seeking better visibility of network data to allow more accurate estimates for opportunities for his assets, and to support decision-making on future development opportunities	• Nick manages a cold chain logistics firm that operates several large refrigerated warehouses • Security of supply is critical, and early notice of any outages or disruptions to supply are important • He is willing to reduce his load at peak times if it allows him to generate income and help the transition to net zero	• Flex Co is an energy platform which aggregates and optimises residential and business LCTs • They want to drive decarbonisation by providing a route-to-market for a portfolio of flex • They use network data to understand more about network needs and analyse network congestion to understand where their response could be most impactful	• ESO balances the transmission network in real time • The amount of flex connected to the distribution network is growing, but is not accessible via the BM or Ancillary Services markets • ESO would like to access that flex in a coordinated way • Collaborating with all participants of the energy system encourages a more resilient, balanced transmission network	• Steve is a local authority planner. • He is keen to deliver on new policies and higher standards for carbon reduction of new-build homes, so that his community benefits • He'd would welcome input from his DSO and some support on how to optimise LA planning from his DSO • He is also on the board of the community energy community team.	• Amy is an EV & heat pump owner (through the UKPN foundation) who lives in the outskirts of London • She is passionate about climate change and using low carbon technologies • Amy uses an aggregator and is on her supplier's agile electricity tariff

Below we provide more detailed personas for each of the above customer or stakeholder types, highlighting their wants and needs, as well as the services our DSO will develop and provide to meet those needs.

In each persona, we have split the customer's needs into two categories – 'connecting customers' and 'in-life service'. For the former, connecting customers, we identified a set of needs related to the connections process; in the example of a DER customer, this means needs such as greater opportunities for network access and the need for access to curtailment forecasts to feed into investment cases. For the latter, 'in-life service', we have listed the day-to-day needs of a customer or stakeholder who is interacting with the DSO. For example, with a local authority planning stakeholder, this means needs such as support from UK Power Networks in helping them to develop plans that expedite their Climate Action Plans.

Some customers, such as residential customers may participate in DSO flexibly services indirectly, for example via an aggregator or energy supplier, however it is important that we understand their direct needs so we can ensure the products and services we develop are appropriate.

Finally, we consider how market participants' needs are likely to evolve between now and the end of RIIO-ED2 and summarise the services that we are proposing for each of the customer types, based on our understanding of their needs, and ultimately how these will need to evolve through the RIIO-ED2 period.

Distributed generation customers

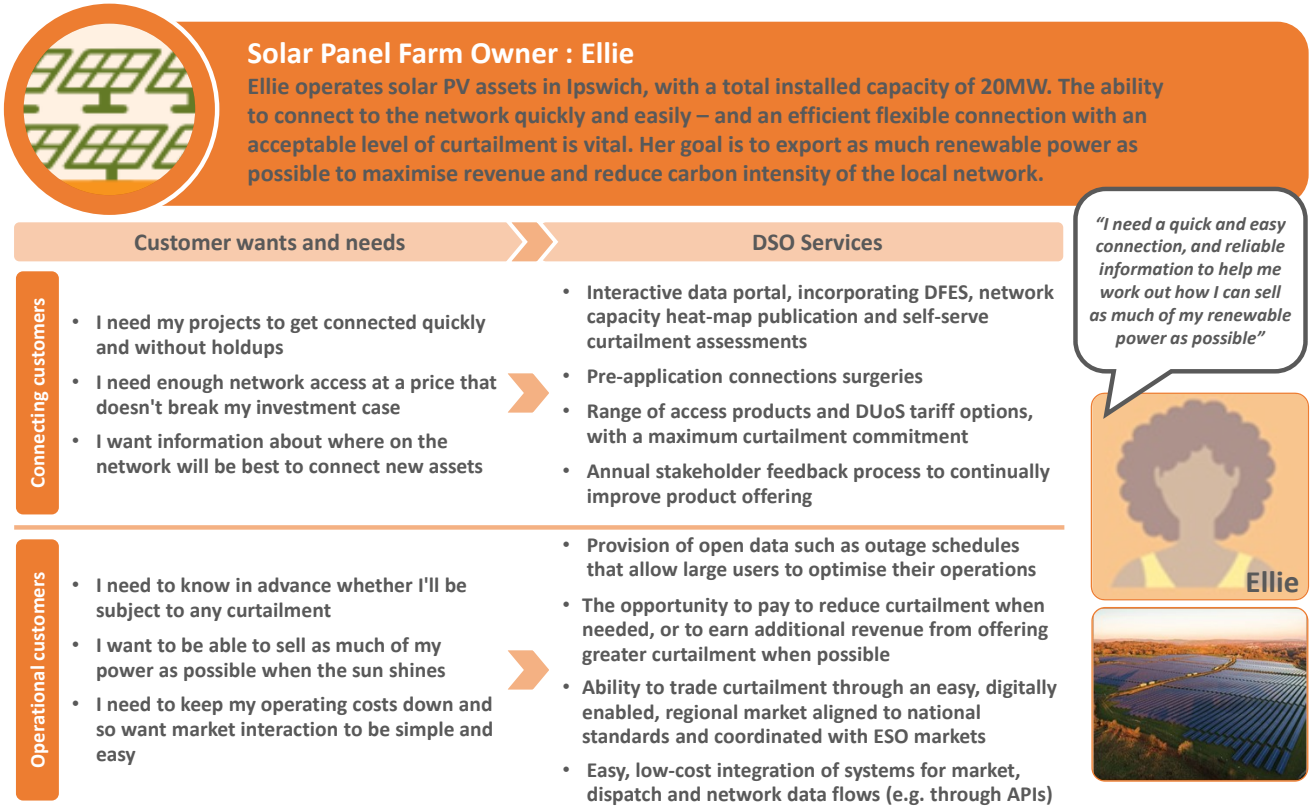
There has been an explosion in the number of connection requests from developers of distributed generation over recent years. These customers are looking for timely and cost-effective connections to the network, the ability to export as much of their generation as feasible, and good visibility of constraints to the amount of power they can export.

As we have demonstrated through the success of our Active Network Management programme and Flexible Connections products through RIIO-ED1, developers of renewable generation projects are in some cases willing to accept a level of curtailment of their output, if that means a faster and cheaper connection. This curtailment allows us to create more space on the network and connect more renewable energy assets.

These developers are increasingly looking to the DSOs and the ESO to set out their future needs for flexibility services, and to describe how these will be procured.

Figure 7 sets out a high-level summary of our understanding of the needs of this customer type, and the corresponding services that the DSO can offer to deliver against those needs.

Figure 6: Distributed generator customer persona



The services our DSO can offer

For Distributed Generation (DG) customers, the DSO can offer a range of connection options, allowing customers to connect faster and more cheaply in exchange for providing flexibility during periods of network constraint. Furthermore, providing developers with accurate long- and short-term forecasts and analysis of network capacity, and online curtailment estimation, will be an important source of insight to help them plan their investments, and understand when and where to apply to connect.

In near-term and operational timeframes, there is an opportunity to enable more efficient allocation of network access between participants in constrained areas, through the introduction of trading of curtailment obligations/secondary trading of access rights. Our publication of short-term forecasting and near-term operational schedules, coupled with a platform to enable secondary trading, will enable participants with flexible connections – to reallocate capacity amongst a group depending on who values it most, and in doing so will also enable price discovery for the value of network access. Further details of these proposals are set out in Sections 3.4 and 3.5.

We anticipate the volume of DG customers compared to other assets to increase significantly in the near-term, and as such intend to deliver services to support their needs early in the RIIO-ED2 timeframe.

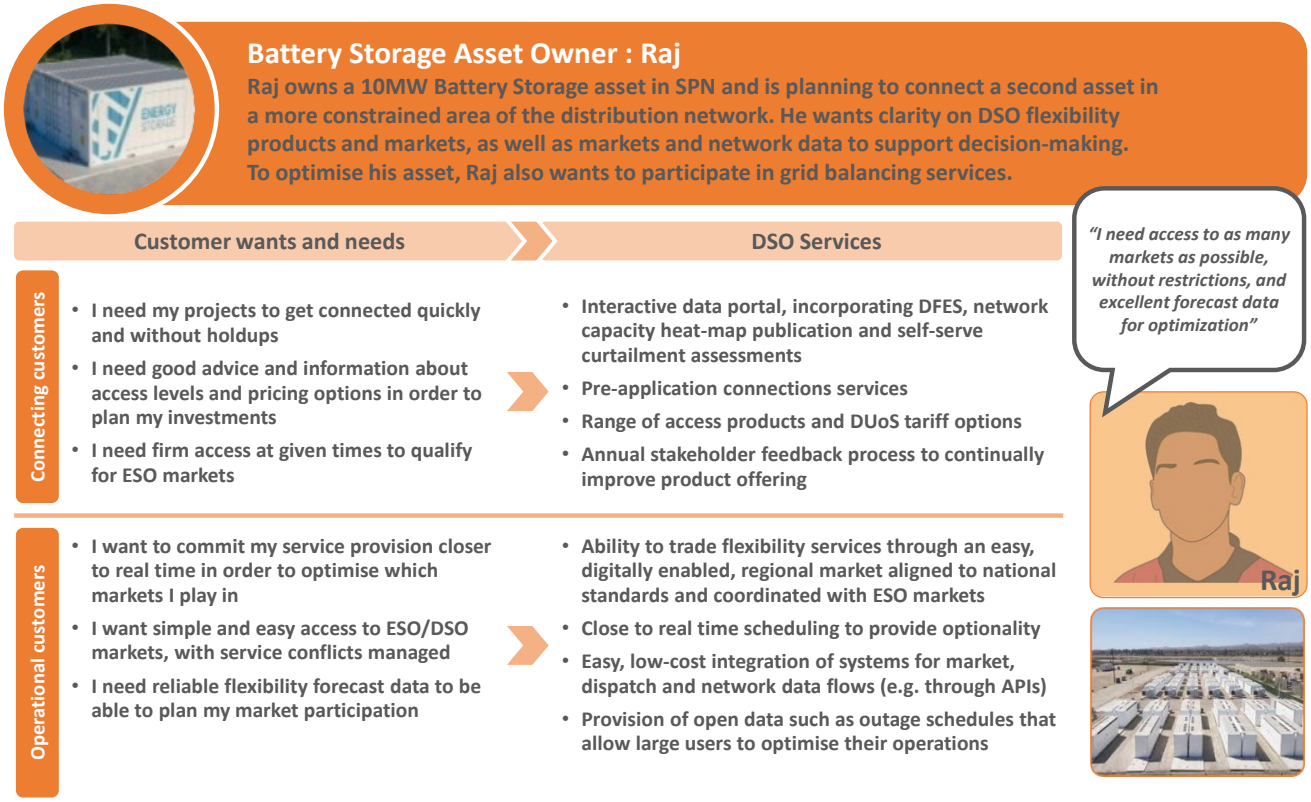
Battery storage customers

Like distributed generators, storage asset owners are also increasingly looking for timely and cost-effective connections to the network. They are also seeking easy access to markets for their flexibility, and good forward visibility of the future needs of system operators. These developers are increasingly looking to the DSOs and the ESO to set out their future needs for flexibility services, and to describe how these will be procured, to underpin their business cases.

Storage will play an increasingly vital part of the DSO's ability to ensure the network operates in the most efficient way possible. To facilitate this, we expect that storage assets will need closer to real time market functionality, to ensure they are able to optimise charging and discharging behaviour. They will also need increasing levels of coordination as distribution flexibility markets grow in conjunction with established ESO balancing and ancillary services markets.

Figure 8 sets out a high-level summary of our understanding of the needs of this customer type, and the corresponding services that the DSO can offer to deliver against those needs.

Figure 7: Distribution-level battery storage customer persona



The services our DSO can offer

For distribution-level battery storage customers, the DSO can offer a range of connection options, including firm options which allow maximum access to the network and to qualify for key ESO market revenue streams such as dynamic containment. Interactive data portals and network capacity heat maps, as well as flexibility market data, will allow storage developers to identify the optimal locations for assets.

The introduction of closer to real-time market operations, alongside coordination with ESO, will allow greater participation for DER customers, who are less inclined to commit their flexibility far ahead of time, which could lock them out of wider market opportunities that might emerge.

For further details on how we will seek to establish real-time operations and coordinated market access with the ESO, see Sections 3.4 and 3.5.

Stakeholders said…

There is strong support for as close to real time procurement as possible for flexibility. Stakeholders suggest our role is to focus on enabling the market to develop and be successful, to drive liquidity.

Large energy users (industrial and commercial customers)

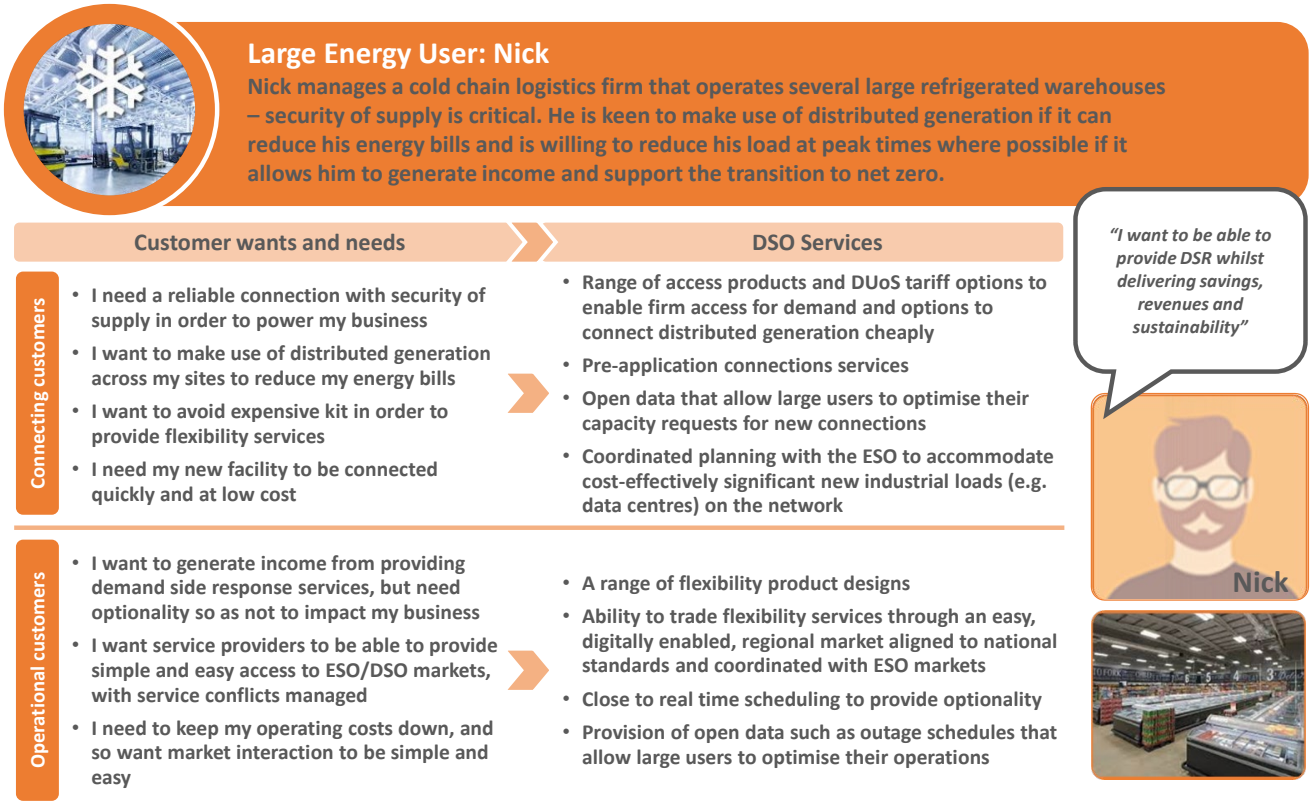
For industrial and commercial users of electricity, reliable and cost competitive supplies of electricity are a high priority. Like their domestic counterparts, these customers are also becoming increasingly sophisticated consumers and producers of electricity. Over recent years, considerable investment 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 ESO'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 (for instance linked to the development of new business parks or university campuses) which connect a range of DERs, such as renewable generation and storage, with demand customers over a private network.

Smaller commercial customers may currently 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.

Figure 9 sets out a high-level summary of our understanding of the needs of this customer type, and the corresponding services that the DSO can offer to deliver against those needs.

Figure 8: Large energy user customer persona



The services our DSO can offer

For a Large Energy User (LEU), speed of connection, security of supply, and how to keep costs low through the use of on-site generation or lower cost access products, will be key concerns for enabling their operations. Our pre-application connections surgeries will help to provide connecting customers with advice on these options, and to explore the potential to provide demand-side response services both for the DSO and for the ESO.

In operational timeframes, existing LEUs will require advance visibility of scheduled flexibility services, allowing them to plan their operations and potential demand side response. Whilst it is likely that many will engage with the market via intermediaries like an aggregator, coordinated access to ESO markets will be important, in order to enable them to maximise the value of their flexibility across markets. For any LEUs that do choose to transact via our Distribution Market Platform, we will need to ensure that we provide a great customer experience and a platform that is low cost to integrate with via Open APIs.

The needs of these customers are active in the market now, and through early provision of a transparent marketplace we will aim to stimulate greater participation in flexibility markets from LEUs.

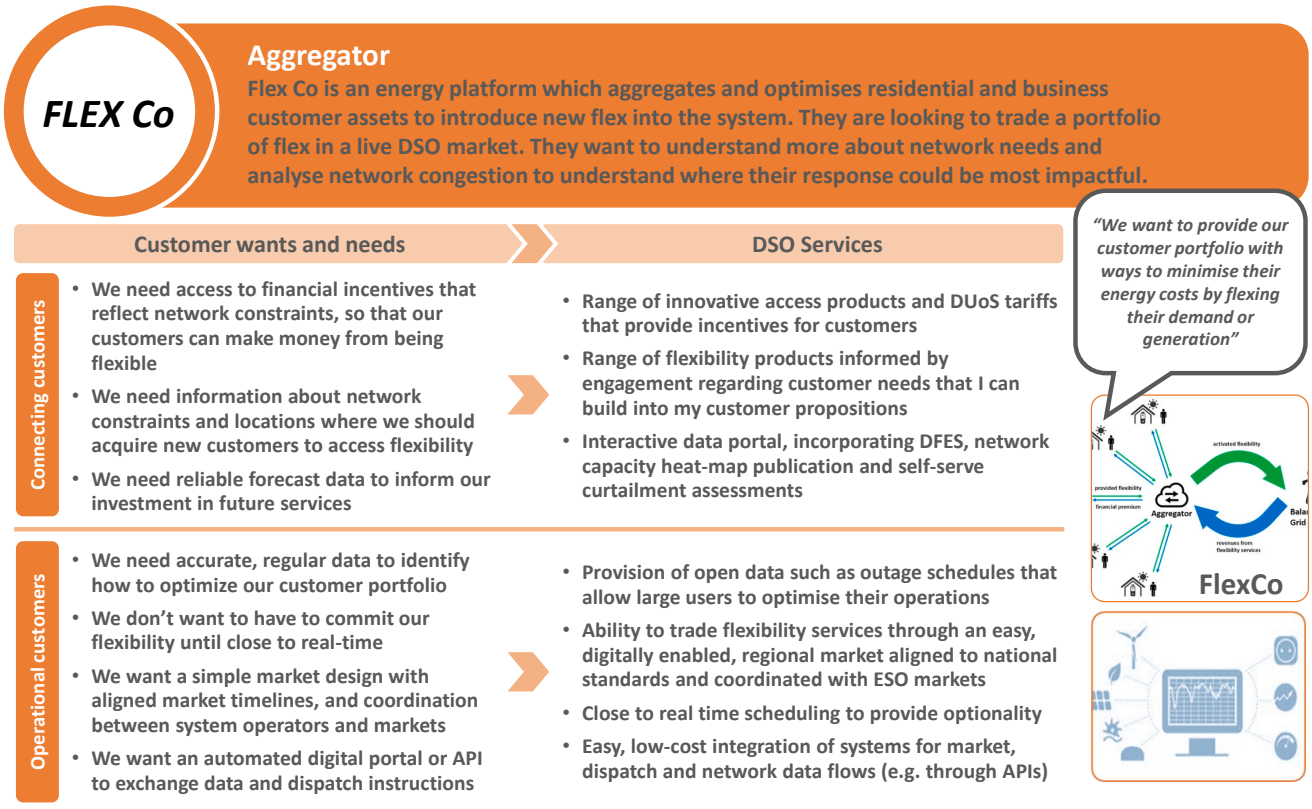
Aggregator

As the energy system becomes more decentralised, there is a growing volume of small, localised flexibility resources, such as small businesses or households with electric vehicles. These smaller scale decentralised consumers can play an important role in delivering network flexibility but require aggregation to group their collective capacity into a larger and meaningful service that can then be sold to system operators such as the DSO.

Whilst scale has traditionally been a barrier to market participation at the smaller end of the market, aggregators have emerged to play significant roles in innovating through new technology and platforms that provide a route to market for the smaller participants such as consumers or small generators. Aggregators (and/or energy suppliers playing the aggregator role) are expected to be a crucial route to market for residential customers, with their ability to aggregate LV load into a material flexibility response capability, whilst also simplifying the flexibility services and interactions with the end customer.

Figure 10 sets out a high-level summary of our understanding of the needs of this stakeholder type, and the corresponding services that the DSO can offer to deliver against those needs.

Figure 9: Aggregator persona



The services our DSO can offer

For aggregators, customer acquisition is driven by identifying opportunities to harness customer flexibility to deliver against market opportunities. The DSO therefore needs to ensure that aggregators are provided with clear information regarding networks constraints and locations, and with market signals and incentives that enable them to build attractive customer propositions. Engagement will be needed with aggregators to ensure that product designs are suitable to translate into customer propositions – particularly those focussed on consumers and LV flexibility.

In operational timeframes, aggregators will be looking for coordination with ESO markets, accurate short-term forecasting data to inform their optimisation, and closer to real-time operations to enable them to maximise the value of their portfolio across markets without committing far in advance. They are also technically advanced, and will require a market platform and dispatch infrastructure that is simple to integrate with, and facilitated via open API standards for market data flows.

Further detailed on our proposals for the market platform are set out in Section 3.5.

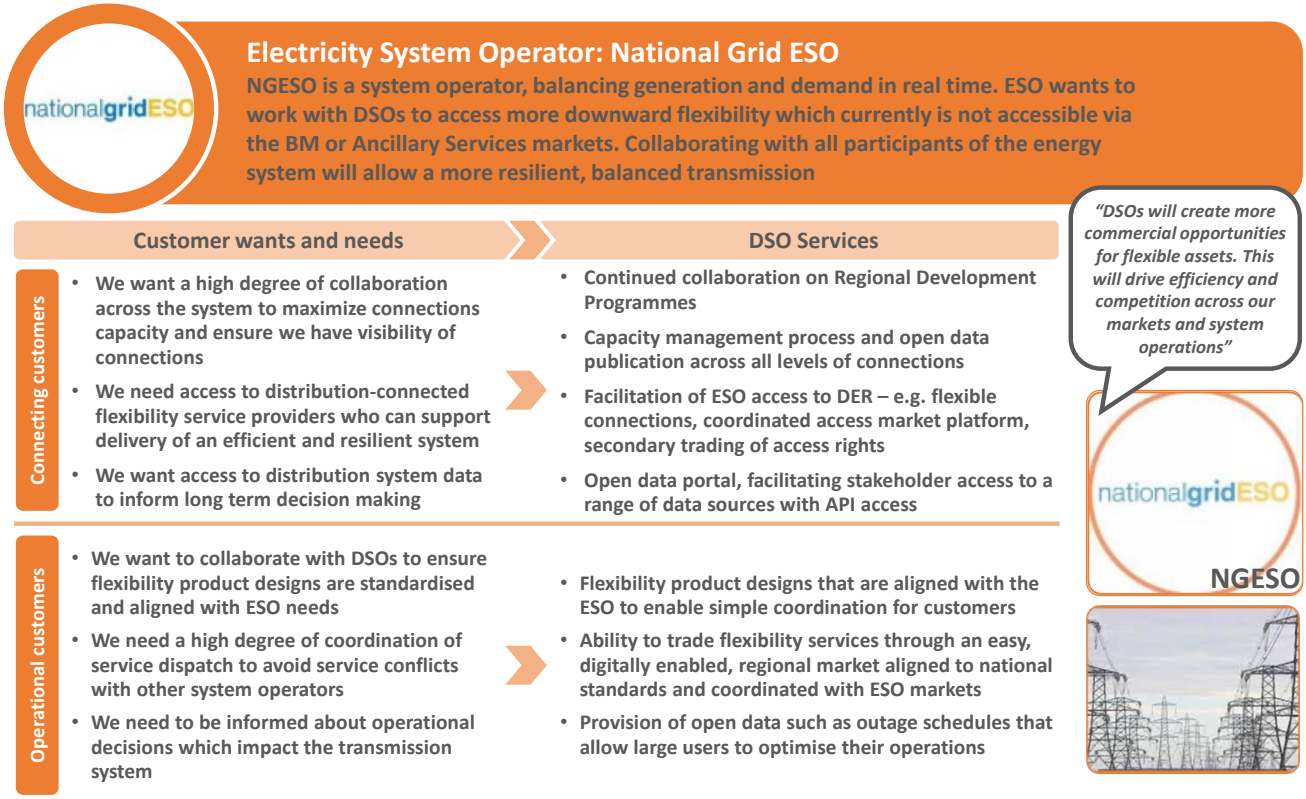
System operators

System operators such as National Grid's ESO are changing. Large thermal generators connected to the transmission system are being replaced with renewables and distributed generation that the ESO has less visibility over, making its task of balancing the system and the service it procures increasingly complex. The ESO has committed to being able to run a zero carbon electricity system by 2025.

As a result, system operators need new sources of flexibility, and are now buying different mixes of services across markets to manage the system, some of which extend down into the distribution network, such as ESO's Optional Downward Flexibility Management service which was introduced in 2020. Through our Regional Development Programmes, National Grid ESO has recognised the need to coordinate with DSOs to draw on DERs to help manage challenges on the transmission system created by the changing nature and location of generation, whilst managing the risk of service conflicts through coordination.

Figure 11 sets out a high-level summary of our understanding of the needs of this stakeholder type, and the corresponding services that the DSO can offer to deliver against those needs.

Figure 10: System operator persona



The services our DSO can offer

The DSO and ESO need to collaborate to enable the integration of DER onto the distribution network, and our Regional Development Programmes have proven a model for collaboration that we will scale up through RIIO-ED2. With an increasing volume of connections expected, an efficient process for capacity management will also be required.

A key need for the ESO will be in gaining coordinated access to distribution-connected DER for the provision of national system services, particularly as the proportion of flexibility connected at distribution level grows. The DSO can pursue several services to enable this, including alignment of flexibility product designs and of market timeframes for procurement scheduling and dispatch, sharing of operational forecast data and service schedules, and through the market platform itself, in facilitating joint visibility and coordinated dispatch between the ESO and DSO.

Further detailed on our proposals for the market platform are set out in Section 3.5.

Stakeholders said…

Stakeholders believe it is important for the future energy system to take account of wider whole system impacts in the planning and operation of the network. They expect planning activities to be coordinated with wider parties.

Local planning stakeholders (Local and Regional Authorities)

There are 127 Local and Regional Planning Authorities in our network areas, which are involved in planning and facilitating the development of their local communities. Increasingly, these organisations are setting out Climate Action Plans to bring about the delivery of Net Zero in their areas. Local Area Energy Planning (LAEP) is a key enabler of Net Zero, through seeking to understand the cross energy-vector needs in a given area and identifying the least cost investment pathways to Net Zero.

Alongside developing our RIIO-ED2 business plan, UK Power Networks has worked with 6 Local Authority stakeholders to co-develop an approach to supporting them in this challenge, providing insight and analytics support, as well as guidance as to what a credible LAEP needs to contain to deliver sufficient confidence to unlock investment in infrastructure.

Figure 12 sets out a high-level summary of our understanding of the needs of this stakeholder type, and the corresponding services that the DSO can offer to deliver against those needs.

Figure 11: Local authority planner persona

The services our DSO can offer

As set out in our Whole Systems Strategy (Appendix 19a to our business plan) we will work with all 127 local and regional planning authorities in our areas to co-develop and understand their Climate Emergency plans. In-line with these plans, we will apply a transparent framework to assess and understand the level of certainty in Local Authority plans and will augment our DFES to go faster where sufficient certainty exists.

To support this, we will establish a dedicated a local area planning team of 5 increasing to up to 20 employees by the end of RIIO-ED2 that will offer a range of services, including annual engagement and support with stakeholder engagement; planning support, through our guidance framework and digital support tools; and consultancy services including data provision, research and commercial advice.

See section 3.3.2 and our Whole Systems Strategy (Appendix 19a to our business plan) for further details on these proposals.

Residential customers

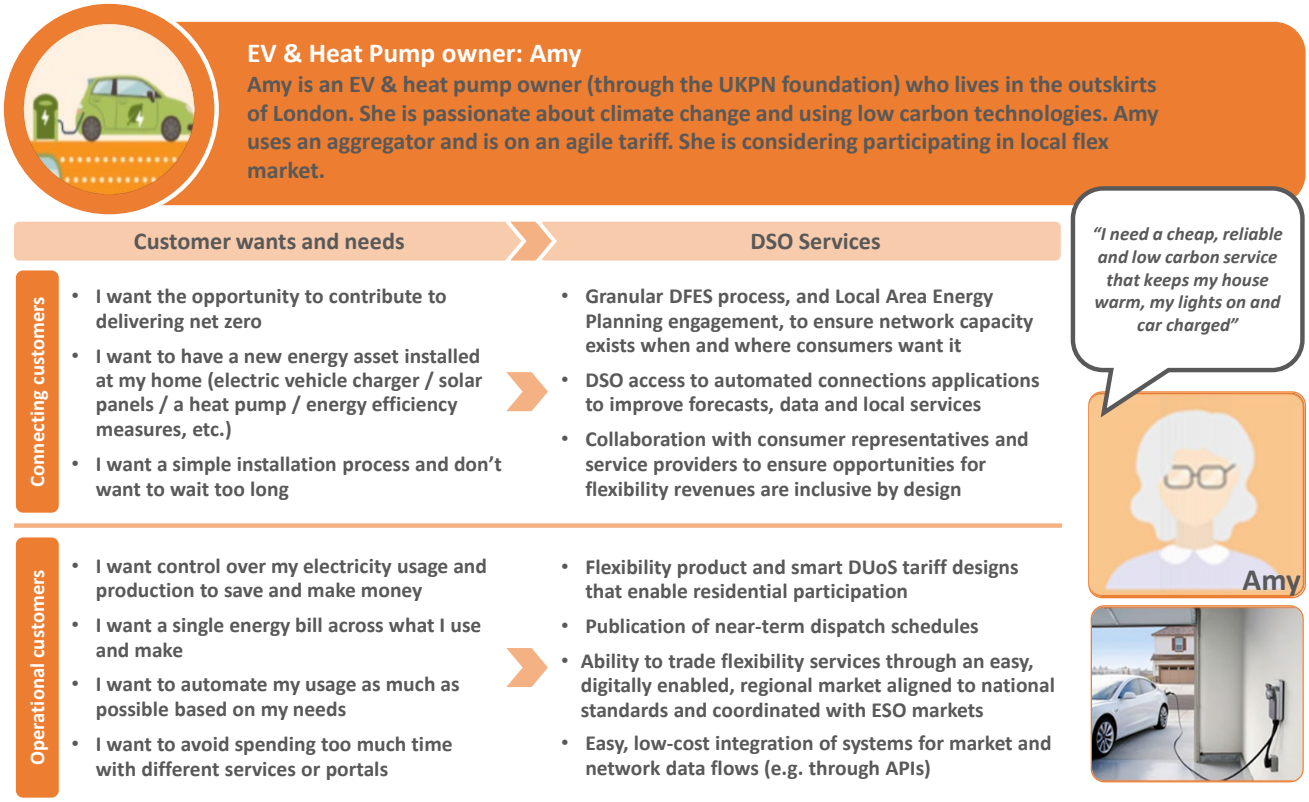
With the growth of EVs and greater use of electricity in heating (and cooling) in the future, residential customers will be increasingly reliant on electricity to meet their future energy needs. Maintaining reliable and affordable supplies, whilst decarbonising the system, will be paramount. Advances in energy efficiency are required, both in the heat retention properties of the housing stock to enable low carbon heating technologies, and energy consumption performance devices and appliances.

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 enabled for smart appliances, smart meters, storage and control leading to 'connected living'. The ability to manage energy in the home remotely exists now through 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.

Figure 13 sets out a high-level summary of the illustrative needs of the "average" residential consumer/prosumer (accepting that this segment contains a wide variety of customer types with varying needs), and the corresponding services that the DSO can offer to deliver against those needs.

Figure 12: Residential customer persona



The services our DSO can offer

Our approach to promoting consumer engagement in flexibility is to nurture a rich ecosystem of service providers that we will collaborate with to develop and procure flexibility services. We will seek to understand consumer behaviour, inform and adapt our propositions and bring them to market through third party intermediaries that have direct access to consumer and their homes. Our approach is explored further in our Whole Systems Strategy (Appendix 19a to our business plan), and in section 3.5.

We understand that whilst we are one step removed from the residential consumer, we have a role in safeguarding consumer protection and the consumer experience. Through the development of flexibility products (including energy efficiency) that give customers an opportunity to participate in the flexibility market, we will help ensure residential customers' needs are met and that no customer is left behind in the energy transition.

Stakeholders said…

There is strong support from stakeholders and customers to ensure smarter networks do not leave customers in vulnerable circumstances behind. Customers in vulnerable circumstances expect tailored services to enable them to share in the benefits of new technology.

2.5 How these challenges and trends have shaped our DSO strategy

Figure 14 below summarises a small number of the high priority insights that we have taken from our review of DSO challenges, our learnings from our progress through RIIO-ED1, and our engagement with customers and stakeholders.

This insight has provided the foundations upon which the four pillars of our DSO strategy are built.

Figure 13: Key insights that have shaped our strategy

Summary customer and stakeholder insights	Pillars of our strategy
• Momentum is clear in the drive to deliver Net Zero, and drivers across all dimensions of Political, Economic, Socio-Cultural, Environmental and Legal are here to stay • The DSO is at the core of facilitating Net Zero, as the uptake of low carbon technologies connected at the grid edge, such as electric vehicles and heat pumps, increases • Customers and stakeholders expect UK Power Networks to play a valuable role in enabling the delivery of Net Zero, ensuring no customer is left behind • Customers and stakeholders want to participate, and want us to make data available to enable them to play their part in delivering Net Zero	**Helping our customers play their part in Net Zero and supporting innovation in energy services**
• To enable Net Zero, one of our primary challenges is to connect low carbon generation to the system as quickly as possible • We are facing an unprecedented increase in connection volumes, and must employ smart solutions if we are to enable connections at the required pace • Connecting customers expect a focus on flexible connections to encourage greater participation, and transparent data to assist in planning when and where to connect • There is support for UK Power Networks to invest where required to integrate more environmentally friendly technologies into the electricity distribution network	**Providing timely and affordable access to our network by accelerating the connection process**
• Incorporating the level of demand and generation growth required to facilitate Net Zero could drive significant reinforcement costs to deliver sufficient network capacity • The use of flexibility services can minimise costs through optimal use of network capacity – DSO capabilities are required to plan for and manage the future volume of flexibility • There is a clear expectation that a smarter network should not come at the expense of affordability and reliability, and that UK Power Networks is responsible to open planning to enable the best whole system solution • Stakeholders support us taking a flexibility first approach, and there is strong support for as close to real time procurement as possible for flexibility, including at low voltage	**Reducing customer bills through sector-leading DSO operations**
• Overcoming these challenges using smart solutions fundamentally requires customers (both demand and generation) to participate in flexibility. This will only be possible if we stimulate the market through transparent planning and operations • Transparency in planning, operation and markets is critical to build trust, and drive participation and market liquidity. Stakeholders believe the ring-fencing of DSO functions is a requirement to achieve this, including to effectively manage conflict	**Building trust and confidence in independent distribution system operation**

The needs of our customers, and correspondingly the capabilities and requirements of the DSO, will continually evolve between now and the end of RIIO-ED2, based on a variety of factors such as the growth in DER and LCTs. This evolution gives rise to a set of strategic "turning points" that drive the need for the DSO services we need to provide to customers, and therefore the capabilities we need to develop to deliver them.

Figure 15 sets out the turning points that are driving our capability development roadmap.

Figure 14: DSO "turning points"

What is driving the need?	What are the turning points?	How does the DSO need to respond?	When is this needed?
Rapid growth in connected DG and DER	• We anticipate significant growth in load and connections volumes as customers seek to deliver decarbonisation ambitions • There will be a point at which the DSO must maximise the use of non-network solutions to accommo date this growth at least cost	• Establish a transparent marketplace and network development process to build trust, and drive market participation	• From the start of RIIO-ED2, to stimulate the market ahead of forecast demand increases
	• There may be a point at which network constraints hold back DG connections in some areas due to Distribution or Transmission network constraints	• Enable secondary trading of access rights, to maximise the use of available capacity • Expand ESO-DSO coordination via Regional Development Programme	• Plan for the start of RIIO-ED2, in line with forecast DG volumes
Rapid growth in the volume of flexibility service providers and assets registered	• Our current dispatch and settlement processes are not automated, and will not cope with the forecast volume increase • There will be a point at which customer service may be impacted, and our cost-to-serve may outweigh the value of the services provided	• Establish an automated market platform and dispatch and settlement process, to cope with increased transaction volumes, and to keep cost-to-serve low	• From the start of RIIO-ED2, as this is already becoming a challenge at today's volumes
	• As the system becomes more dynamic, it will become less efficient to "lock in" services ahead of time, as needs, or the price of offered services, may change • There will be a point at which the cost of flexibility will become limited by our ability to respond dynamically	• Progress to closer to real-time market and network operations to reduce cost of flexibility over time	• From the middle of RIIO-ED2, embedding the capability ahead of higher volume operations at the end of the period
Growth in flexibility service providers who need closer to real-time options	• Some DER (such as storage) prefer not to commit their flexibility ahead of time, as this can restrict them from optimising the value of their flexibility across markets • We will begin to limit the ability of DER to participate in DSO flexibility services if we do not provide closer to real-time markets, reducing liquidity, and limiting our ability to reduce the cost of flexibility	• Progress to closer to real-time market and network operations to enable a broader range of flexibility providers to participate	• Start now in order to deliver complex capabilities by the middle of RIIO-ED2, the volume of providers with these needs will increase in this timeframe
Facilitating whole system access to flexibility and ESO coordination	• The DSO must facilitate access for SOs to flexibility services connected to our network – forecast to grow from 38% of available flexibility resources today to 45% by 2040 • DER within ANM zones are excluded from ESO markets; equally DG and storage connected under flexible connections can have limited scope to participate in ESO markets – worth around £1bn annually • There will be a point at which we may hold back investment in DER provision	• Expand ESO-DSO coordination via Regional Development Programme • Dynamic system coordination schemes to reduce curtailment and enable customers with flexible connections to have greater access to ESO markets	• Start now in order to deliver complex capabilities by the middle of RIIO-ED2 • Ensure maturity by the end of ED2 due to increase in distribution-connected flexibility
Ability to harness the value of growth in LV flexibility	• We are seeing significant growth in low carbon technologies (e.g. electric vehicles and heat pumps) connecting to our LV network – this will continue strongly in ED2 • There will be a point at which this will begin to drive significant reinforcement needs if we cannot gain access to the flexibility of customers and their assets at the LV level • In addition, if we cannot facilitate access for these customers to wider markets, we may hold back investment in LV flexibility	• Invest in LV visibility to enable LV flexibility • Develop flexibility products that incentivise LV customer propositions • Build market and network operations efficient enough to leverage high volume (and low value) LV flexibility services	• Mature capabilities for procurement and dispatch for the end of RIIO-ED2, in line with forecast volumes at LV levels

The evolution of these turning point give rise to three phases to our DSO roadmap – to establish the transparent DSO market; embedding real-time operations; and then expanding our reach into high volume LV flexibility. Figure 16 illustrates these phases, and the key DSO services that we will deliver at each stage.

Figure 15: Defining the DSO service roadmap

3 Our DSO strategy and proposals for RIIO-ED2

3.1 Our commitments under the four pillars of our DSO strategy

In our business plan document, we provide a summary of our DSO strategy and proposals, and set out our 8 DSO commitments under four key "pillars".

In this stakeholder summary document, we will explain the rationale that has shaped our strategy, and describe how our DSO will function, and the outputs and outcomes it will create. We also set out the performance metrics that we are proposing to provide clarity and transparency on each area of activity and enable our stakeholders to hold us to account.

Our strategy and proposals are set out under four key sections:

- **Building trust through transparency;**
- **Role 1: Planning & Network Development;**
- **Role 2: Network Operation; and,**
- **Role 3: Market Development.**

Figure 17 below sets out our 8 DSO commitments that are introduced in our business plan document, illustrating how they align to Ofgem's proposed DSO roles, and whether we believe our proposals meet or exceed Ofgem's baseline expectations.

Figure 16: How our strategy and commitments deliver against Ofgem's baseline expectations for each DSO role

The pillars of our strategy	Our commitments	Alignment with Ofgem's DSO role expectations		
		Role 1	Role 2	Role 3
1. Building trust and confidence in independent distribution system operation	**DSO1:** We will build trust and confidence by establishing a legally separate DSO business unit by 2023, creating an independent DSO Supervisory Board, and through our annual DSO forward plan of action. We will measure our compliance against the DSO:DNO Operational Agreement, targeting 100% compliance during RIIO-ED2 and reporting on this annually for transparency.	Exceed	Exceed	Exceed
	DSO2: We will deliver operational transparency by publishing our day-ahead operational plan and schedule of flexibility services and curtailment, and a monthly control room dispatch decision report from the start of RIIO-ED2.		Exceed	
2. Reducing customer bills through sector-leading DSO operations	**DSO3:** Our DSO function will deliver up to a £410m reduction in load related expenditure during RIIO-ED2 through increased competition and use of LV flexibility, including at the domestic level.	Exceed		
	DSO4: We will keep our costs down by taking a "flexibility and energy efficiency first" approach over RIIO-ED2 and will "market test" all network needs before considering reinforcement. These needs will be procured through a range of long-term and short-term markets and products, which are inclusive by design and ensure no customer is left behind in the energy transition.			Exceed
	DSO5: We will collect real time data through monitoring in all LV networks where we are forecasting constraints over RIIO-ED2 and will target 100% coverage of the rest of the network through advanced analytics using smart meter data. This will give us better insight to run the network at higher utilisation and to defer reinforcement actions for as long as possible.	Exceed		
	DSO6: We will develop a new DSO stakeholder satisfaction survey. Once we establish a baseline at the start of RIIO-ED2 we commit to improving our score by at least 10% over the period and publishing an annual DSO forward plan that will explain how we are responding to stakeholders' priorities.	Meet	Meet	Meet
3. Providing timely and affordable access to our network by accelerating the connection process	**DSO7:** We will offer a range of firm and flexible connection products, from lowest cost through to highest access, with a maximum curtailment commitment from the start of RIIO-ED2, and will annually update our products based on stakeholder feedback			Exceed

4. Helping our customers play their part in Net Zero and supporting innovation in energy services	**DSO8:** We will be the UK's leading DSO in network data provision through a best practice service that opens data according to user priorities and customer value-add. Our ability to meet users' data needs will be measured as part of an annual stakeholder survey from the start of RIIO-ED2.	**Meet**	**Meet**	**Meet**

Our DSO will be our main delivery vehicle for our Whole Systems Strategy, which is set out in Appendix 19a to our business plan. Figure 18 summarises the key actions within the Whole Systems Strategy that the DSO will support.

Figure 17: Actions that our DSO will support in our Whole Systems Strategy for Facilitating Net Zero at Lowest Cost

#	Whole Electricity	Role 1	Role 2	Role 3
1	We will expand the geographic area of our South East Regional Development Programme (RDP) in RIIO-ED2 and deliver an RDP in East Anglia by 2024, as agreed with the ESO. We will unlock up to £130m of whole system benefits during RIIO-ED2.	✓	✓	
2	We will work with the ESO to expand the Power Potential trial to be a business-as-usual offering across our EPN and SPN regions by 2028. This will be a world-first large scale rollout of a whole system reactive power management solution.	✓	✓	
3	Over RIIO-ED2 we will deliver 1GW of DER capacity at no more than £8m, using smart interventions and new innovations, reporting progress in our annual business plan.	✓		
4	We will make our connections process faster and easier for our residential customers connecting low carbon technologies. We aim to instantaneously process 80% of general enquiries (GE) supply upgrades via self-service offerings, delivering a 9/10 experience over RIIO-ED2.			
5	For each year of RIIO-ED2, we will develop high quality marketing information which can be used by third party intermediaries, to encourage an increase in customer use of low carbon technologies, unlocking greater participation in flexibility markets.			✓
6	We will develop an energy efficiency flexibility product, running tenders every 6 months, starting in 2023.			✓
	Whole Transport			
7	We will assess and if necessary upgrade supplies for 728,000 homes free of charge to accommodate connecting LCT's by coordinating with installers.			
8	We will create an additional 248MW of LV network capacity to unlock LCT related demand across our networks.	✓		
9	We will reduce street-works costs and transport disruptions in London by collaborating with other statutory bodies on at least 40 collaboration projects in RIIO-ED2.			
10	We will use well-defined uncertainty mechanisms to prepare for a possible accelerated LCT uptake by ensuring capacity is released in a timely manner, facilitating an additional 847MW of LV capacity for LCT uptake, and supporting an additional 1.1m homes connecting an LCT.	✓		

11	We will run a process to identify and address market failures with respect to the provision of on-street charging, unlocking over 2,400 public charge points in areas of market failure by the end of RIIO-ED2.	✓		
12	We will run a process to identify and deliver an additional 7-8MW of capacity in areas located near 14 motorway and trunk road service stations, by running a call to market in 2024 and 2025, ensuring a maximum of 30 miles between charging across our regions.	✓		
	Whole Heat			
13	By 2028 we will proactively provide LCT and energy efficiency information to 1,4m of our customers located within zones earmarked for electrified heating.			✓
14	We will ensure that 71% of off-gas grid homes in our regions have the suitable capacity to decarbonise their heating and transport by the end of RIIO-ED2.	✓		
	Whole System Planning			
15	We will engage with all 127 regional and local planning authorities on their climate plans each year of RIIO-ED2, offering a three-tiered support service utilising a framework to assess, develop action plans and deliver investments where a prescribed level of certainty is achieved in period.	✓		
16	By 2024, we will provide core planning datasets via an on-line self-service energy planning tool to support the planning process for our local authorities, helping them make the best choices for their communities.	✓		
17	We will provide proactive services to our DER by expanding our digital outage planning and automatic restoration tools, to minimise disruption and maximise their system access throughout RIIO-ED2.		✓	
18	We will embed a requirement to have explicitly considered whole system solutions as part of our investment planning and investment governance by the start of RIIO-ED2.	✓		

3.2 Building trust through transparency

3.2.1 A stakeholder summary of our proposals

Establishing the DSO as a neutral system planner and market facilitator

The experience from RIIO-ED1 points to distribution networks that appear to be spending or over-investing when it is not needed. An example of this is where DNOs have invested heavily on the secondary networks whilst only a fraction of low carbon technology forecasts materialised. Such actions create distrust towards the DNOs and raise concerns that the DNOs do not always look for the best outcome for all, but for the best outcome for their shareholders.

Separating out the DSO role from the DNO is complex, but critical for demonstrating transparency and ensuring a whole system approach to delivering Net Zero.

The required outcomes centre on facilitating whole system solutions, delivering efficient system access, optimising the use of flexibility, and most importantly keeping the lights on using all available resources. The pace and scale of change on our networks is requiring us to rapidly expand our DSO capabilities to avoid being a blocker to the energy transition.

Going forward, the use of flexibility on distribution networks can help to avoid the significant levels of expenditure associated with building a network to cater for the maximum peak demand (or export) created by new low carbon technologies. This has led to calls by industry for DNOs to focus on utilising the existing network as much as possible by operating flexibility markets. Nevertheless, as stressed by the Committee on Climate Change and in the recent report from the Carbon Trust and Imperial College (Flexibility in Great Britain[13]), targeted investment in network upgrades will also have a critical role in meeting long-term needs, and has wider benefits in ensuring that there is sufficient network capacity to get large volumes of low cost zero carbon electricity to customers able to consume or store it when it is most abundant.

Some commentators believe that the only way of achieving optimal decisions is to have full ownership separation between network and system operation, because otherwise conflicts of interest will result in a capital bias and waste the flexibility resource. However, the feasibility, costs, and incremental benefits of full ownership separation (over and above the legal separation we are proposing) are unclear, and risks cost duplication with little additional benefits in terms of transparency.

Our plans for a legally separate DSO within UK Power Networks acknowledge the responsibility we have to remove conflicts of interest, whether perceived or real, in order to build confidence in our approach to planning and operating the system, and in developing flexibility markets. By becoming a trusted system planner and market facilitator, we aim to create a virtuous cycle between flexibility providers and us, which increases liquidity in flexibility markets and ultimately delivers decarbonisation at lowest cost for our customers and wider society.

> ***The Committee on Climate Change (6th Carbon Budget)***
>
> *"It is important that grid capacity constraints do not impede growth of electric vehicle deployment in the 2020s, given the emissions savings and cost savings they will bring. It will therefore be important to make anticipatory investments to upgrade electricity networks"*

> ***OVO (Response to Ofgem's RIIO-ED2 consultation)***
>
> *"DNOs should be rewarded for making better use of the existing network, rather than building new infrastructure. One mechanism to achieve this is to make the ratio between maximum capacity and the average load on a network a primary metric for adjusting network company revenues"*

Establishing a legally separate DSO

The DSO will be responsible for nurturing an approach to whole system planning, and operating a market for flexibility and access products that can significantly reduce the cost of delivering electricity network capacity. Stakeholders' trust in the independence of the DSO will be a significant factor in its success.

At present, our DSO-related activities are conducted from several areas in our business. This approach has served us well to date, enabling a clear focus internally for innovation in flexibility services and new connection products, whilst also gaining good feedback from stakeholders, customers, and flexibility service providers. However, in development of our DSO Strategy for RIIO-ED2 we have undertaken further extensive stakeholder engagement and worked through an operating model design process. Our conclusion from undertaking this work is that there are several challenges in continuing with the current model in which DSO functionality is embedded in the DNO business.

Whilst transparency delivered through clear processes and data publication will go some way to providing confidence, it will not address the perceived conflict of interest inherent in any model in which the DSO is ultimately governed by the DNO. It will also result in Directors who hold accountabilities for both DSO and DNO outcomes, leading to reduced transparency in decision making, and potentially raising questions over how the best outcomes for customers have been achieved if all decision makers in the process have dual responsibilities.

[13] https://publications.carbontrust.com/flex-gb/analysis/

Our experience pushing ahead with our DSO development has shown us that delivering a fully-fledged DSO operation will be a transformative change challenge, and we believe that any model based on incremental evolution 'in the line' will not create the focus, commercial mind-set, customer centricity, and step change in ambition required to succeed. **It will also fail to confront instances where processes are not clear and grey areas in decision making exist.**

Having considered the costs and benefits of a range of operating model options, and informed our thinking through a rigorous design process, we have concluded that to be successful a DSO must be established **at least as a fully ring-fenced entity**. Given that stakeholders are telling us that delivering transparency is critical to achieving the benefits of the DSO, it is clear that **the minimal incremental costs of legal separation are both warranted and appropriate, and the feedback we have received since the publication of our July submission has reinforced this view.**

Developing a clear DSO operating model design has also allowed us to fully explore the most appropriate division of responsibility between the DSO and DNO, and identify the key process hand-off points between the two entities, as well as areas where a potential loss of synergy in decision making and resourcing is needed to ensure transparency and the management of conflicts of interest.

We are therefore setting out what we believe to be the UK's first clearly defined operating model of how a legally separated DSO could work in the best interests of customers. Our intention is to establish this for the start of RIIO-ED2. **Accordingly, we characterise our plans in terms of "the DSO" and "the DNO", their relative accountabilities, and the processes and hand-offs between them**.

Our DSO will mimic the ESO in that it will similarly run an open network planning and development process, develop new products and services that promote efficient real-time markets, oversee transparent network operation, and will be accountable for system costs.

This clear separation between DSO and DNO business units **significantly exceeds Ofgem's baseline expectations for transparency**. We believe this will address any conflicts of interest concerns, and greatly aid transparency, which our customers are saying is vitally important. It will ensure that DSO will take a whole system perspective, and be at the heart of driving the push towards Net Aero, at the lowest possible cost for all energy consumers.

Our operating model for the beginning of RIIO-ED2 is based on the following key foundational actions:

1. Key organisational changes to create an agile, transparent, DSO business unit within UK Power Networks on day 1 of RIIO-ED2 with clear accountabilities, **set-up as a separate legal entity within UK Power Networks Group** with appropriate governance and controls.
2. Development and publication of a **DSO:DNO Operational Agreement** (modelled on the SO-TO Code) setting out key interactions, and encompassing our transparent process across all roles and how they are governed.
3. **An independent DSO Supervisory Board,** which will provide assurance of our compliance with the DSO:DNO Operational Agreement, represent the views of our customers and stakeholders, and ensure that customers get the best-value solutions. The independent DSO Supervisory Board will review and approve key DSO investment decisions to provide extra assurance that the best-value solutions for all customers are taken forward.

We will bring all aspects of working with our customers, stakeholders and peers in planning and operating the efficient, low carbon distribution systems of the future – forecasting, strategic planning, product development, regional and local area planning – under the DSO umbrella.

This separation has enabled us to develop a clear strategy across all DSO roles, with clear accountabilities for the DSO and DNO – for instance in how decisions are made for network development (with the DSO accountable for cost of network expansion, and the DNO accountable for reliability and delivery efficiency), how flexibility service dispatch decisions are made in operational timeframes, and how Distribution Market Operations functions can be carried out via a partnership with a third party platform provider.

Transparency of performance and benefits

Our customers have told us the importance of ensuring the DSO transition delivers tangible customer benefits, and expect us to develop a clear set of metrics to measure our progress. We will also report specific metrics that measure our performance against each of our commitments, as well as wider relevant and regularly reported metrics. Our proposals for these metrics and are set out in the following sections.

Alongside operational measures, such as the extent of network monitoring or the provision of network data to stakeholders, our engagement showed the importance of being transparent on our progress in delivering for our customers. We have therefore committed to developing an annual DSO forward plan, and a stakeholder satisfaction measure focused on the performance of the DSO function.

Delivering transparency through open data publication

Our customers and stakeholders are telling us that they want access to as much data as we can possibly share with them. UK Power Networks want to be recognised as the driving force enabling the market to develop the tools they want, by providing the data required to support their development.

This year we have launched our DSO Dashboard[14] on our website, providing detailed, real-time data on multiple parts of our network. It was developed using the open-source platform Grafana, following best-in-class industry methods to ensure we can evolve the dashboard in the most efficient way possible. We will progressively expand the dashboard, adding more data streams and features based on user feedback. We have continuously worked to improve the quality and transparency of our open data in RIIO-ED1 and will continue to further improve our data publication standards throughout RIIO-ED2.

Stakeholders told us that they want open, accessible, and accurate information, and as much of it as possible, proactively shared in the formats they want. This includes planning data (e.g. to enable customers to plan when and where to apply to connect to the network); operational data (e.g. to facilitate whole system coordination with the ESO); and market data (e.g. to provide clarity on the value of services in given locations on the network). In sections 3.3.2, 3.4.2 and 3.5.2 we provide a detailed list of the data items we intend to publish to support each DSO role.

Within our Data best practice strategy (Appendix 17b), we set out the foundational investments we are planning to deliver to ensure reliable, accessible, and interoperable data for our targeted smart-grid capabilities. Core to this is the development of a cloud-based data infrastructure to facilitate the development of a highly curated Enterprise Data Model and corresponding CIM based Unified Network Model to deliver standardised, interoperable network data. Our Digitalisation strategy (Appendix 17a) will also support our DSO in improving the way that we share data, whilst also ensuring that we achieve international best practice standards. This strategy focuses on facilitating open data, in line with the recommendations of the Energy Data Taskforce, by providing easy access to robust and interoperable data for our stakeholders and customers.

3.2.2 Our proposed commitments and metrics for delivering transparency

We believe that establishing a legally separate DSO will foster confidence in our decision making, thus stimulating greater engagement and competition, and the clear accountabilities and incentives on individuals will lead us to maximise the benefits of our investments in DSO capabilities. We are therefore making the following commitment

Commitment DSO1: We will build trust and confidence by establishing a legally separate DSO business unit by 2023, creating an independent DSO Supervisory Board, and through our annual DSO forward plan of action. We will measure our compliance against the DSO:DNO Operational Agreement, targeting 100% compliance during RIIO-ED2 and reporting on this annually for transparency.

Table 1 summarises the proposed performance measures to support this commitment.

Table 1: Summary of proposed performance measures for DSO1

Performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Compliance with the DSO:DNO Operational Agreement	Exceeds	n/a - output exceeds baseline expectations	Annual independent audit	Zero major non-compliance issues in annual report

We also commit to capturing and improving against a stakeholder satisfaction score to deliver transparency of our progress toward developing a DSO that delivers for customers and stakeholders:

Commitment DSO6: We will develop a new DSO stakeholder satisfaction survey. Once we establish a baseline at the start of RIIO-ED2 we commit to improving our score by at least 10% over the period and publishing an annual DSO forward plan that will explain how we are responding to stakeholders' priorities.

[14] https://innovation.ukpowernetworks.co.uk/open-data/?tab=4

Table 2 summarises the proposed performance measures to support this commitment.

Table 2: Summary of proposed performance measures for DSO6

Performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Overall stakeholder satisfaction with our DSO forward plan and progress	Meets	Customer satisfaction score (across multiple areas of DSO) Once a baseline is set at the start of RIIO-ED2 we commit to improving this score by 10% through the period	Annual Stakeholder Satisfaction Survey	n/a – this output is a baseline requirement

Finally, we will also commit to support the delivery of transparency through open data publication:

Commitment DSO8: We will be the UK's leading DSO in network data provision through a best practice service that opens data according to user priorities and customer value-add. Our ability to meet users' data needs will be measured as part of an annual stakeholder survey from the start of RIIO-ED2.

Table 3 summarises the proposed performance measures to support this commitment.

Table 3: Summary of proposed performance measures for DSO8

Performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Data customer satisfaction score (captured via the stakeholder satisfaction survey)	Meets	Customer satisfaction score - data publication Once a baseline is set at the start of RIIO-ED2 we commit to improving this score by 10% through the period	Annual Stakeholder Satisfaction Survey	n/a – this output is a baseline requirement

3.3 Role 1: Planning & Network Development

3.3.1 How our proposals for Role 1 deliver against Ofgem's expectations

Ofgem's proposed headline activity for Role 1 is to "Plan efficiently in the context of uncertainty, taking account of whole system outcomes, and promote planning data availability".

The baseline expectations focus on:

- Enhancing forecasting, simulation and network modelling capabilities, investing in monitoring equipment where valuable, and exploring the use of data from third parties.
- Having in place standard and effective processes for sharing a comprehensive range of network planning information to meet the needs of stakeholders and customers.
- Having in place transparent and robust processes for identifying and assessing options to resolve network needs, optioneering across flexibility and whole system options.

In RIIO-ED1 we have made significant progress in building foundational DSO capabilities that will support Role 1:

- We have driven extensive innovation and investments to expand our network visibility and monitoring capabilities, with a specific focus on the LV network.
- We were one of the first DNOs in the UK to be able to gain access to aggregated half-hourly consumption data from smart meters with our Smart Meter Data Privacy Plan, approved by Ofgem in February 2020.
- In 2017 we were the first UK DNO to tender for flexibility in the open market, and since then we have market-tested c. £300m of load related capex, translating into £70m of flexibility revenue potential that we have made available to participants for the RIIO-ED1 period, and awarded more than £45m of flexibility through to 2028.
- To date there is now over 4.2GW of accepted flexible connection capacity in UK Power Networks' areas.
- We have developed a set of Distribution Future Energy Scenarios (DFES), describing the evolution of demand and generation across our licence areas out to 2050, and invested in our Strategic Forecasting System providing detailed forecast scenarios at the LV level.
- We were the first GB DNO to embark on a Regional Development Programme (RDP) with the ESO and have co-developed enhancements to the way in which we share and use data across the distribution / transmission boundaries.
- We have published a DSO Dashboard[15] on our website, providing detailed, real-time data on our network.

Our proposals build on our strong foundations and investments delivered in RIIO-ED1 and put forward a comprehensive range of deliverables that will meet these needs, and in some areas go further.

As set out in section 3.2, we will be establishing a legally separate DSO, which will enable us to over-deliver on the need for transparency through the investment planning process in Role 1. As we set out below, our approach to investment planning will be exceeding expectations by empowering the DSO to make investment decisions. The DSO will be responsible for networks options analysis and deciding between networks and non-networks solutions for creating additional capacity on the network. This will enable a clear separation of accountability for cost for network expansion (in the DSO) and reliability and delivery efficiency (in the DNO), thus creating a tension to reveal the trade-off between cost and reliability.

Our DSO's core role is to open new markets to competion to deliver best value for consumers. This is not limited to expanding flexibility services but we are now also proposing to extend it to competition in network asset build. We are setting out a DNO-first commitment to tender over £100m of load-related needs (15 major schemes), and any connections driven reinforcement above £10m in value, over the RIIO-ED2 period. We expect to reduce this materiality threshold over time.

We will also be establishing a Distribution System Operability Framework (DSOF) as a core part of our planning outputs, to enable greater visibility of our service needs to customers and stakeholders, thus stimulating investment in future services.

Finally, we will establish a Local Area Energy Planning team to engage with all 127 of the Local and Regional Planning Authorities in our areas through RIIO-ED2 and support them in developing the clarity and confidence required to incorporate their proposals for delivering Net Zero into our investment plan.

3.3.2 A stakeholder summary of our proposals for Role 1

In this section we set out a stakeholder summary of our proposals for:

- Delivering enhanced network visibility;
- Developing enhanced forecasting, simulation and network modelling capabilities;
- Processes for sharing network planning information; and,
- Delivering a transparent network development process, including the introduction processes for identifying and assessing options to resolve network needs, and competition in delivery of distribution network infrastructure.

[15] https://innovation.ukpowernetworks.co.uk/open-data/?tab=4

Delivering enhanced network visibility

Electricity networks are required to build new network visibility and monitoring capabilities at the LV network level, and evolve existing capabilities at the primary and grid network level, to support an increasingly intelligent network that supports flexible demand and generation.

The main drivers for investing in network visibility and monitoring are uncertainty in the magnitude, timing and location of DER uptake, and to facilitate the delivery and operation of distribution flexibility services. This is particularly relevant considering the expected clustering effect in high LCT uptake areas, where there is a risk that our forecast scenarios are surpassed, and a rapid increase in DERs will challenge our ability to deliver an optimal programme of investment to ready the network. Given the limited level of LV network visibility today, there is a pressing need to invest in network visibility and monitoring to enable us to respond rapidly to any divergence from our forecasts.

We have undertaken extensive innovation during RIIO-ED1 to expand our network visibility and monitoring capabilities, with a specific focus on the LV network, and are investing £15m during RIIO-ED1. We have successfully demonstrated a range of solutions for increasing data capture at the EHV, HV and LV network level, alongside automation and control, to inform our proposed options for RIIO-ED2.

Hardware-based monitoring requires significant investment, and therefore investments should be prioritised in constrained areas of the network, such as areas in which we are forecasting the highest EV uptake, to proactively prepare the network to be ready for the Net Zero transition. Consequently, there is a need to undertake least regret activity to broaden network visibility capabilities using alternative means to physical monitoring to achieve visibility across the networks faster and cheaper.

Going forward, we will need to expand network visibility and monitoring capabilities across our regions, and pull on a smart toolkit that includes a range of solutions – not only monitoring devices, but also software-based network visibility, smart meter data, and data from third parties such as EV smart chargers and grid edge devices. Our aim for RIIO-ED2 is to ensure that we have full visibility of both the EHV and HV networks, and a proportionate cross-section of our LV network.

Our vision is to use a smart toolbox to drive and achieve LV network visibility and monitoring, and our strategy is based on two key principles:

Innovation informing our DSO strategy - Project Envision

Project overview

Our innovation project Envision is split into two focus areas:

- Developing and trialling a software-based, machine learning tool to enhance visibility and unlock fresh insights into demand on our network so we can continue to facilitate Net Zero. Using the tool will significantly lower costs and produce results sooner.
- Exploring what third party data is available by speaking to those who hold the data. This could include data from distributed energy resources (DER), those who install electric vehicle charging points, local heat networks and community energy schemes. The information collected will help us understand if and how new datasets could improve network visibility

How the project will inform our strategy

Findings from the project will help inform how data can be used to model our visibility of the LV network and will support our strategy of adopting a data first approach to network visibility.

1. **Taking a data-first approach:** maximising the use of data to achieve network visibility faster and cheaper – data we are already measuring on the network, data collected from smart meters, and wider third-party data – utilising frontier data analytics methods to gain low voltage network insights faster and cheaper compared to traditional methods of physical monitoring; and,
2. **Deploying physical monitoring economically and efficiently:** utilising real time physical monitoring where we forecast distribution constraints, or where we are actively managing the network through flexibility services and smart connections (e.g. time profiled connections).

Under our proposals, by the end of RIIO-ED2, 30% of UK Power Networks' low voltage underground network will be monitored in real-time, and we will have visibility of modelled demand across 100% of the underground and overhead networks through predictive analytics. Our approach is designed to stay ahead of the LCT growth curve by embedding the processes, culture, digital skills, capabilities, and tools that DSOs need to make best use of data.

Developing enhanced forecasting, simulation, and network modelling capabilities

Identifying system needs relies on the ability to deliver suitable short- to long-term forecasts, and model uncertainties that reflect the effects of multiple technology drivers. To model the uncertainties in the pathway to a Net Zero economy, we have developed a set of Distribution Future Energy Scenarios (DFES) describing the evolution of demand and generation across our licence areas out to 2050. The scenarios produced seek to encompass the range of potential outcomes for a broad range of the key drivers of demand and generation on the networks over the period.

In February 2020 we published our first DFES, including bespoke forecasts for over 40 key technologies and drivers. All the data was made publicly available via our Open Data Portal. As part of the Open Networks Project, all DNOs agreed to

standardise their DFES on a single set of scenario frameworks based on the National Grid ESO Future Energy Scenarios[16]. A key benefit of this is to ensure that all companies present the information in a common framework for stakeholders. UK Power Networks published updated DFES in December 2020[17] that were based on this agreed framework.

Throughout RIIO-ED2 we will work to keep these scenarios up to date and supplement the DFES with enhanced projections and modelling capabilities. We have already made significant investments in our forecasting and modelling capabilities through RIIO-ED1, and throughout RIIO-ED2 will look to further enhance these capabilities by adopting a programme of continuous stakeholder engagement, aligning with government policies, and by considering the impacts of emerging technologies and changes in customer behaviours. We will also augment our models by improving their accuracy, granularity and by using new data sets and advanced probabilistic modelling techniques. This may include, for example, forecasting customer response to price signals, and updating diversification assumptions as demand becomes more sensitive to price.

Another key investment during RIIO-ED1 has been the development of our Strategic Forecasting System (SFS) that uses datasets such as population growth, building growth, economic growth, low carbon technology trends, and historical load data to inform long-term network needs. The SFS takes inputs from the DFES and combines them with historic network data to generate a range of outputs to supplement our Grid Code data exchange requirements, and to inform the creation of our Regional Development Plans, Long Term Development Statement (LTDS) and Network Development Plan (NDP).

SFS gives us a view of demand and generation impacts across the full range of voltages. There is a need now more than ever to better understand network utilisation, not only at primary level networks but also on secondary networks where the impact of LCTs such as EVs and heat pumps will be seen. The SFS provides this view, and with increasing network visibility will allow us to more accurately forecast when interventions will be needed, allowing us to maximise the utilisation of existing networks.

Becoming a DSO will require us to develop enhanced forecasting, simulation, and network modelling capabilities, as we seek to find ways of accommodating LCTs within increasingly constrained networks. The future needs for network modelling include an improved ability to model the behaviour of DER and the impact of flexibility service options on network constraints; extending the reach of modelling across voltages, constraint types and DSO:DSO and DSO:ESO boundaries; and enhanced dynamic and scenario-based modelling techniques.

During RIIO-ED2, we will continue to extend network modelling and analysis packages where appropriate, and will modernise existing data management and analytical capabilities. Where existing packages are unable to meet future requirements, we will either go to the market for new network modelling packages or will develop in-house tools.

Processes for sharing network planning data

UK Power Networks has been on a journey of digitalisation since 2015. Since then, we have continuously engaged with our regulator and stakeholders across the board to ensure an open flow of communication. In June 2019 the Energy Data Taskforce (EDTF), jointly commissioned by Government, Ofgem and Innovate UK, set out five key recommendations to modernise the UK's energy system and drive towards a Net Zero carbon future. To build such a system we are making our operational data open and freely available to create a collaborative industry hub. In October 2021, our Open Data portal went live, making our data accessible in line with EDTF's recommendations. This is a key foundational capability for our DSO journey that we will build on in RIIO-ED2 and it is detailed in our Data and Digitalisation Strategy.

We understand from our stakeholder feedback the importance of providing forward visibility of available capacity on the network and likely future needs for distribution flexibility services. Through our Strategic Load Forecasting project, the DFES process, and roll out of network monitoring and smart meters our ability to forecast future system needs will improve considerably. This will help us to provide the greater visibility that our customers are looking for. In turn, this will allow us to improve the utilisation of our networks and increase participation in distribution flexibility services markets driving down flexibility procurement costs. Therefore, we are strongly incentivised to maximise information provision.

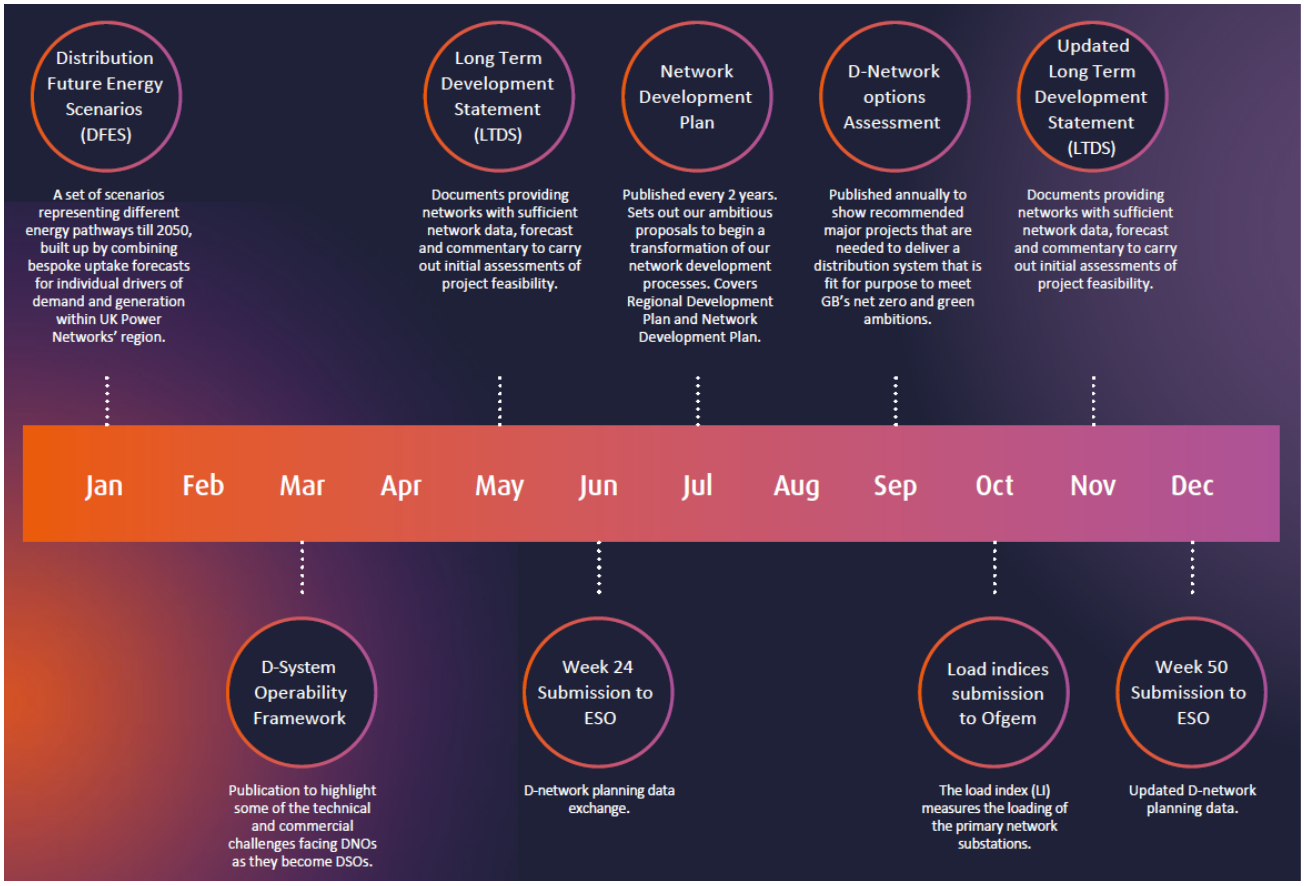
We will develop our SFS so that stakeholders can gain interactive access to forecast data to inform their plans, and to ensure that future licence conditions relating to publication of forecast data are complied with. The use of a single platform to generate this data will ensure a level of consistency and accuracy that will give confidence to its users. Access to this data will also support our Local Authority stakeholders when deriving their local area energy plans. We see this as a key area for collaboration and signalling where investment or market-based approaches are needed.

Publishing operational data and outputs of the periodic assessments of system needs is key to signalling to market participants where there are revenue opportunities to help resolve system constraints. Later in this section we set out our approach for identifying and assessing network needs, which will give rise to a variety of planning outputs that will be published, alongside network data. Figure 19 below gives a time-based view of these publications.

[16] Further details on the National Grid Future Energy Scenarios frameworks can be found here: https://www.nationalgrideso.com/document/173801/download

[17] https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2021/01/2020-DFES-Report-Final-January-21.pdf

Figure 18: How we will share planning data through RIIO-ED2



We have recently published a DSO Dashboard[18], which provides detailed, real-time data on multiple parts of our network. It is currently launched in beta mode as we seek customers/stakeholders to co-create the future of the dashboard with us. The DSO dashboard shows live data on each part of our network listed by Grid Supply Point (GSP). It was developed using the open source platform Grafana. Using an open source approach follows best-in-class data industry methods and means we can build the dashboard in the most efficient way possible.

Figure 19: DSO dashboard

[18] https://innovation.ukpowernetworks.co.uk/open-data/?tab=4

The dashboard displays:

- Volumes of active and reactive power at each GSP and the trends over time.
- How much power is flowing through UK Power Networks transformers as the power moves from high to lower voltage and into customers' homes and businesses.
- All power generators connected to the network and how much power they are producing at any one time.

Having data such as network topology, heat maps, and capacity information is helpful for our customers, as it gives them an opportunity to carry out assessments before making connection applications, which in turn enables us to have a leaner team that is more efficient in dealing with requests and providing better service to the customer.

We are also cognisant, however, that we have a broad customer base, and it will not be a case of a 'one size fits all' approach. We will therefore continue to evolve our existing interactive mapping tools to deliver the range of functionality required by our stakeholders. This is, and will continue to be, an iterative process, driven by the feedback received from our targeted regular customer engagement forums. Whilst currently the DSO Dashboard provides a wealth of static data (network capacity, asset, DER and estimated curtailment data), further enhancements will be made to allow customers to view and download historic operational and monitoring data to further inform their investment proposals. Although access to the mapping tool is currently given via our website, further work will be undertaken in RIIO-ED2 to improve accessibility.

Whilst we anticipate making a significant volume of data available via the CIM format, such as LTDS, Week 24 and network topology/asset data, this will also be complimentary to publishing Regional and DNO based Network Development Plans. Working with industry we will ensure that the approach to LTDS, NDP and DFES remains consistent across DNOs and provides easy access for stakeholders through dedicated data portals. Using these industry forums, we will look to inform improvements throughout the regulatory period based on the feedback we are receiving from our stakeholders and the evolving nature of the system. Table 4 presents a view of the data items that we plan to publish in support of DSO Role 1.

Table 4: Data items that we plan to publish specific to Role 1

Item	Type	Frequency	Recipients
Network Development Plan (NDP)	Data / Report	Every 2 years	All
Distribution Future Energy Scenarios (DFES)	DSO Deliverable	Annually	All
Long Term Development Statement (LTDS)	Data	Bi-Annually	All
Regional Development Plans	DSO Deliverable	Annually	All
Flexibility Procurement Statement	DSO Deliverable	Annually	All
Statement of Works / Transmission Impact Assessment	DSO Deliverable	Ad Hoc	ESO
Distribution System Operability Framework (DSOF)	DSO Deliverable	Annually	All
Load indices Submission	Data	Annually	Ofgem
Network Capacity Heat-map	Data	Monthly	All
D-Network Planning Data (Week 24 data, Week 50 updates)	DSO Deliverable	Annually	ESO
Network State Data (DSO Dashboard)	Data	Near Real Time	All
Distributed Generation Mapping Tool	Data	Monthly	All
Distribution Network Options Assessment Publication (D-NOA)	DSO Deliverable	Annually	All

Delivering a transparent network development process

Our primary challenge in the next decade will be enabling the rapid uptake of DER to facilitate delivery of the UK's Net Zero ambitions, through maximising the use of existing capacity, wherever possible, and the timely release of additional capacity. This will need to be achieved whilst delivering network safety, security, and reliability and at best value for consumers.

Our goal for role 1 is to deliver an open, transparent, and competitive network development approach to enable this, building strong partnerships to anticipate needs and to deliver them quickly. To inform our proposals, we reviewed the National Grid ESO model, and challenged ourselves as to how far toward, or beyond, this model we should set our ambitions.

The GB transmission network planning arrangements include a top-down forecasting, planning and network option analysis process led by the ESO, with detailed network solutions designed and built by the three on-shore TOs. The ESO role in planning is to ensure efficient transmission network investment, through facilitating connection applications, identifying and publishing future transmission system needs under the Future Energy Scenarios (FES), developing the Electricity Ten Year Statement (ETYS), to identify which parts of the network are most constrained and where reinforcement would be most needed, and running the Network Options Assessment (NOA) to assess alternative solutions. The analysis provided by the ESO supports the needs cases for large strategic transmission projects which go to Ofgem for approval.

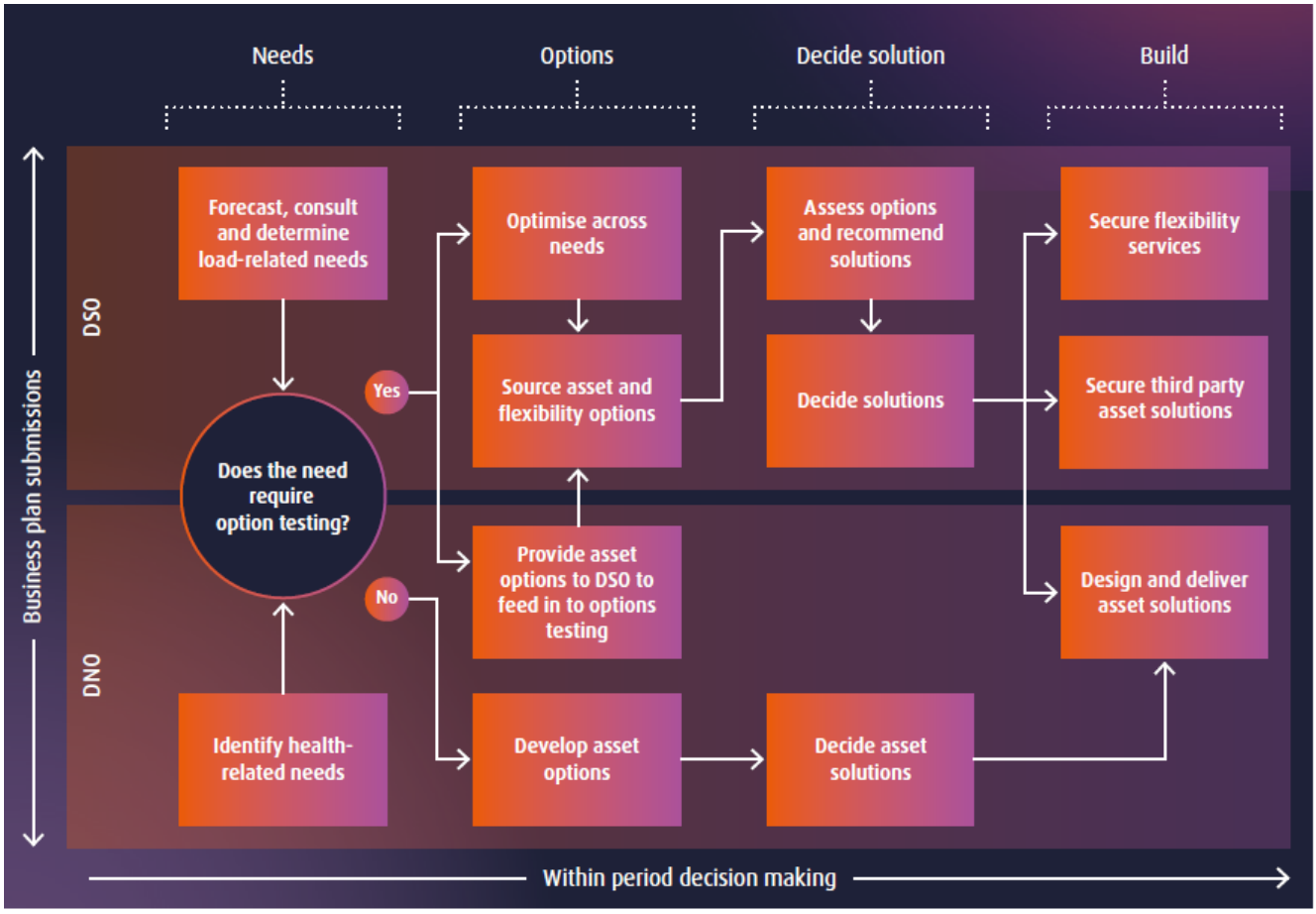
The TOs develop their investment plans to deliver baseline demand and reliability upgrades, based on industry wide planning and reliability standards set by the ESO (such as the SQSS), and to deliver load-related needs based on the strategic planning documents (i.e. FES, ETYS and NOA) from the ESO, with Ofgem's approval. During the price control period, investment plans may be reviewed in light of the ESO's annual publications.

The ESO can recommend the most economic reinforcements, whether build or alternative options[19], to deliver against load-related needs, and when they should be made, but the TOs must gain regulatory approval for load related expenditure, which for larger projects is through the Strategic Wider Works process. The ESO typically does not assess network asset replacement projects which do not increase network capability or individual customer connections. The TOs are responsible for detailed design and build of approved projects. The appropriate "hand-over" point between the ESO and TOs for optioneering and high-level design is being re-evaluated as part of the Competitively Appointed Transmission owner (CATO) regime, with both very early (pre-high-level design and option selection) and early (pre-detailed design) being considered.

Like the ESO model, we envisage a process by which the DSO provides a strategic planning role encompassing a range of system needs, with the DNO developing investment plans according to industry-wide standards and informed by the DSO planning functions. Where there is optionality, our DSO will decide on the load related network solutions to be delivered, subject to regulatory scrutiny, to provide assurance that perceived conflicts of interest are fully addressed. In our proposed approach, the DSO will take accountability for the cost of delivering network capacity (across both asset and service solutions), and the DNO will take accountability for reliability and delivery efficiency, thus creating a tension to reveal the cost trade-off between cost and reliability. To enable this, the DNO could have the right to appeal decisions made by the DSO through an internal but transparent arbitration mechanism that we will set up as part of our DSO:DNO Operational Agreement.

Figure 21 illustrates a simplified view of the process. For the business planning process that we are in now, we see the (nascent) DSO and DNO working together to submit a business plan that meets our licence obligations and delivers the best value for customers. Going forward, the DSO, through its strategic load forecasts and DFES processes, will be primarily accountable for identifying future load-related network needs, but with the DNO providing its input on an on-going basis. Health and connections-related needs will be identified by the DNO and provided to the DSO.

Figure 20: Investment Decision Process for RIIO-ED2



[19] 2020 ESO NOA publication: https://www.nationalgrideso.com/document/162356/download

Facilitating networks competition

Our approach for setting up a legally separate DSO, with independent oversight, lends itself well for the potential introduction of competition for the build of larger distribution projects. Chapter 15: Competition in our RIIO-ED2 business plan outlines our proposals to drive competition into our traditional activities to maximise cost efficiency, by offering at least £100m of RIIO-ED2 project value to a wider pool of distribution network and connections delivery service providers. We will work with stakeholders to define the detailed scope of this work which will include load-related reinforcement schemes as well as connections-driven reinforcement and diversionary programmes.

Enabling customer connections

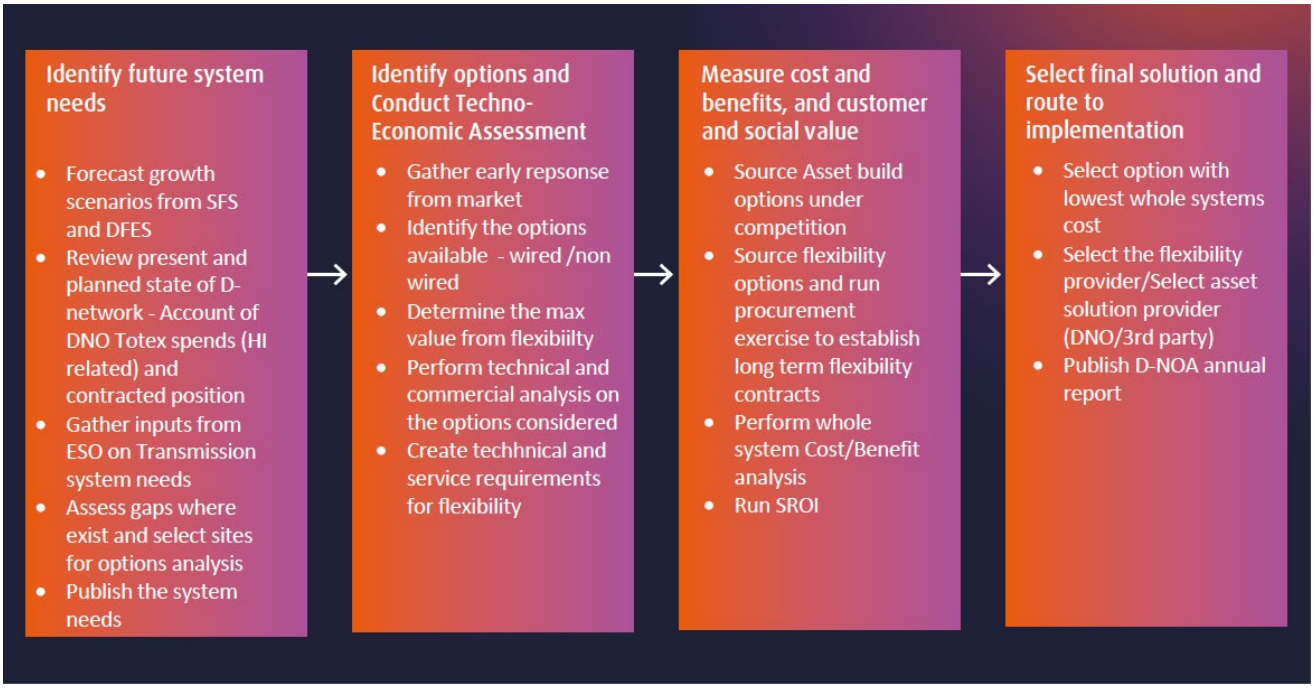
Providing timely and cost-effective customer connections is at the core of supporting decarbonisation. We believe that these activities will be best delivered if managed in close coordination between the DNO and DSO capabilities. This is a high volume (c. 65,000 connections enquiries per annum), mostly transactional activity and needs to remain tightly coordinated. The DNO will lead the customer interface and design of options to connect to the network, and wider reinforcement options where additional upstream capacity is needed to accommodate the customer.

The DSO may propose alternative solutions for the customer utilising flexibility to create some of the needed capacity, or suggesting flexible access rights that could benefit the customers. This will ensure that the use of flexibility solutions is fully integrated with the connections offering process to deliver best value for customers in the thriving connections market. Furthermore, it will accelerate the shift from reactive to proactive – rather than simply responding to connection requests on a case-by-case basis, we would look to anticipate future needs, working with a range of customers and other stakeholders to identify common solutions, where we can identify opportunities for cost savings through synergies.

Our processes for identifying and assessing options to resolve network needs

Our over-arching approach to delivering a transparent network development process will form the basis for our proposed approach to undertaking the Distribution Network Options Assessment (DNOA) process, which is illustrated in Figure 22.

Figure 21: Our process for identifying and assessing options to resolve network needs



As highlighted above, our strategy for Load Related Expenditure is to begin to manage substations and associated circuits with flexibility at high utilisation rate, to defer reinforcement for as long as possible. Once the assets that will be constrained in the future are identified, a process to identify the primary options to deliver the needs would be triggered.

A combination of whole system options, alongside market-based and asset-based options, will deliver a broad spectrum of standalone and hybrid solutions that will ensure efficient development and investment into the distribution networks. The DSO will assess both the flexibility solution options and the asset-based options. If there are multiple options to address a given need, then these will be studied in turn for their economic benefit via a Cost Benefit Assessment (CBA).

In April 2021, we adopted the Common Evaluation Methodology (CEM) into our CBA methodology. The development of CEM provides transparency on how decisions are made to choose the most suitable solution to meet network needs (between traditional network asset solutions (reinforcement) and procuring flexibility services from generators, storage operators or

demand side response. As this approach develops – for instance to enable standardised whole system assessment approaches – we will incorporate these changes into our methodologies.

As well as the straight economic value of flexibility, it has been recognised that flexibility also has an 'option' value. In the face of considerable uncertainty in future load growth, it keeps a DNO's options open prior to committing to an expensive capital solution (such as upgrading a transformer with a 45+ year economic life), should load growth turn out different to that expected. This is particularly pertinent given the different potential pathways to Net Zero.

UK Power Networks is committing to including this option value in its network options evaluation approach during RIIO-ED2. Currently there is no accepted method for this, although the ENA Open Networks programme is working through this in its 2021 work-plan for enhancements to the Common Evaluation Methodology. We believe that a common accepted approach across the industry is needed, and we see little value in individual DNOs deploying their own methods which risk becoming 'black boxes' and do little for improving transparency or standardising valuation methods. We will implement this for our flexibility services procurement as soon as there is an industry agreed standard method, approved by Ofgem, which we would expect would be no later than the start of RIIO-ED2.

During RIIO-ED2 we will publish the framework for our Network Options Assessment process, the accompanying cost benefit analysis methodology, and the resultant recommendations and rejected options on an annual basis.

As a DSO, we will coordinate on investment planning activities with DNOs, TOs and the ESO to identify and assess Whole System impacts within the electricity vector, and to identify value-additive opportunities and potential solutions. In our Whole Systems Strategy (Appendix 19a to our business plan), we describe a process for whole system coordination at the planning stage, which enables commitments including:

- Extending our Regional Development Programmes, and annually reporting on progress;
- Offsetting transmission costs via continued development of our Power Potential programme with the ESO across EPN and SPN by the end of RIIO-ED2, as well as through the coordinated adjustment mechanism;
- A whole systems assessment in all our investment decisions, reported in our annual DSO forward plan and via our Network Options Assessment (DNOA) publication, described below; and,
- Reducing street works costs in London through greater coordination with wider licensees.

A key pillar of our strategy is in undertaking least-regrets investment, based on our DFES scenarios, which will be facilitated into the investment process through the load-related needs above. To reduce uncertainty, we will work with our customers and partners to understand how their plans and ambitions are evolving during RIIO-ED2.

Innovation informing our DSO strategy – Power Potential project

Power Potential is a project which UK Power Networks is delivering with National Grid Electricity System Operator (ESO). Through this project we are enabling DER to deliver reactive and active power services to National Grid ESO, using generators connected to the distribution system to help manage voltage constraints on the transmission system – a world first.

How the project will inform our strategy

This project has proved a successful service provision for the ESO, and resulted in an approach that we will scale up in RIIO-ED2

For example, as set out in our Whole Systems Strategy **we will work with all 127 local and regional authorities in our areas to co-develop and understand their Climate Emergency plans**. In-line with these plans, we will apply a transparent framework to assess and understand the level of certainty in Local Authority plans and will augment our DFES scenarios to go faster where sufficient certainty exists. To support this, **we will establish a dedicated a local area planning team increasing to up to 20 employees by the end of RIIO-ED2 that will be responsible for supporting local authorities**.

This team will offer the following services to support Local Government planners, and other associated bodies:

- Stakeholder engagement – annual engagement with all regional planning authorities, and support in coordinating wider whole system engagement;
- Climate Action Plan guidance framework – application of a Climate Action Plan reference framework, providing guidance on the planning outputs required to enable investment in network assets;
- Energy system planning support – provision of digital energy system planning portal, and support / training to enable energy system modelling and forecasting;
- Research and data provision – provision of research and networks/system data to support local planning;
- Commercial support – Commercial expertise to support funding applications and cost/benefit assessment; and
- Energy system consultancy – ad-hoc consultancy support to answer questions regarding energy systems and assets.

This team will be supported by a digital planning support environment, which we are developing to assist regional planning authorities in developing their plans, and to make the application of the Climate Action Planning framework as efficient and user-friendly as possible.

3.3.3 Our proposed commitments and metrics for Role 1

By deploying smart sensors and techology, together with advanced analytics to have more visibility of network utilisation and capacity, we will enhance our ability to deploy smart solutions to create capacity, and to defer (and potentially avoid) reinforcement investment for as long as possible.

We are therefore making the following commitment in relation to Network Visibility under the DSO Role 1:

Commitment DSO5: We will collect real time data through monitoring in all LV networks where we are forecasting constraints over RIIO-ED2 and will target 100% coverage of the rest of the network through advanced analytics using smart meter data. This will give us better insight to run the network at higher utilisation and to defer reinforcement actions for as long as possible.

Table 5 summarises the proposed performance measures to support this commitment.

Table 5: Summary of proposed performance measures for DSO5

Performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Quality of LV visibility network data	Meets	LV visibility coverage based on minimum criteria on data quality and format Targets linked to secondary reinforcement and the number of substations requiring intervention	Annual DSO forward plan and progress report	n/a – this output is a baseline requirement
Network Visibility and Monitoring Coverage (third party data/ software based - % of customers)	Exceeds	n/a - proposal is beyond baseline expectations	Annual DSO forward plan and progress report	100% coverage (modelled data)
% of network visibility data that is accessible to stakeholders	Meets	100% of available network visibility data (subject to data triage)	Weekly refresh via data portal	n/a – this output is a baseline requirement

Our DSO will run an open investment planning process, consulting on scenarios for system needs and comparing flexibility and whole system solutions sourced from the market with asset-based solutions provided by the DNO (and in future also by third party network operators). We will do this all the way down to the low voltage network to maximise opportunity for domestic level participation and cost savings for consumers.

Our approach will enable direct distribution network cost savings, reducing both our RIIO-ED2 proposals, as well as creating enduring reinforcement deferral (and potentially avoidance) benefits.

We are therefore making the following commitment in relation to the network development process under DSO Role 1:

Commitment DSO3: Our DSO function will deliver up to a £410m reduction in load related expenditure during RIIO-ED2 through increased competition and use of LV flexibility, including at the domestic level.

Table 6 summarises the proposed performance measures to support this commitment.

Table 6: Summary of proposed outputs and performance measures for DSO3

DSO outputs and performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Forecasting accuracy	Meets	Compares forecasts against actuals on an annual basis on thermal load at Primary level, as currently reported in LTDS +/- 15% for LTDS, Week 24 and NDP	Annual DSO forward plan and progress report	Potential to benchmark across DSOs
Enabling competition	Meets	% of needs being tendered X years ahead (banded 3 years ahead, 2 years ahead, 1 year ahead)	Annual DSO forward plan and progress report	n/a – this output is a baseline requirement

On-time publication of annual DNOA methodology consultation	Meets	On-time publication	Annual DNOA consultation	n/a – this output is a baseline requirement
On-time publication of annual DNOA outputs	Meets	On-time publication	Annual DNOA outputs	n/a – this output is a baseline requirement
On-time publication of required planning data and outputs	Meets	100% compliance with agreed timeframes	Data availability as required per item	Evidence of enhanced granularity, comprehensiveness and stakeholder engagement in core planning outputs
Quality of stakeholder engagement in development of DFES scenarios	Meets	Customer satisfaction score - Once a baseline is set at the start of RIIO-ED2 we commit to improving this score by 10%	Annual Stakeholder Satisfaction Survey	n/a - regularly reported evidence only
Utilisation index	Exceeds	Regular reporting of network utilisation at granular levels, using actual and modelled data	Annual DSO forward plan and progress report	We will measure the actual and forecast utilisation of our 120,000 transformers on an annual basis (we will aim to maintain network utilisation within +/- 10% of the agreed target)
Carbon intensity of electricity consumed on our networks at GSP	Meet	n/a - regularly reported evidence only	Annual DSO forward plan and progress report	n/a - regularly reported evidence only
Number of Local Authorities engaged with to inform local areas plans and DFES assumptions	Exceeds	Consultation with key regional Local Authorities as part of business-as-usual DFES stakeholder engagement process	Annual DSO forward plan and progress report	Establish a dedicated Local Area Planning team and specialised forecasting tools to enable regional planning Engagement with 100% of Local Authorities in our region in RIIO-ED2
Number of Local Authorities utilising our digital planning support service	Exceeds	Consultation with key regional Local Authorities as part of business-as-usual DFES stakeholder engagement process	Annual DSO forward plan and progress report	Provide a planning support portal and engage with Local Authorities to encourage them to build local plans within the tool
Local and Regional Authority stakeholder satisfaction scores	Meets	Consultation with key regional Local Authorities as part of business-as-usual DFES stakeholder engagement process	Annual DSO forward plan and progress report	We will report on engagement scores for local authorities on an annual basis (we will target an average of 90% satisfaction over RIIO-ED2)

3.4 Role 2: Network Operation

3.4.1 How our proposals for Role 2 deliver against Ofgem's expectations

Ofgem's proposed headline activities for Role 2 are to "promote operational network visibility and data availability" and "facilitate efficient dispatch of distribution flexibility services".

The baseline expectations focus on:

- Improving network visibility and identification and sharing of operability constraints, to help avoid conflicting actions being taken by other network and system operators.
- Providing the ESO with information across timescales about the DER it is planning to instruct to dispatch, to promote coordination and enable DER to stack value.
- Making available operational data that supports network users and other relevant stakeholders to make better decisions about how to use the network.
- Maintaining a transparent decision-making framework for when DER are instructed to dispatch in real-time, to promote coordination, liquidity, and whole system efficiencies.
- Enabling secondary trading through data provision and collection.
- Developing efficient, scalable, and separable dispatch instruction infrastructure, avoiding proprietary systems, with clear types of dispatch instruction and circumstances for use.

In RIIO-ED1 we have made significant progress in building foundational DSO capabilities that will support Role 2, including:

- Engaging with stakeholders and other networks regarding the definition of common DNO services and dispatch decision guiding principles, as part of the Open Networks Product 3 in Workstream 1A, Dispatch & Settlement processes.
- Delivering coordinated dispatch with the ESO through our Power Potential project, as well as the Optional Downward Flexibility Management (ODFM) initiative – the first live operational trials of this kind in the world.
- Delivered foundational investments establishing our DERMS platform, to enable our flexible connections products and initial capabilities in flexibility services dispatch at EHV and HV levels, via open standards and using web APIs.
- As set out in our Digitalisation Strategy, we are also continuing to invest heavily in the integration of data across our systems, the digitisation of vectorised network data, and the implementation of a data model aligned to the Common Information Model, in accordance with the recommendations of the Energy Data Taskforce.

Our proposals build on our strong foundations and investments delivered in RIIO-ED1 and put forward a comprehensive range of deliverables that will meet these needs, and in some areas go further. We believe these proposals for Role 2 will be exceeding Ofgem's expectations in several areas and will deliver enhanced value for customers and stakeholders.

As set out in section 3.2 , we will be establishing a ring-fenced and legally separate DSO business unit, which will enable us to over-deliver on the need for transparency in Role 2 through establishing a **separable DSO Control Room**. This DSO Control Room will contain all short-term forecasting, outage planning, scheduling and dispatch capabilities, as set out in the sections below, and will enable full transparency of dispatch decisions via the **DSO:DNO Operational Agreement** and our **Control Room Transparency Report**. In addition, we will go further than Ofgem's expectations by pro-actively establishing support for secondary trading via a third-party market platform, for both distribution flexibility services and curtailment obligations, as set out in greater detail in section 3.5.

3.4.2 A stakeholder summary of our proposals for Role 2

In this section we set out a stakeholder summary of our proposals for:

- Our strategy for delivering transparent network operation;
- How we will promote operational network visibility and data availability;
- How we will develop a transparent dispatch decision-making framework;
- How we will forecast, plan and share our schedule of curtailment and dispatch; and,
- How we will develop efficient, scalable and separable dispatch infrastructure.

How we will deliver transparent network operation

Historically, DNO network operations have focused on maintaining network reliability and safety, delivering planned outages, and responding to unplanned events and faults. This has been achieved primarily through network switching and smarter network technologies such as network automation.

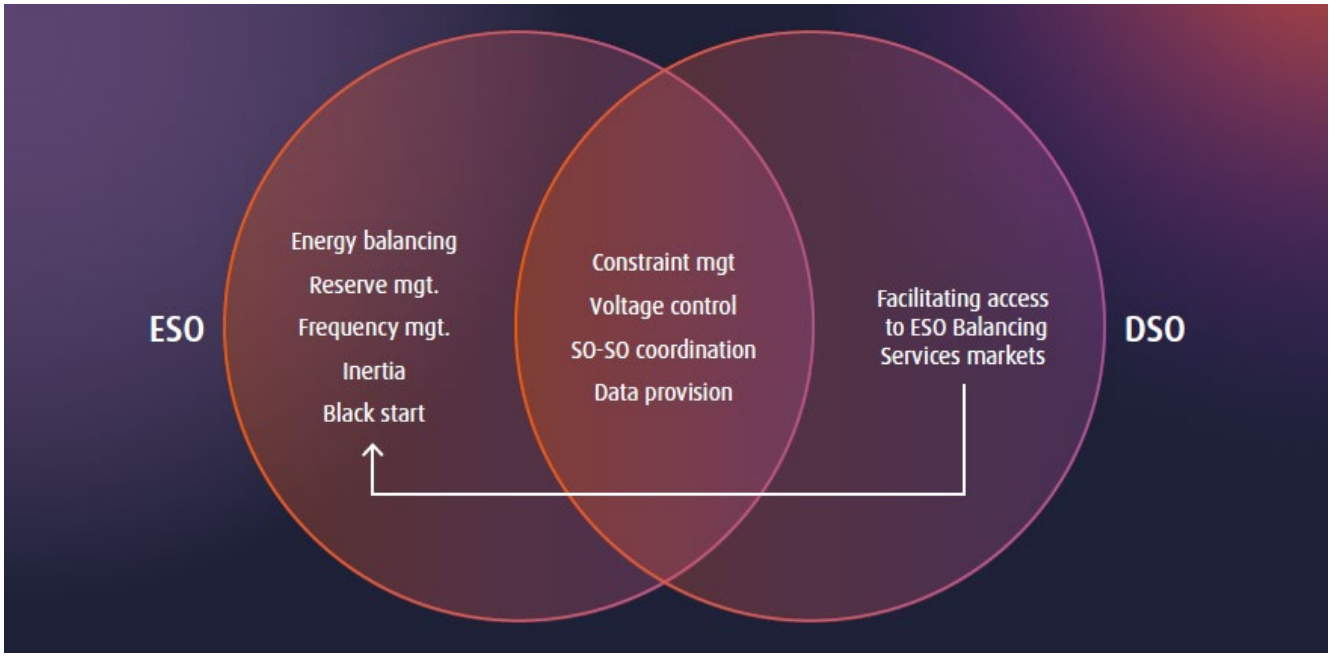
Going forward, our goal for DSO Network Operation is to lead the way in the use of flexibility services to support all network and system needs where they deliver value for consumers, leveraging real-time optimisation to deliver the highest levels of network utilisation and network access for users.

To support this, network operation will become a more dynamic activity, with a focus on coordinating the dispatch of DER to facilitate the efficient operation of the distribution system, whilst maintaining reliability, and avoiding the need for unnecessary reinforcement. This will require a transformation in how we operate the network, with operational planning processes that integrate service options, visibility of network conditions and required actions as constraints emerge, and the ability to optimise and dispatch services in real-time.

In developing our vision for DSO network operation, we have considered the National Grid ESO / TO model as a mature example of separate system and network operations and challenged ourselves as to whether this model would be appropriate at distribution level. Some of the activities in operating a distribution system are common with those in operating a transmission system, such as managing thermal and voltage constraints, and providing operational data. However, the ESO has additional responsibilities that the DSO does not have, such as overall energy balance for the system, ensuring sufficient reserve, managing frequency and Electricity System Restoration following a major outage.

Figure 23 below illustrates the differences in scope of the ESO and DSO role in terms of services managed.

Figure 22: Scope of ESO and DSO roles in operational timeframes



Another difference between transmission and distribution level system operation is that there is also a higher degree of network redundancy on the transmission system, and as such network outages (unless they are very major) are less likely to lead to situations with customers off supply, just an increase in system operation costs. At distribution level, DNOs are responsible for millions of connected customers, compared to hundreds at transmission level, and with lower levels of redundancy in the network (and fewer choices), network outages are much more likely to lead to customers off supply.

Also, network and system operations are more intrinsically linked at the distribution level, since flexibility solutions and network solutions (such as load transfers) are more interchangeable, and options for fault resolution are very specific to the local network topology. Whereas a battery can provide frequency response to the ESO from anywhere on the system, for a battery to be able to provide restoration services to the DSO following a distribution network fault, it must be in a very specific location which cannot be easily predicted in advance.

These considerations introduce a complexity in distribution system operation that is not present at the National system level, making an exact analogy difficult and the separation of DSO and DNO accountabilities less clear cut.

Our proposal is therefore to develop our network operation capabilities in a separable manner with our existing Network Operations and Control Room environment, whilst testing the practicality and benefits of further separation as we move accountabilities into the DSO. Our intention is for the DSO to be accountable for cost of network expansion (both of any asset solutions selected via Role 1, but also of any flexibility solutions or services to be dispatched on the network) and the DNO accountable for maintaining reliability.

For the start of RIIO-ED2, we intend for the DSO to be responsible for operational planning and scheduling the flexibility services required to deliver network capacity and facilitate works on the network. Operational planners will schedule services according to a clear dispatch decision making framework, which will be developed with stakeholders and building on our existing framework. Service options will be facilitated via our market platform that will be coordinated access for the ESO (and other DSOs) to enable whole electricity system coordination of service dispatch.

How we will promote operational network visibility and data availability

During the development of this business plan, stakeholders have told us that we should simply be publishing as much operational data as possible, standardising formats with other DNOs to save time and investment for participants, and focussing primarily on making data available, including via APIs in machine readable formats where appropriate, above attempting to provide value-added analytics tools.

They need this data to help them understand how they can maximise the utility of their assets, and how they should be investing in order to provide even more services to address network needs. They are also telling us that the provision of data should also be focussed on providing transparency of decision making, building trust with participants that flexibility services are being appropriately utilised, and that the rationale for dispatch decisions is reported and understood.

Through our annual DSO Forward Plan and stakeholder satisfaction survey we will continually update participants on the progress of our data investments, and the schedule for release of more data items. As set out in 3.2 and Commitment DSO8, we will publish data via both our data portal and our DSO Dashboard.

Table 7 sets out the scope of operational data that we are intending to publish in relation to Role 2. All data published and shared will be subject to a data triage process, in line with data best practice. This will include working with our data team and data protection officer to ensure that we follow GDPR principles when sharing and publishing data. We will work with other DNOs and the ENA to adopt common approaches to data sharing as far as possible, ensuring that the recipients of the data have a standard format across the various DNOs.

Table 7: Scope of operational data that we intend to publish for Role 2

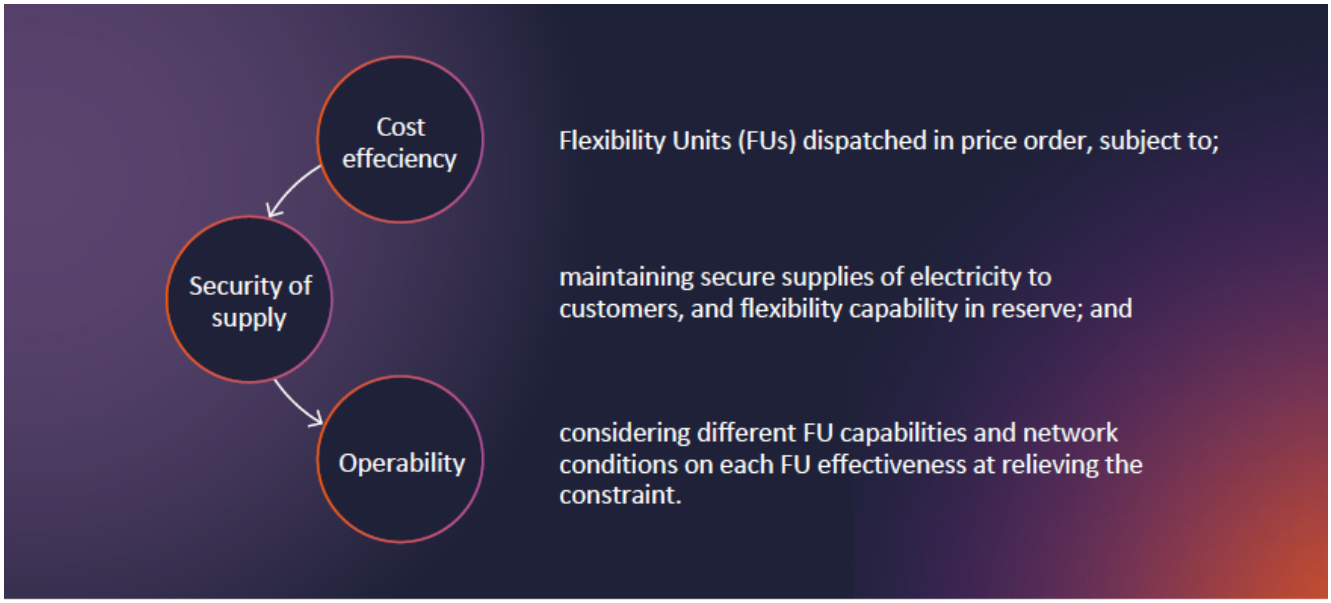
Item	Type	Frequency	Recipients
Dispatch Framework Publication	DSO Deliverable	Annually	All
DER Register	Data	Monthly	All
Near-Term Demand & Generation Forecasts	Data	Real Time	All
Outage Plans (long-term and near-term)	Data	Annually to daily	All
Operational Schedule of Services Dispatch	Data	Annually to daily	All
Detailed System Studies	DSO Deliverable	Ad Hoc	ESO
Dispatch Control Room Transparency Report	DSO Deliverable	Monthly	All
Historic Constraint Data	Data	Monthly	All
Network Topology Data	Data	Monthly	All
Historic Feeder MW/MVA Utilisation	Data	Monthly	All
Historic Utilisation & Curtailment under ANM	Data	Monthly	All
Losses ay Substation Level	Data	Monthly	All
SRS / Connection agreements / ECI data	DSO Deliverable	Monthly	ESO

How we will develop a transparent dispatch decision-making framework

Throughout RIIO-ED1 we have engaged with stakeholders and other networks regarding the definition of common DNO services and dispatch decision guiding principles, including flexibility commitments in 2018, and a common industry-wide set of key steps to the implementation of flexibility services markets in Britain in 2019. The steps outlined a consistent and transparent approach to the way that DNOs will run competitive tenders, agree contracts and use flexibility services to manage the grid. The fourth of the steps outlined focuses specifically on providing clarity on the dispatch of services, ensuring that DNOs take a fair and clear approach to the dispatch of flexibility services to meet electricity system or network needs by setting out the terms and methodology adopted. This includes any decision-making criteria underpinning the dispatch of services.

Building on from this, we were part of the Open Networks Product 3 in Workstream 1A, Dispatch & Settlement processes. This workstream focused on undertaking a review of current dispatch and settlement processes across DNOs, identifying good practice, and proposing an approach to achieving commonality. The work included developing principles for decision making criteria for the selection of solutions pre-dispatch – cost efficiency, security of supply, and operability. UK Power Networks has adopted the dispatch decision making principles as part of our procurement and contracting framework for flexibility services.

Figure 23: Our Dispatch Decision Making Principles



In addition to our work with the ENA, we have also been exploring coordinated dispatch with the ESO during RIIO-ED1 through our Power Potential project, which is focused on providing voltage control for transmission network constraints, as well as the Optional Downward Flexibility Management (ODFM) initiative, which was focused on using generators on the distribution network to resolve demand issues on the transmission network.

Going forward, we intend to engage stakeholders in advance of the start of RIIO-ED2 to develop a formalised dispatch decision making framework, for scheduling and real-time optimisation. The current work plan for 2021 for the Open Networks Workstream 1A (Flexibility Services) includes elements relating to developing a set of principles and dispatch primacy rules with ESO for addressing flexibility service conflicts (T-D). We will continue to be part of this working group to help support elements of our decision-making framework around primacy rules.

Alongside any ENA process, we will commit to publishing our dispatch decision making framework, as well as updates on at least an annual basis, and more frequently should any major updates be implemented within a year. We will engage stakeholders in co-developing this framework via our quarterly flexibility forum; DG forums; and bespoke engagement events.

Overall, the purpose of our dispatch decision making framework will be to determine and dispatch the best value option for consumers across the whole system, either in operational planning and scheduling timeframes, or in real-time in response to changing network conditions or events.

How we will forecast, plan, and share our schedule of curtailment and dispatch

Short-term Forecasting

At present, forecasts are used for longer-term operational planning, and are produced periodically to provide a relatively static view of forecast network conditions, to be factored into outage plans and the assessment of the risk of actions.

Going forward, this will become a more dynamic and automated activity used in operational planning timescales as we iterate running arrangements (i.e. network configuration, outage plans, and service schedules) in the run-up to real-time, utilising a range of data sources and modelling techniques to generate forecasts of the behaviour of DER, and ultimately expected network flows and constraints to be managed.

Publication of forecasts across timeframes can also provide customers with valuable information with which to plan their operations – particularly where constraints may lead to curtailment, or opportunities for service provision or secondary trading of pre-contracted obligations.

For the remainder of RIIO-ED1 we will design and develop the forecasting algorithm, and evaluate the best solution options, considering for example an Open Access Tool or with a UK Power Networks selected vendor. Moving into RIIO-ED2, our focus will be on building the selected platform and transferring it into business-as-usual, alongside building interfaces with multiple internal systems such as DERMS, PowerOn, DigSILENT and DPlan.

Operational planning and scheduling

Traditionally, operational planning has focussed on developing outage plans to enable planned events, delivering switching to facilitate planned work on the network, as well as maintaining contingency plans to be executed during unplanned events. This is typically facilitated by collating planned work requirements, conducting system studies utilising planning support tools

to identify least-risk running arrangements, and deciding on a combination of switching actions and potentially network reconfiguration and standby backup generation services to facilitate an outage.

This has traditionally involved a primary focus on the 'outage' as the major planning focus, with outage managers allocated to specific outages, which they own across planning timeframes. Going forward, the focus of operational planning will initially need to consider the daily service schedule and curtailment required to deliver network capacity and access, as contracted to enable reinforcement deferral and higher network utilisation running arrangements. This will require a cultural shift in operations, and a complete review of the end-to-end process and organisation required.

Today flexibility services are scheduled forward of delivery based on a longer-term forecast on a year/month ahead basis, often at the procurement stage where the DER is contracted to provide its energy for specific time periods. As part of the evolution of our flexibility services capability, the scheduling process is being developed to support a range of product types, based on the ENA definitions for Secure, Sustain, and Dynamic products. The majority of dispatch scheduling is currently conducted pre-fault, but we are working towards developing capabilities to dispatch post-fault and support restoration.

Our DSO operational planning and scheduling function will take as an input the generation and demand forecast, as well as the translation of this into the network load flows and constraints forecast. Detailed system studies are carried out today to plan for outages, and in future these studies will also consider flexibility services to support the operational plan.

This operational plan and schedule will be published at various intervals across the timeframes, and will constitute a key output from DSO network operation. Sharing this with the ESO will provide clarity regarding the services we intend to instruct to dispatch, across a range of planning timeframes, and will support network users and other relevant stakeholders to make better decisions about how to use the network.

At the day-ahead stage, we intend to lock-down our running arrangements ahead of real-time, and optimisation will pass into real-time systems – i.e. optimisation from this point is carried out on the basis of real-time network data (in turn generating short-term forecasts of emerging network conditions), rather than based on day-ahead forecast data. If any changes to the dispatch schedule are required in response to changing network conditions, disruptions in outage delivery, or unplanned events, any such operational decisions will be taken transparently and in accordance with the dispatch decision making framework. Where dispatch deviates from the market schedule, commercial incentives will be in place to compensate DER.

In the case of unplanned events, and faults in which service options cannot play a material role in supporting the network, business-as-usual control management processes will take priority to maintain network safety and security and restore customer supply where necessary.

Finally, as an enabler to delivering the transparency required regarding operational decisions related to DSO actions, we will also set up an operational assurance function, which will be responsible for conducting and publishing post-event reviews through our monthly Control Room Transparency report.

Efficient, scalable and separable dispatch instruction infrastructure

Our DER dispatch and management capabilities are being delivered through our DERMS implementation programme. The DERMS solution includes a suite of smart applications hosted centrally at the UK Power Networks control centre as well as the smart logic application within the smart substation RTUs.

For management of Flexible connections, the centralised DERMS application for Flexible connection (previously referred to as ANM solution) will monitor and manage the flexible generation and load using the SCADA systems that includes PowerOn, RTUs and SCADA communication infrastructure. The ANM solution has significantly evolved over the RIIO-ED1 period since its inception from the innovation project Flexible Plug and Play, and we will continue to develop its capabilities to provide cheaper and faster connection to our flexible customers, as well as to continually reduce the curtailment levels.

For management of flexibility services and whole system coordination, we are currently developing and trialling dispatch solutions, and we intend to explore the development of an open standard dispatch solution during the RIIO-ED1 period. We also intend to promote the use and standardisation of open APIs across all the UK networks and the ESO via the ENA, so that 3rd parties can easily develop their systems and issue dispatch instructions to DER.

Dispatch instructions will either be scheduled in advance, or sent in real-time or near real-time, and will involve either demand/generation turn-up/turn-down, or the dispatch of reactive power to manage voltage constraints. The ENA's Open Network Project has defined agreed standards for service definitions, and we are committed to remaining aligned to these standards as they evolve to make it easy for customers.

As we set out in Section 3.5, we intend to partner with a third-party market platform provider to establish Market Operations functions, including closer to real-time procurement and dispatch activation, as well as secondary trading. For standard flexibility products traded on the market platform, we expect that market outcomes would normally be communicated by the Market Operator functions. In general, we would anticipate that it will be the DER (and/or its aggregator) that decides how to dispatch the DER based on optimising against market commitments, and adjusting its dispatch to fulfil the trade as closely as possible, with any over- or under- delivery captured by the settlement rules.

We would not normally anticipate the DSO directly controlling the DER to optimise the network, unless there is a specific contract between the DSO and DER which allows DSO primacy of dispatch instruction – for instance as is the case with flexible connections products. Predominantly, dispatch signals will therefore be instructions rather than hard-control signals, with participants metered and financial incentives embedded in flexibility contracts to incentivise them to follow those instructions.

3.4.3 Our proposed commitments, and metrics for Role 2

Our goal for DSO Network Operations is to ensure that the flexible resources connected to our system are utilised where they can add most value – be that in balancing the overall system, providing system services to the ESO, or delivering distribution flexibility services to us. To ensure that these resources are optimised will require data, increasingly standardised market arrangements, and coordinated dispatch across system operators.

To support this, network operations will become a much more dynamic activity. This will require a transformation in how we operate the network, with operational planning processes that integrate service options, visibility of network conditions, actions to address emerging constraints, and the ability to dispatch services in real-time.

We also believe we are over-delivering against requirements for transparency through establishing a ring-fenced DSO business unit, and as part of this our DSO will establish a DSO Control Room.

Our key commitment under Role 2 is:

Commitment DSO2: We will deliver operational transparency by publishing our day-ahead operational plan and schedule of flexibility services and curtailment, and a monthly control room dispatch decision report from the start of RIIO-ED2.

Table 8 summarises the proposed performance measures to support this commitment.

Table 8: Summary of proposed performance measures for DSO2

ben	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Curtailment efficiency	Meets	Measures the actual cost of curtailment vs the forecast and would capture whether the DSO has made efficient decisions for both DER operators and wider customers Target would be set based on the average level of curtailment the DSO has defined as being cost efficient	Monthly control room transparency report	n/a – this output is a baseline requirement
On-time publication of operational plan across timeframes up to day-ahead, from the start of RIIO-ED2	Exceeds	n/a - output exceeds baseline expectations	Across timeframes up to day-ahead, via secure channels and data portal	On time publication of day-ahead plan and schedule
On-time publication of monthly control room transparency report from the start of RIIO-ED2	Exceeds	n/a - output exceeds baseline expectations	Monthly	On time publication of monthly transparency report
Transparency of dispatch decision making, with rationale for decisions made	Meets	100% compliance with dispatch decision making framework	Monthly control room transparency report	n/a – this output is a baseline requirement
MWh of flexibility services dispatched	Meets	n/a - regularly reported evidence only	Monthly control room transparency report	n/a - regularly reported evidence only

Forecast and actual curtailment levels	Meets	n/a - regularly reported evidence only	Monthly control room transparency report	n/a - regularly reported evidence only

3.5 Role 3: Market Development

3.5.1 How our proposals for Role 3 deliver against Ofgem's expectations

Ofgem's headline activities for Role 3 are to "provide accurate, user-friendly and comprehensive market information" and "Embed simple, fair, and transparent rules and processes for procuring distribution flexibility services". The baseline expectations focus on:

- Collating and publishing as much relevant data as reasonable that will help market participants identify and value opportunities to provide distribution flexibility services, including actively engaging market participants to understand what data and information is helpful.
- Having clear processes in place for developing standardised distribution flexibility services products, identifying the optimum combination of longer- and shorter-term lengths of markets and contract lengths reflecting the network need.
- Having clear, comprehensive and transparent mechanisms and commercial structures for coordinating distribution flexibility services and ESO flexibility services procurement.
- Making available the necessary data to enable secondary trading.
- Ensuring market support services enable simple and cost-efficient participation in markets, enabling third party platforms to 'plug-in' to DNOs' flexibility procurement processes, and provide services where they could do so more efficiently.
- Introducing proportionate measures to address actual and perceived conflicts between its market development and network ownership roles or other business interests.

In RIIO-ED1 we have made significant progress in building foundational DSO capabilities that will support Role 3, including:

- In 2017 we were the first UK DNO to tender for flexibility in the open market, and since then we have market-tested c. £300m of load related capex, translating into £70m of flexibility revenue potential that we have made available to participants for the RIIO-ED1 period, and awarded more than £45m of flexibility through to 2028.
- Working through the ENA's Open Networks project to standardise products and services with other DSOs (which currently focus on the definitions for Secure, Sustain, Dynamic and Restore services), and with the ESO on making it easier for DER to access their markets.
- Demonstrating a strong track record of co-designing new products with our customers and stakeholders, first through our Future Smart consultation and through the establishment of our Flexibility Roadmap and regular Flexibility Forums.
- Working with third parties via the Piclo Flex platform for our flexibility tenders and building out our DERMS capabilities collaborating with organisations such as Smarter Grid Solutions, GreenSync and Nexant.
- Working closely with National Grid ESO on designing services and market platforms that enable the coordinated dispatch of DER through our Regional Development Programme (RDP) in the South East, our completed Power Potential and KASM trials, and Energy Exchange trial in development.

Our proposals build on our strong foundations and investments delivered in RIIO-ED1 and put forward a comprehensive range of deliverables that will meet these needs, and in many areas go further. We believe these proposals for Role 3 will be exceeding Ofgem's expectations in a number of areas and will enable enhanced value for customers and stakeholders. As set out in section 3.2, we will be establishing a ring-fenced and legally separate DSO business unit, which will enable us to over-deliver on the need for transparency in Role 3 through a clear separation of market development and network ownership roles, supported by the **DSO:DNO Operational Agreement**.

We will also be exceeding expectations through our approach to the development of the Distribution marketplace. Our strategy sets out a vision for an independent, coordinated access platform on which the DSO, ESO and DER participants can effectively and easily buy and sell flexibility services. This Distribution Market Platform may ultimately involve an ecosystem of providers, with interactions facilitated via data flows and open APIs, to maximise the potential for third party participation.

Finally, we will exceed Ofgem's expectations through enabling secondary trading of both flexibility services and curtailment obligations/access products via the Distribution Market Platform, to minimise inefficient curtailment and access costs for customers and maximise service participation.

3.5.2 A stakeholder summary of our proposals for Role 3

In this section we set out a stakeholder summary of our proposals for:

- Our strategy for enabling a transparent marketplace, to address actual and perceived conflicts of interest;
- Our vision for a future distribution marketplace, enabled by third party market platform providers;
- Processes for developing and amending distribution flexibility services products;
- How we will work to protect and engage 'disadvantaged' customers and address 'hard-to-reach' flexibility;
- How we will provide accurate, user-friendly and comprehensive market information.

Our strategy for enabling a transparent distribution marketplace

Our vision for the DSO Market Development role in RIIO-ED2 is heavily informed by the extensive experience we have to date through the flexibility tenders we have run, the successful uptake of innovative flexible connections and access products, innovation trials such as Power Potential, Shift, Optimise Prime and Energy Exchange, and leadership in industry initiatives on the future of DSO, such as the ENA's Open Networks project. Wider industry feedback on our Future Smart (DSO Strategy), the Flexibility Roadmap and our regular Flexibility Forums has also been invaluable.

Our philosophy regarding the development of flexibility markets through RIIO-ED1 has been to move fast, make participation easy, and then to refine and evolve the products and services as we learn more about their effectiveness in facilitating the operation of the distribution system, and gain feedback from our customers.

Our DER customers have told us that they want to see us developing new markets for networks flexibility services at the distribution level, **to procure more of our needs closer to real-time**, and to ensure integration of markets so that they can easily sell their flexibility where it is most valued in the whole system.

For RIIO-ED2, we plan to give the DSO responsibility for all aspects of access product and distribution flexibility services design. We believe the rationale for doing this is clear, since we are making our DSO accountable for optimising utilisation of the network, whole system coordination, and facilitating Net Zero. There is a clear interplay between these three aspects of network usage and bringing product and services design close to strategic planning and load forecasting makes sense.

UK Power Networks aims to be a market leader in supporting and progressing the development of distribution flexibility markets and the associated market platforms, to allow DER access to new potential revenue streams and products and services, as well as to ensure we can meet the flexibility needs of the DSO.

We believe that a dynamic Distribution Market Platform will be integral to the effective operation of the distribution system during RIIO-ED2, and we intend to channel all our system needs through such a platform – including forward tenders for flexibility services and running day-ahead and within-day markets.

Alongside UK Power Networks initiatives such as Energy Exchange or Optimise Prime, in which we are trialling new markets for flexibility, there are several other market trials underway across Europe or in the UK that, supported by DNO or NIA funding, are testing closer to real-time market operation. It is clear that marketplace providers will play an essential role in operating flexibility markets and providing independent and transparent market operation in future.

It is therefore our intention to partner with a third party (or small number of third parties) to operate our Distribution Market Platform, rather than building a solution ourselves. This area is evolving fast, and we want to employ 'best of breed' market solutions wherever possible and avoid getting locked into a certain technology or provider over the long-term and so will seek industry standardisation of market data flows.

We envisage that **data flows between the Distribution Market Platform and DSO functions will be facilitated via Open API interfaces**, and by taking this approach we will be **establishing Market Operations functions which can scale and interface openly with multiple markets and platforms.** We believe that as the number of DER connecting to our network grows, so will market participation and liquidity.

The Distribution Market Platform may ultimately involve an ecosystem of providers, but we believe that partnering at the early stage of market development will allow us to help platform developers to grow their portfolio of services more quickly than if this had to be undertaken without partnerships, at the same time helping expedite the development of this crucial component of the future of procuring flexibility and DSO services. In the near-term, we therefore expect we will need to partner with organisations that are developing distribution market platforms, to help them drive platform and market development. We also expect to help 'make the market', and this type of collaboration between DSO and Distribution Market Platforms will encourage the participation of DER in these markets and help ensure security of supply in meeting DSO flexibility needs.

At this stage, we do not know how the DSO and Distribution Market Platform of the future might be regulated and incentivised. However, in the interim we believe that it is our responsibility to be as transparent as possible, and we aim to create a delineated market operation function within a legally separate DSO business unit for the start of RIIO-ED2. This will provide valuable insights for Ofgem, and stakeholders, on potential approaches to future regulation. We will also include the 'rule book' for the distribution markets within our **DSO:DNO Operational Agreement**.

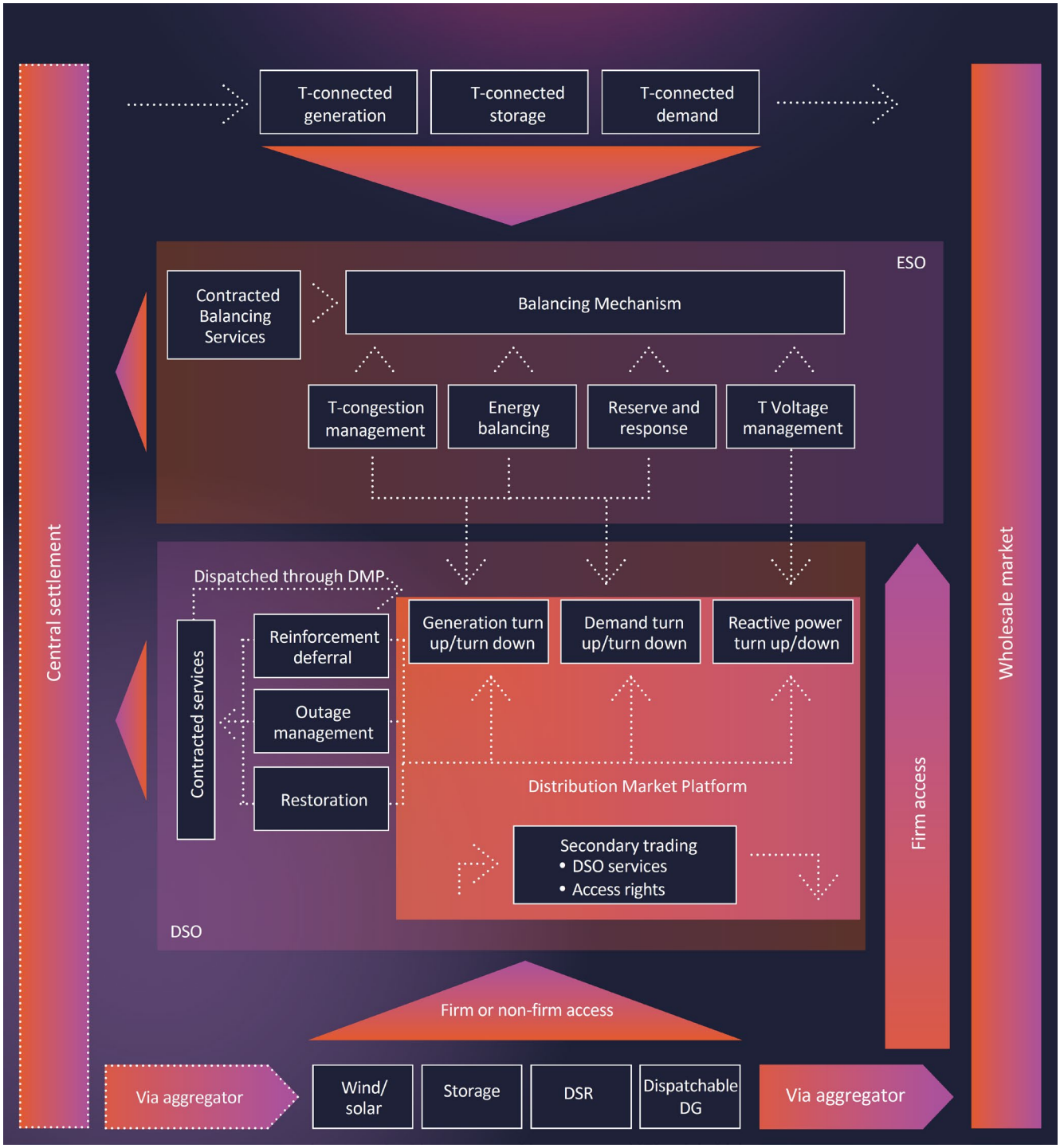
We are conscious that the future role and scope of the Distribution Market Platform may change as the result of wider industry reform during RIIO-ED2. Our strategy is to lead in this area, and inform policy making through learning. We aim to be ambitious but also to adopt a least-regrets approach to investment.

Our vision for a future Distribution marketplace

Our strategy in market development is to also ensure that we are enabling 'coordinated access' and developing services which align to those of the ESO, such that the ESO can access resources that help it to operate the transmission system, and DER to optimise the value of their flexibility across different system needs.

Figure 25 below builds on a schematic, first presented in our Future Smart consultation that shows how we see the Distribution Market Platform operating within the system operation 'ecosystem'.

Figure 24: Overview of how the Distribution Market Platform Integrates within the System Operation Ecosystem



Starting with the operational timeframe, DER will post their bids and offers on the Distribution Market Platform for active and reactive power turn up and down. To concentrate liquidity into the real-time markets, and hence promote increasingly transparent and reliable price signals, it is our intention to execute forward contracted services through the real-time platform

based on their utilisation prices, as well as potentially availability payments when these apply. Network Operations will have visibility of the available volumes of different services at different network locations (but not prices). Where they choose to deploy a market versus a network solution to manage, they will send an instruction to the DSO, and offers/bids will be taken in price order to meet the volume requirement of Network Operations.

In addition to the day-ahead/real-time markets, we plan for the Distribution Market Platform to host tenders for forward contracts for certain distribution flexibility services, on an annual and monthly ahead basis. Our strategy is to move more of our services procurement closer to real-time during RIIO-ED2, and we will need to balance the needs not to stifle the real-time markets, with optimising costs by securing services in advance where forward visibility for providers and longer-term contracts allows them to provide services more competitively, and for us to forecast our system services costs more accurately.

A mix of forward and near-term procurement will be required, which will need to be explored by keeping closely engaged with our customers and learning by doing. We plan to be transparent with what we have learned, and keep our customers informed (through DSOF, Flexibility Forums) of how we plan to evolve our strategy to maximise the potential for flexibility solutions to drive value for our customers.

We expect the volume of system services the DSO is procuring to increase significantly over the RIIO-ED2 period, with an increasing proportion being purchased closer to real-time. Just how much will depend not only on the pace of load growth, but also the outcome of other market reforms, particularly the Access SCR. Ultimately, stimulating flexibility at the distribution level will come through a combination of reformed access rights (for certain users) and greater temporal granularity in DUoS charging, as well as expanded procurement of DSO flexibility services.

Our current market design assumptions seek to accommodate explicit access rights, curtailment trading, and secondary trading of flexibility services. Requirements for, and development of, two-sided markets will depend in part on the outcomes of the Access SCR, and what our customers are telling us. Whilst we are incorporating some secondary trading functionality in our plans for a Distribution Market Platform, we will design it such that this functionality could be adapted later.

We also illustrate in the schematic the possibility that DER providing services to the DSO and ESO could also be participating in local energy markets. It is not in our business plan to host local energy markets, but we will aim to facilitate these wherever we can, provided there is no impact on reliability or costs for our customers.

We do not envisage that the Distribution Market Platform will be the only route to market for DER into the ESO's Balancing Services markets, as our customers have told us they do not want that, but it would provide one solution for DER who do not have firm access onto the distribution (and ultimately transmission) network. Hence, we believe it might become an increasingly attractive option for DER looking to keep connection/access costs low, but not preclude themselves from additional revenue opportunities where the system can accommodate this.

Processes for developing and amending distribution flexibility services products

In our strategy, we set out our commitment to keep our costs down by taking a "flexibility and energy efficiency first" approach, publishing a transparent process to meeting our system needs, and procuring through a range of long-term and short-term markets and products. To enable this, we will need to have in place a robust process for developing and amending distribution flexibility services products, and the capabilities in our team to deliver it. We will also need a comprehensive range of products to enable service provision from a corresponding wide range of technologies, including energy efficiency.

For RIIO-ED2 we plan to give the DSO responsibility for all aspects of access product and distribution flexibility services design. We believe the rationale for doing this is clear since we are making our DSO accountable for optimising utilisation of the network, whole system coordination, and facilitating Net Zero.

We anticipate a very significant increase in the procurement of flexibility services both to manage the existing network and accommodate cost-efficiently new connections during RIIO-ED2. We will extend our flex procurement to more low voltage areas and procure it for new applications such as outage management and restoration services. This will require the creation of new distribution flexibility service products.

How the distribution networks are used and the system operated will be a function of (a) how capacity is allocated, (b) DUoS signals (and customers' response to these), (c) the procurement and utilisation of system services by system operators, and (d) the functioning of the wholesale market. Access arrangements (including the connection boundary) and DUoS signals are subject to Ofgem's ongoing Access SCR.

However, understanding the interplay between these four elements will be central to the DSO's role and efficient operation of the distribution system. We believe the following principles will be fundamental in designing future access products, network tariffs and distribution flexibility services:

- Deploying the appropriate combination of access products, network tariffs and distribution flexibility services that maximises the utilisation of existing assets and reduces the need for new asset infrastructure to the benefit of all network users;
- Looking to develop novel connections/access solutions that enable DER and LCTs in particular to connect quickly and cheaply to our networks and maximise the value of their assets;

- By getting closer to our customers, anticipating their needs better, and maximising choice;
- Designing products and services that maximise participation from a range of technologies;
- Allowing secondary trading of products and services, where practical;
- Facilitating access to ESO Balancing Services by coordinating product and services design, where possible;
- Standardising product and services design with other DSOs;
- Ensuring that non-engaged, and particularly vulnerable, customers are not disadvantaged;
- Trialling new products and services through innovation projects;
- Considering the carbon impacts of different solutions and maximising the opportunities from energy efficiency; and,
- Maximising the forward visibility of available capacity, and likely future network service needs, to aid siting decisions for DER developers (and consequently improving network utilisation).

How we will work to protect and engage customers and address 'hard-to-reach' flexibility

Our approach to promoting consumer engagement in flexibility is to nurture an ecosystem of service providers that we will collaborate with to develop and procure flexibility services. We will seek to understand consumer behaviour, inform and adapt our propositions and bring them to market through third party intermediaries that have direct access to consumer and their homes. Our approach is explored further in our Whole Systems Strategy (Appendix 19a to our business plan). We understand that whilst we are one step removed from the consumer, we have a role in safeguarding consumer protection and the consumer experience.

We will fulfil this role through actions such as:

- Support adoption of minimum standards for aggregators such as ADE's Flex Assure Code and will lead developments to further tailor such codes to residential flexibility.
- Building data flows that allow interested parties to have a common view of the customer status. For example, we have started sharing power cut status with aggregators – allows them to understand the impact on their smart charging customers of power outages.
- Understanding the customer feedback providers receive on their UK Power Networks flexibility customers and work with them to improve where necessary.
- Giving the flexibility service providers the opportunity to score us in terms of their customer experience as part of our DSO metrics; and,
- Managing service performance of flexibility providers in line with their contractual arrangements.

Innovation informing our DSO strategy – Urban Energy Club project

In collaboration with EDF Energy and Repowering London, our innovation project Urban Energy Club is supporting customers living in small flats with limited space and financial capabilities to participate in the flexibility market. The project will create flexibility service opportunities for customers living in high density urban areas through virtual ownership of shared energy storage asset and 'club-type' commercial models.

How the project will inform our strategy

The insights from this project will help inform the role local networks can play in facilitating the participation of potentially excluded communities in a smart flexible energy system and the Net Zero transition.

In addition, the DSO will also have a key role in delivering our Vulnerability Strategy (Appendix 8), which details our approach to ensuring that our RIIO-ED2 Business Plan is developed incorporating 'Vulnerability by Design'. This strategy is set to deliver four main outcomes for our customers:

- Fair and appropriate access to the opportunities presented by the energy market.
- An affordable energy supply, above and beyond our impact on bills.
- Protection and safeguarding from detriment stemming from aspects, particular new aspects, of the energy market.
- Wider social value, including by supporting customers in fuel poverty and ensuring no one is left behind in the energy transition.

To deliver these outcomes, our Vulnerability strategy is built on three strategic pillars:

1. Supporting our customers in vulnerable circumstances through all of our service journeys.
2. Delivering greater support to our people and communities in need; and,
3. Innovating for all.

The DSO will have a key role in delivering our Vulnerability strategy, and in particular supporting pillar two and our **Social Delivery Programme**, and our commitment that **'We will provide education and targeted support to ensure no one is left behind in the changing energy system'**. In doing so, the role of the DSO will fall into the following three themes:

- Engaging with customers and communities to provide education and support, and to gain insight to shape our flexibility service designs;
- Ensuring our flexibility services incorporate 'Vulnerability by Design'; and,
- Ensuring our flexibility services programme has a dedicated (and measurable) level of focus on hard-to-reach flexibility, to ensure no one is left behind in the changing energy system.

Finally, we will publish an annual vulnerability report that will highlight how vulnerability is embedded in our organisational culture, and report on our progress in enabling vulnerable customers to participate in the energy transition.

How we will provide accurate, user-friendly and comprehensive market information

We understand the importance on market information for market participants, particularly in embryonic markets where price discovery is critical in creating confidence and therefore liquidity. Therefore, we are committed to publishing all non-commercially sensitive market information in easily accessible formats.

Table 9 below sets out our current thinking on market information to publish, but we will listen to our customers and stakeholders and add to this list over time. We aim to make this data available via our data portal, and potentially directly from the Market Operations platform provided by our third-party partner(s).

Table 9: Market Information that we intend to Publish for Role 3

Item	Type	Frequency	Recipients
Flexibility Roadmap Consultation & Publication	DSO Deliverable	Annually	All
Standardised Flexibility Product Specifications	DSO Deliverable	Ad Hoc	All
Range of Access Products & Pricing Options	DSO Deliverable	Ad Hoc	All
Flexibility Service Requirements	DSO Deliverable	Weekly / Daily	All
Flexibility Tenders	DSO Deliverable	Bi-Annually	All
DER Contracted	Data	Weekly / Daily	All
API Standards for Market Platform Data Flows	DSO Deliverable	Annually	All
Operational Planning Margin Requirement	Data	Weekly / Daily	All
Flexibility Services Volumes, Prices & Costs Report	Data	Daily	All
Flexibility Market Insight Reporting	Data	Daily	All

3.5.3 Our proposed commitments, and metrics for Role 3

Our strategy sets out a vision for an independent, coordinated access platform on which the DSO, ESO and DER participants can effectively and easily buy and sell flexibility services. We will seek to understand consumer behaviour, inform and adapt our propositions and bring them to market through third party intermediaries that have direct access to consumer and their homes. addition, the DSO will also have a key role in delivering our Vulnerability strategy – in particular supporting our Social Delivery Programme. We therefore set out the following commitment with respect to the use of flexibility:

Commitment DSO4: We will keep our costs down by taking a "flexibility and energy efficiency first" approach over RIIO-ED2 and will "market test" all network needs before considering reinforcement. These needs will be procured through a range of long-term and short-term markets and products, which are inclusive by design and ensure no customer is left behind in the energy transition.

Table 10 summarises the proposed performance measures to support this commitment.

Table 10: Summary of proposed performance measures for DSO4

Performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Value of optioneering	Meets	Evaluates the consumer value from running the D-NOA process, which compares all the options available to meet a network requirement	Annual DSO forward plan and progress report	n/a – this output is a baseline requirement

		It would capture both direct and whole system savings to consumers from DSO actions to seek alternative solutions On track for delivery of £410m savings in CBA core scenario		
% of network needs procured through short-term market	Potential to exceed	Evidence of progress to establishing short-term market capabilities (start of RIIO-ED2) Capabilities in place and tested/available by 2025 at the latest	Annual DSO forward plan and progress report	In the event that sufficient market depth allows, we will aim to exceed expectations by routinely lowering our threshold for procuring forward flexibility to ensure we meet our needs
MWh of ESO services procured through Distribution Market Platform	Exceeds	n/a - output exceeds baseline expectations	Monthly control room transparency report	Provision of coordinated access platform for coordination of DSO and ESO services is beyond baseline expectations
Customer and stakeholder satisfaction in the DSO's engagement to understand their requirements for participation in flexibility markets, including pre-qualification, contract types, and valuations	Meets	Customer satisfaction score - flexibility market development Once a baseline is set at the start of RIIO-ED2 we commit to improving this score by 10% through the period	Annual Stakeholder Satisfaction Survey	n/a - regularly reported evidence only
Cycle time of new customer registration process	Potential to exceed	Process < 10 days	Annual DSO forward plan and progress report	Evidence of fully online customer experience, with automated approvals available (for qualifying customers and assets)
Number and diversity of flexibility providers (technologies / size of assets)	Meets	Measure of the diversity of technologies that provide services to the DSO	Annual DSO forward plan and progress report	n/a – this output is for information only
Proportion of flexibility sourced from inclusive consumer flexibility products	Meets	% of kWh contracted / dispatched from sub-set of flexibility service products	Annual DSO forward plan and progress report	n/a - regularly reported evidence only
MWh of flexibility dispatched vs. procured	Meets	MWh dispatch in line with core scenario	Monthly control room transparency report	n/a - regularly reported evidence only

In addition, we make the following commitment with regards to the use of firm and flexible connections products:

Commitment DSO7: We will offer a range of firm and flexible connection products, from lowest cost through to highest access, with a maximum curtailment commitment from the start of RIIO-ED2, and will annually update our products based on stakeholder feedback.

Table 11 below summarises the proposed outputs and performance measures to support this commitment.

Table 11: Summary of proposed outputs and performance measures for DSO7

DSO outputs and performance metrics	Meets / Exceeds	Evidence / target for meets	Frequency / How reported?	Evidence / target for exceeds
Stakeholder satisfaction on flexible connection products	Meets	Customer satisfaction score - flexible connections offering Once a baseline is set at the start of RIIO-ED2 we commit to improving this score by 10% through the period	Annual Stakeholder Satisfaction Survey	n/a – this output is a baseline requirement
# / % customers connecting under flexible connections arrangements	Meets	n/a - regularly reported evidence only	Annual DSO forward plan and progress report	n/a - regularly reported evidence only
£ connecting customer savings due to flexible connection arrangements	Meets	Regular reporting of £ connecting customer savings due to flexible connection arrangements	Annual DSO forward plan and progress report	n/a - regularly reported evidence only