Environment Report 2020/21

THE UK'S 25 BEST BIG COMPANIES TO WORK FOR 2021

INVESTORS IN PEOPLE™
We invest in people Platinum

UK Power Networks
Delivering your electricity

Contents

1 Introduction

1.1 Executive Summary

We are pleased to present UK Power Networks' Environment Report for the regulatory year 2020/21. This document fulfils an annual requirement under standard condition 47 (Environment Reporting) of the Electricity Distribution Licence and has been prepared on behalf of our three licensed distribution companies: Eastern Power Networks plc (EPN), London Power Networks plc (LPN), and South Eastern Power Networks plc (SPN). It updates stakeholders on our performance across the key environmental measures we work to and our efforts to deliver environmental benefits for our customers and the wider communities in the regions we serve.

Protecting the environment is central to our aim of being a respected and trusted corporate citizen, a key part of our vision to be consistently the best-performing Distribution Network and System Operator in the UK. We strive to have a positive effect on the environment in which we operate, working closely with communities and their representatives to identify areas where we can play an active, beneficial role.

The environmental commitments in our RIIO-ED1 Business Plan are listed in section 1.3 and remain an important focus area for UK Power Networks. Key activities in 2020/21 are outlined below and covered in more detail in the following sections.

- We continued to work closely with stakeholders to identify schemes that would benefit from the undergrounding of overhead lines to improve visual amenity. We are currently progressing 36 undergrounding schemes of varying size. For more information please see section 2.2.

- In 2020/21 a total of 187,519 litres of cable fluid were lost in our three licence areas. This represents a 20% reduction compared to average performance in the DPCR5 period but is slightly behind our target of 183,369 litres for 2020/21, based on our commitment to reduce cable fluid losses by 2% year on year in RIIO-ED1. We have maintained our focus on improving the prioritisation, response and repair time of cable fluid leaks, targeting the poorest performing circuits in our network. For more information please see section 2.3.

- We set ourselves an overall target to reduce our business carbon footprint (BCF) by 2% for each year of the RIIO-ED1 price control period. This amounted to a 16% total reduction against our baseline year of 2014/15 by 2022/23. As of 31 March 2021, we are pleased to report a reduction of 30.9% in our BCF, which is significantly ahead of this target and also represents a 7.3% reduction on the previous year's figures. In 2020/21 UK Power Networks became the first DNO to have its carbon reduction plan and targets verified by the Science Based Targets initiative (SBTi). This is an independent verification so we can be confident that our measurements and our targets are robust and in line with the latest science as well as with the goals agreed in the Paris Agreement. For more information please see section 2.4.1.

- In 2020/21 we continued to meet our annual target for the RIIO-ED1 period of emitting less than 0.2% of the total amount of sulphur hexafluoride (SF_6) in service. SF_6 leakage overall was 0.12% of the SF_6 in service in 2020/21. We continue to invest in leak reduction projects in order to reduce the impact on the environment. During the year we refurbished 132kV circuit breakers at the Brunswick Wharf B, City Road and West Ham Super Grid substations in our LPN licence area, and at the Sellindge substation in our SPN licence area. Our 2021/22 plans include investment targeted at further leak reduction work. For more information please see section 2.4.2.

- We continued with our programme of upsizing or replacing network assets to manage distribution losses. On our HV and LV networks, upsizing main line conductors in 2020/21 will yield annual improvements of 1,051 MWh and 678.2 MWh respectively. Over the last 12 months we have increased the size of the distribution transformers at 306 of our sites, reducing losses by 1,622.4 MWh per annum. We have also replaced 1,090 distribution transformers and 11 primary and grid transformers with Ecodesign specification units, yielding further annual improvements of 3,142.1 MWh and 1,546.4 MWh respectively. Looking ahead, we will continue to develop our tools and processes and embed them into our business-as-usual activities. We will also continue to consider the impact our developing DSO capabilities are likely to have in this area and investigate how new approaches and technologies, such as flexibility and our Active Network Management System, interact with network losses. For more information please see section 2.4.3.

- In 2020/21 our programme of work to tackle theft in conveyance led to 333 cases being resolved across our three licence areas. During the year we continued to work with other distributors and suppliers to promote more effective electricity theft reduction efforts across the industry. UK Power Networks remains an active and engaged member of the industry's Theft Issues Group, providing a distributor's perspective on plans for future theft detection and mitigation activities. As members of the UK Revenue Protection Association, we have shared best practice and operational approaches that have allowed field investigations to safely continue during the COVID-19 pandemic. For more information please see section 2.4.3.

- We continued to invest in the flood protection programme to ensure that customer supplies are protected from flood risk and to achieve our commitment of protecting 78 substations from the impact of flooding during the RIIO-ED1 price control period. In 2020/21 we successfully flood-protected 11 substations serving in excess of 86,000 customers, bringing the total number of mitigations so far in RIIO-ED1 to 60. During the year UK Power Networks was an active and willing participant in a number of public meetings, forums and consultations, which included proposals in Tilbury, Yalding and East Peckham. For more information please see section 2.5.

- In 2020/21 UK Power Networks generated 4,448 tonnes of office and depot waste, which represents a reduction of 732 tonnes on the previous year. Of this 531 tonnes (12%) ended up in landfill. The remaining 3,917 tonnes (88%) were diverted from landfill and either recycled or used for energy recovery. While this is significantly ahead of our annual target for the RIIO-ED1 period of 70% diversion from landfill, it is just short of the annual target of 90% we have set as part of our Green Action Plan (GAP). We have committed to achieving the Carbon Trust Waste Standard, which is internationally recognised and awarded to organisations that manage and successfully reduce their waste output. We are finalising our submission to the Carbon Trust with the aim of achieving the certification in 2021/22. This will also enable us to develop our circular economy approach to managing the material coming into our business and disposal/reuse routes. For more information please see section 2.5.

- As part of our GAP we have committed to increasing the biodiversity potential of 100 of our larger sites by 20-30% by December 2021, to provide habitat for wildlife. During 2020/21 UK Power Networks worked with Suffolk Wildlife Trust to restore a pond in the grounds of an electricity substation at Ilketshall and provide breeding opportunities for great crested newts. Once the pond has refilled naturally and the broadleaf plants required by newts for egg-laying have re-emerged, we hope the newts will use it for breeding. For more information please see section 2.5.

- Our programme of engagement and environmental awareness training continued throughout 2020/21, mindful of social distancing requirements and other limitations during the COVID-19 pandemic. We continued to evolve our RoSPA accredited Working within the Environment training course by delivering it online. In addition, our environment team continued to deliver training to enhance environmental awareness within the business, including ad hoc calls and training with customer advisers. For more information please see section 2.5.

- Innovation is the lifeblood of progress at UK Power Networks. Over the last six years of the RIIO-ED1 period we have adopted over 50 innovative solutions into our business-as-usual operations and delivered approximately £284 million of customer savings. The challenge of a net zero economy by 2050 is a key driver of this innovation and the impetus for many of the projects we have under way. In 2020/21 we launched a number of heating-focused projects to deepen our understanding of the electrification of heat and our role. These included Heat Street, which will forecast where and when electrification of heat is likely to occur and how it should be facilitated; Communiheat, which will trial a roadmap for electrification of heat in off-gas grid communities; and HyCompact, which will trial a compact hybrid gas and electric heating system. Collaboration remains a key part of our innovation journey and in 2020/21 we conducted more than 60 external innovation sessions to connect with stakeholders. This allowed us to work on various different projects with a variety of stakeholders, including traditional technology vendors, software start-ups, energy suppliers, vehicle and fleet operators, local public bodies and BEIS. For more information please see section 3.

- From a smart metering perspective, we have continued to work closely with the Data Communications Company (DCC) and other DNOs to support the delivery of improvements within the DCC infrastructure and data communications systems. During 2020/21 we integrated our DCC adaptor into our business systems and applications, providing users with the capability to carry out smart meter energisation status checks. We also worked with our customer services teams to embed the use of smart meter data in accordance with our digital strategy; developing our power cut webpage, contact centre automation and Interactive Voice Response (IVR) telephony capabilities. For more information please see section 3.

We very much hope that our stakeholders will find this report of interest and look forward to providing an update on our performance in 2021/22.

1.2 Our business/who we are

At UK Power Networks we manage the distribution of electricity from the National Grid and locally connected generation to 8.4 million homes and businesses via our networks in London, the east and south east of England. Our licensed companies EPN, LPN and SPN are responsible for operating and maintaining these networks, ensuring we provide safe, reliable and efficient electricity supplies to existing customers and timely, cost-effective connections to new ones. We are purely a network operator. We do not generate or buy electricity, nor do we sell it to customers.

Our operating area (see Figure 1) covers 29,250 square kilometres and includes most of London as well as large areas of rural and agricultural land and over 500 miles of coastline around the south east of England. It has many environmental landscape features that are of great importance – Areas of Outstanding Natural Beauty, National Parks, Sites of Special Scientific Interest, unique waterways such as The Norfolk Broads, and Central London which is rich in archaeological significance.

Figure 1: Our operating area

As a provider of an essential service we occupy a privileged position in society and also have an important role to play in safeguarding the environment in which we operate. We must consider the design and construction of our infrastructure, the use of oil and other insulation products on our network, and the factors which contribute to our BCF from the energy used to light and heat our offices and depots to the vehicles we use. When installing new equipment on our network we ensure that we consult with relevant statutory authorities and other appropriate bodies at the earliest possible opportunity. Every effort is made to identify potential environmental impacts at the earliest planning and design stage of projects and to mitigate any harm.

Our greatest contribution to protecting the environment lies in how we facilitate our customers' journey towards a decarbonised world and develop our future DSO capabilities to deliver a secure, reliable low carbon energy system that addresses their evolving needs. To learn more about the technological advances we are making to support the UK's transition to a net zero carbon economy, please see section 3.

1.3 Purpose of this report

This report presents our activities in relation to environmental matters during the 2020/21 regulatory year. It includes information on:

- Improving visual amenity
- Reducing oil leakage from our assets
- Managing and reducing our BCF
- Minimising SF_6 emissions from our assets
- Reducing technical and non-technical distribution losses from our network
- Protecting our substations from flood risk
- Our Green Action Plan (GAP)
- Promoting biodiversity
- Reducing noise pollution from our assets
- Managing and preventing waste
- Increasing environmental and ecological awareness
- Using innovative solutions to minimise the impact of our activities on the environment and enable the low carbon transition
- Exploring and realising the benefits of smart metering

Where applicable, we present progress against the environmental targets in our RIIO-ED1 Business Plan. These are:

- Underground the equivalent of 80 kilometres of HV overhead line in SPN and 96 kilometres of HV overhead line in EPN in Areas of Outstanding Natural Beauty and National Parks
- Reduce cable fluid leakage of 207,000 litres by 2% per annum
- Reduce our BCF by 2% per annum
- Maintain SF_6 leakage at less than 0.2% as a proportion of SF_6 in service
- Continue to recycle 70% of office and depot waste and 98% of street works spoil
- Investigate all noise issues and address all non-compliant sites
- Protect 78 substation sites from the risk of flooding
- Innovation expenditure of 0.5% of allowed revenues and win largest market share of the NIC competition

2 Managing Our Environmental Impact

2.1 Introduction

We play an important role in safeguarding the environment in which we operate and have robust policies and procedures in place to ensure we comply with all relevant environmental legislation and industry codes of practice. The Electricity Act specifically requires us to consider natural beauty, flora, fauna and geological or physiographical features of special interest, and sites, buildings and objects of architectural, historic or archaeological interest, and do what we reasonably can to mitigate any effects. All other environmental legislation is assessed for relevance to our activities as a DNO. Relevant activities include environmental permitting, pollution prevention, waste management and the preservation of historic and natural habitats.

Where practicable and achievable, we seek to surpass the basic level of environmental compliance and work to enhance our positive impacts on the environment, whether that be improving biodiversity opportunities at suitable locations, minimising waste and maximising recycling, or working with our supply chain to improve our environmental performance. Our Green Action Plan (GAP) provides a suite of targets focused on energy use, carbon emissions, waste, water, biodiversity and pollution. We have also completed our carbon footprinting in line with the Green House Gas (GHG) protocols and had our carbon targets verified by the Science Based Targets initiative (SBTi). Both the SBTi and GAP initiatives have helped ensure we have a very strong foundation to build upon for our RIIO-ED2 Environmental Action Plan (EAP). We are also facilitating the societal transition to net zero to ensure that we can accommodate electric vehicles (EVs), low carbon heat and distributed energy while at the same time developing plans to reduce our own operational carbon footprint.

We have Environment Agency permits to operate three waste transfer stations and seven waste oil storage facilities. Electrical insulating oil removed during routine maintenance is reprocessed and reused, thereby reducing demand for new oil to be extracted. Through training and monitoring, high levels of compliance with our environmental permits are maintained. When working in protected habitats such as Sites of Special Scientific Interest or where protected species may be impacted, we consult with Natural England and, where appropriate, apply for relevant licences. Suitably qualified ecologists are engaged to help us with these activities. We also consult English Heritage if our work might have an impact on scheduled monuments or other protected historic sites.

Environmental governance is provided by our Health, Safety and Environment Committee, which is chaired by our CEO. This is cascaded through the organisation via local and business Health, Safety and Environment Committees. Our Environmental Management System meets the ISO 14001:2015 standard requirements and is subject to external verification and audit by DNV-GL. This system is implemented by relevant business leads and appropriate managers within our organisation who are responsible for identifying and mitigating their respective environmental risks, with guidance and assurance from our Environment team.

We consult with stakeholders, including statutory authorities and other appropriate bodies, to help mitigate the impact of our operations on the environment. At a local level, we seek to build good relationships with local authorities and work collaboratively on initiatives to help reduce the impact of issues such as noise pollution and litter, which can be a source of concern for local communities. We also work with the industry to identify areas of best practice and ensure continuous improvement. Members of our Environment team represent UK Power Networks on the Electricity Networks Association (ENA) Environment Committee, helping to ensure that best practice is implemented from knowledge shared across the electricity and gas sectors.

The following subsections present our 2020/21 performance in relation to visual amenity, oil leakage, our BCF, SF_6 emissions, and technical and non-technical distribution losses.

2.2 Visual amenity

UK Power Networks is a member of a long-established Steering Group that nominates schemes to underground overhead lines within Areas of Outstanding Natural Beauty (AONB) and National Parks (NP) in the EPN and SPN licence areas, observing funding criteria specified by Ofgem.

The group consists of landscape experts (representatives of the AONB and NP Boards within UK Power Networks' footprint) acting as stakeholder representatives, and is chaired and facilitated by Natural England, who hold the national remit to advise on the management of designated landscapes. The group meets every three months to promote and manage the portfolio of work.

UK Power Networks holds the position of a non-voting member within this group, providing the necessary technical guidance to support scheme assessment. The level of support provided varies from scheme to scheme but will always include the provision of a route for the new cable network, substation position and the estimated cost of carrying out the work.

A majority voting process determines approval of schemes with the Chair holding the deciding vote in instances where there is a tie. All new schemes proposed by Steering Group members must undergo a two-stage approval process:

- Stage 1: This is an outline of the scheme which includes indicative routes and budget costs for consultation with stakeholders. The scheme budget is ring-fenced
- Stage 2: This is triggered once stakeholders (landowners) have been consulted, the final cable route/extent of the scheme has been determined and the scheme has been assessed in terms of applicable scoring criteria (see below) and costs

Projects are assessed against scoring criteria prior to being considered for selection. Factors such as the impact on a landscape's character, the impact on visual amenity and the potential impact of undergrounding on features in the landscape (either its biodiversity or rural heritage) are taken into account. As part of this process the proposer will identify whether the scheme is linked to any proposals to seek additional local/national government/industry funding to improve accessibility to a region and increase visitor numbers to a protected landscape. To be eligible for selection a scheme must attain a minimum score of nine points out of a maximum of 48.

Schemes are nominally capped at a cost of £200,000 per kilometre. In some instances, because of technicalities in the delivery of the scheme, the upper limit may be exceeded and the Steering Group retains the discretion to waive this cap. During the Stage 2 process changes to the cable route or positioning of substations may impact on the overall cost of a scheme and where this cost increases by more than 20% of the initial estimate the proposer must seek the Steering Group's approval to continue. In 2020/21 no schemes were withdrawn on this basis.

Approved schemes (those that have completed Stage 2) are referred to UK Power Networks to acquire the necessary consents to deliver the works. During the consenting and delivery phases we continue to work closely with the scheme's proposer on any material issues that arise, such as the re-routing of a proposed cable or the relocation of a substation.

Table 1 identifies 36 schemes of varying size and complexity that are presently being progressed through the various stages of the consultation process. A number of these schemes involve lines operating at differing voltages. For such schemes, the benefits increase as the removal of only one voltage (line) would further highlight the impact of the remaining line(s) on the landscape. This encourages the Steering Group to identify whole distribution system schemes that focus on locations that have the potential to maximise the visual amenity improvement to the greatest number of visitors to the protected landscape.

Scheme	Protected Landscape	Licence Area
Bayfield	Norfolk Coast	EPN
Ludham Marshes	Broads	EPN
Potter Heigham	Broads	EPN
Blyth	Suffolk Coast & Heaths	EPN
Stoke by Nayland	Dedham Vale	EPN
Felixstowe	Suffolk Coast & Heaths	EPN
Blakeney/Morston	Norfolk Coast	EPN
Dunstable Downs	Chilterns	EPN
Latimer	Chilterns	EPN
Orford	Suffolk Coast & Heaths	EPN
Elham Valley	Kent Downs	SPN
Bedgebury Pinetum	High Weald	SPN
Chilham	Kent Downs	SPN
Firle Beacon	South Downs	SPN
Hurtwood	Surrey Hills	SPN
Preston Hill	Kent Downs	SPN
Malling Hill	South Downs	SPN
Raikes Farm	Surrey Hills	SPN
Abinger Hammer Phase 2	Surrey Hills	SPN
A27 Corridor	South Downs	SPN
Moat Farm	High Weald	SPN
Newenden	High Weald	SPN
Birling Phase 2	Kent Downs	SPN
Adur Valley Phase 2	South Downs	SPN
Deans Farm	South Downs	SPN
Olantigh Park	Kent Downs	SPN
Lees Court	Kent Downs	SPN
Swanborough	South Downs	SPN
Littlington South	South Downs	SPN
Royal Military Canal	Kent Downs	SPN
Telscombe	South Downs	SPN
Sheffield Park	High Weald	SPN
Winterfold	Surrey Hills	SPN
Littlington North	South Downs	SPN
Bodsham	Kent Downs	SPN
Swingfield	Kent Downs	SPN

Table 1: Undergrounding schemes in progress in UK Power Networks' operating area

Charge Restriction Condition (CRC) 3J of the Distribution Licence allows DNOs to spend up to 10% of their allocated expenditure on undergrounding lines which extend beyond the boundaries of Designated Areas. Within these requirements, we continue to work with Steering Group members to develop two such schemes in our SPN licence area – Sheffield Park and Royal Military Canal.

Achievements in the 2020/21 regulatory year are shown in the E1 – Visual Amenity worksheets (please see the Annexes and Appendices). During the year we completed an undergrounding scheme at Shotley North in our EPN licence area. No direct work was completed in our SPN licence area.

2.3 Oil leakage

Fluid filled cables (FFCs) account for 35% of all cables running at 33kV, 66kV and 132kV in our three licence areas by length. Leaks from FFCs occur for various reasons, including the failure of ancillary oil equipment (e.g. pipework, monitoring gauges and oil tanks), cable joint failure, cable damage due to third party excavations and incorrect installations.

In our RIIO-ED1 Business Plan we committed to reduce oil leakage from FFCs by 2% per annum for the duration of the RIIO-ED1 price control period. This section provides information about our strategy for reducing oil leakage from FFCs, a summary of 2020/21 performance and details of the work we have undertaken both independently and with key stakeholders.

Key reasons to reduce cable fluid loss include:

- Complying with environmental legislation where the operating code states that the DNO "will take all reasonably practicable steps to prevent pollution of controlled waters", taking advice from the Environment Agency as required[1]
- Ensuring a continuous supply to customers by reducing instances of power loss caused by leaking cables
- Ensuring the network operates as efficiently as possible by reducing the cost to customers of cleaning up oil leakages

Our strategy is to reduce cable fluid loss by investing in the network to refurbish and replace poor condition circuits. Where circuits develop new leaks, we ensure we are at the forefront of new technology and best practice to identify and repair damage as swiftly as possible. For the last few years we have used perfluorocarbon tracer (PFT) for leak location. This technology is based on introducing a controlled volume of chemical tracer which is mixed into pumped cable fluid. Once it has reached the point of the leak, this 'tagged' fluid becomes detectable in the atmosphere or through bore-hole sampling using either a static detector or a vehicle-mounted vapour analyser.

Where leaks occur, we have thorough procedures in place to manage, report and address them, to minimise the amount of fluid lost and its associated environmental impact.

2.3.1 2020/21 performance

Cable fluid loss is measured by the total amount of fluid used to top-up cables less any fluid recovered. A summary of 2020/21 cable fluid loss is provided in Table 2 below. The 2020/21 values have been extracted from the E2 – Environmental Reporting worksheets for each of our licensees and should be read in conjunction with the notes below. For more information please see the Annexes and Appendices.

Licensee	Average annual cable fluid losses – DPCR5[2]	Cable fluid losses – 2020/21[3]	Difference (volume)	Difference (%)
EPN	54,239 litres	38,619 litres	-15,620	-29%
LPN	126,623 litres	98,273 litres	-28,350	-22%
SPN	54,298 litres	50,627 litres	-3,671	-7%
Total	**235,160 litres**	**187,519 litres**	**-47,641**	**-20%**

Table 2: Comparison of cable fluid lost in 2020/21 to historical performance in DPCR5

[1] https://www.ena-eng.org/ENA-Docs/D0C3XTRACT/ENA_EREC_C135_Extract_180902050412.pdf
[2] The data in this column represents the average amount of cable fluid lost and not recovered in each year of DPCR5, the price control period from April 2010 to March 2015.
[3] Cable fluid losses are measured by the total fluid used to top-up cables less the total fluid recovered for all three of UK Power Networks' licence areas.

Based on our commitment to reducing cable fluid losses by 2% year on year in RIIO-ED1, our 2020/21 target was 183,369 litres. Annual fluid filled cable leakage at the end of year six is slightly behind the RIIO-ED1 commitment. In 2020/21 a total of 187,519 litres of oil were lost in our three licence areas. This represents a 20% reduction compared to average performance in the DPCR5 period but is more than was reported last year. Performance was on track until the summer, when ground movements caused a number of substantial leaks in the LPN licence area that were difficult to locate in our network. These were:

- Brunswick to Holloway circuits 1 and 2 (approximately 10,000 litres in the regulatory year)
- Wimbledon to Wandsworth circuits 1 and 2 (approximately 11,000 litres in the regulatory year)
- Holloway to King Henry's Walk circuits 1 and 2 (approximately 5,400 litres in the regulatory year)

We are working to ensure that going forward, cable fluid losses reduce in line with the commitment made in our RIIO-ED1 Business Plan. During 2020/21 the projects described in that document were reviewed to prioritise where circuit performance was known to be poorest. The highest priority projects have been authorised internally at both a senior and executive management level. Some are currently at the execution stage and others are at the design stage with construction planned for 2021/22. Further detail is provided below.

- The Brunswick to Holloway circuit, which was known to be a significant leaker (circuit 2), has been fully decommissioned as of March 2021. Circuit 1 is due to be decommissioned in October 2021.
- The Holloway to King Henry's Walk replacement scheme is in progress, with circuit 1 to be decommissioned in November 2021 and circuit 2 in 2022.

Further progress was made on the installation of pressure transducers to actively manage the pressure within cables, as well as further innovative work to develop a self-healing cable fluid additive (although the latter is still very much in the development stage).

We will continue to look for new ways to improve our performance to ensure we consistently achieve our oil leakage targets in all three of our licence areas.

2.3.2 Initiation of Network Innovation Allowance (NIA) projects

In previous Environment Reports we have provided updates on particular innovation projects which if successful will directly contribute to a reduction in cable fluid loss. An update for the 2020/21 regulatory year is provided below.

- **Self-Healing Cables (registered for NIA as 'Development of Oil-Filled Cable Additive – Phase 2')**

  UK Power Networks is leading this project in collaboration with Northern Powergrid to identify new additives to cable fluid that would seal leaks where they occur without the need for leak location and excavation. The first and second phases of the project are registered under the NIA project NIA-UKPN0030, which started in March 2016 and concluded in March 2020.

  The project has resulted in several significant developments in regard to the self-healing cables themselves, the testing methods and facilities required for the technology to move to both FFC and network demonstration. Building on this initial success, a programme has been developed to investigate whether it is possible to move the technology to the next readiness level, i.e. closer to commercialisation.

  During 2020/21 work progressed on planning for a potential 'phase three' which will focus on the assurance and further work required in a practical environment. Specifically, to ensure that the formulation is electrically compatible over a longer period, the business is exploring a further live circuit trial on an FFC circuit that is due to be overlaid shortly.

  The experience gained during the course of this trial will provide further information for the review of UK Power Networks' policy and standard operational procedures; this will give us more assurance in adopting the technology for a wider network. If successful, we expect that it will provide benefits from reduced cable fluid loss during RIIO-ED2.

- **Pressurised Cable Active Control & Monitoring**

  This project reviewed the operating systems for FFCs so that cables can be operated at lower pressures to reduce leakage without the risk of customer interruptions, extending their operational life. The project is registered under the NIA project NIA-UKPN-0012. It started in September 2015 and concluded in 2019.

  The project developed and trialled a new device, an Active Pressurised Control Unit (APCU), to avoid fluid leakages from cables. An APCU is operated by a variable speed pump and pressure valve to create a pressure differential across the unit, and sensors on either side of the unit to control the flow of oil into and out of the APCU. This allows the pressure of oil inside the cable to be maintained at a constant value, which is expected to avoid cable degradation versus simply operating them within their designed pressure.

  APCU units have been successfully developed and trialled as part of this project. The findings largely suggest that the APCU could be permanently deployed on the FFC network, with confidence in its safe long-term operation. In 2020/21 further work has been carried out to accommodate minor modifications to the original design and adopted as a business-as-usual activity. Current policies and standards are updated to define pressure reduction techniques, based on findings from network trials.

  We anticipate that this solution will provide benefits from reduced cable fluid loss from 2022 onwards, as indicated in our E6 – Innovative Solutions worksheets.

The learning from these projects will be shared with other DNOs so that areas of best practice can be identified to support others in meeting similar commitments.

As the above projects are funded through workstreams that require project specific reporting in the RIGs (e.g. the NIA), they are not recorded under costs or volumes within the E2 – Environmental Reporting worksheets. It is therefore not possible to compare or analyse the costs and volumes included with this worksheet.

2.3.3 Stakeholder engagement

The environmental impacts of cable fluid loss must be managed effectively and we have a partnership agreement with the Environment Agency outlining how we should report, notify and manage cable leaks across the network. We also work with key stakeholders to share best practice and target the poorest performing circuits in our network. In 2020/21 this included:

- Ongoing engagement with the Environment Agency at six-monthly meetings of the ENA Fluid Filled Cable Liaison Group where performance is reviewed and best practice is shared with the other DNOs
- Regular updates to the Environment Agency on the mitigation in place on specific projects and on the progress of capital replacement and refurbishment of FFCs more generally
- Enduring consultation/knowledge sharing with other DNOs, on a six-monthly basis or as required. These meetings focused on the delivery of specific projects where there were opportunities to share learning
- Discussions of individual poorly performing circuits with local stakeholders, including Thames Water, the Canal and River Trust and local authorities (as required), enabling UK Power Networks to hear and take account of their views

2.4 Carbon impact and climate change

2.4.1 Our business carbon footprint

This section describes our BCF reporting process, the various elements of our BCF and how they are measured, and how we track our carbon emissions throughout the year.

In our RIIO-ED1 Business Plan we set ourselves an overall target to reduce our BCF by 2% for each year of the RIIO-ED1 price control period. This amounted to a 16% total reduction against our baseline year of 2014/15 by 2022/23. As of 31 March 2021, we are pleased to report a reduction of 30.9% (see Table 3) which is significantly ahead of this target and represents a 7.3% reduction on the previous year's figures.

Our reporting to Ofgem is done under the rules of the Greenhouse Gas (GHG) Protocol; however, it splits the carbon into subject areas rather than the three scopes the protocol defines.

The GHG Protocol scopes are:

- Scope 1: direct emissions from sources owned or controlled by UK Power Networks
- Scope 2: indirect emissions from consumption of purchased electricity, heat and steam and, in a DNO's case, network losses
- Scope 3: upstream and downstream emissions which are as a result of our activities but outside UK Power Networks' ownership and control, such as those embedded in our supply chain, purchased goods and services, waste disposal and transportation in vehicles not owned or controlled by UK Power Networks

Figure 2 shows how the categories reported to Ofgem map to the GHG Protocol scopes.

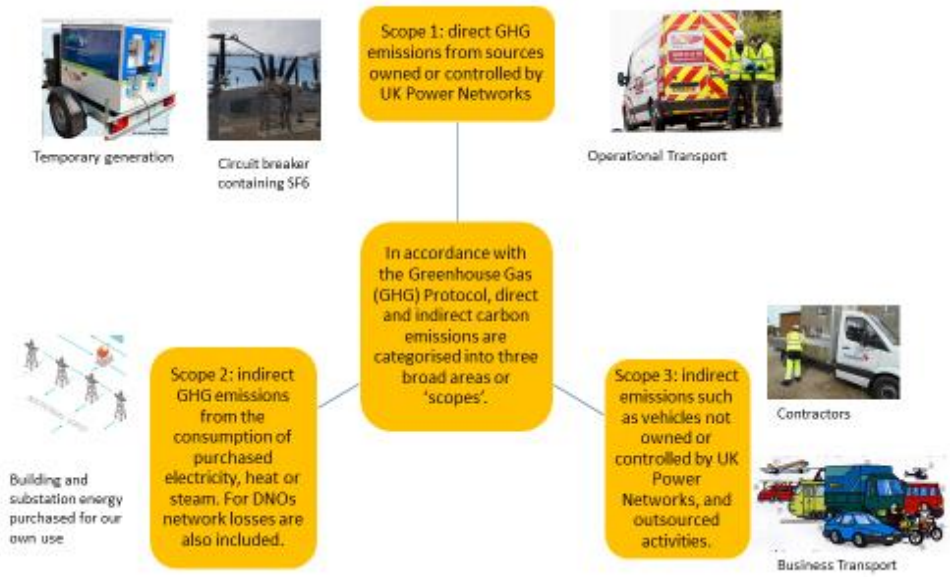


Figure 2: GHG Protocol scopes

First accredited Science Based Target

We have worked in partnership with the Carbon Trust to develop challenging science-based targets (SBTs). Targets are considered to be science-based if they are accredited by the Science Based Targets initiative (SBTi). SBTs must be in line with what the latest climate science says is necessary to meet the goals of the Paris Agreement to limit global warming to well below 2°C (WB2D) above pre-industrial levels and pursue efforts to limit warming to 1.5°C.

In 2020/21 UK Power Networks became the first DNO to have its carbon reduction plan and targets verified by the SBTi. This is an independent verification so we can be confident that our measurements and our targets are robust and in line with the latest science as well as with the goals agreed in the Paris Agreement. We have set challenging, but achievable, targets to reduce UK Power Networks' total carbon footprint by 25% by 2028 from a 2018/19 baseline covering all emissions; scopes 1, 2 and 3. The figures differ slightly from those reported here as they include emissions from our unregulated business, UK Power Networks Services. Reductions reported below are measured against a baseline of 2014/15, the last year prior to RIIO-ED1.

Our BCF methodology

The processes described in this section are used to calculate the BCF for EPN, LPN and SPN. Where data is collected centrally, this is apportioned between the three DNOs based on headcount as of 31 March 2021. If we apportioned based on geographical area, as opposed to headcount, LPN would only be allocated 2% of the shared footprint, which would result in an unrealistically small value.

All data provided is for the regulatory reporting year April 2020 to March 2021. Unless stated otherwise, the UK Government GHG Conversion Factors for Company Reporting, published in June 2020, have been used in all calculations. This approach complies with BEIS guidance to use these factors for any April to March reporting as well as calendar year reporting. Our results for the 2020/21 regulatory year are shown in the E3 – Business Carbon Footprint worksheet (please see the Annexes and Appendices).

Our BCF reporting process

Distribution losses account for 96.3% of our total BCF and are the focus of a separate strategy (please see section 2.4.3). Focusing on our BCF without losses highlights the potential for sustainability improvements in other areas. Excluding distribution losses, in 2020/21 the largest elements of our BCF were operational transport (32.1%) and building and substation energy usage (24.9%), followed by temporary generation (16%), business travel (5.7%) and fugitive (SF_6) emissions (5.6%). We also include contractor fuel used directly on UK Power Networks projects, contractor fuel used in plant and equipment, and contractor travel claims, which account for 15.6% of our footprint. These elements are illustrated in Figure 3, which provides a breakdown of our BCF excluding distribution losses over the last seven years.

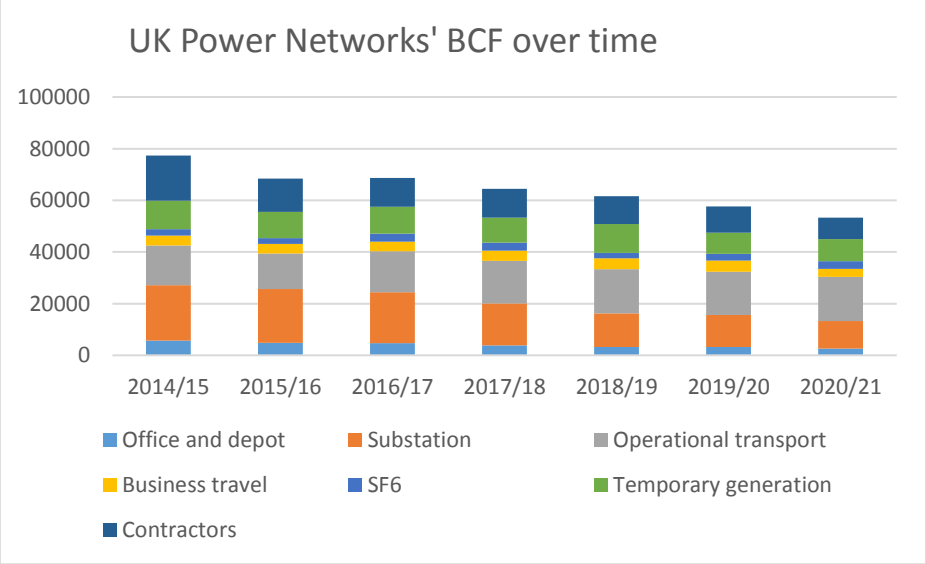


Figure 3: UK Power Networks' BCF breakdown excluding distribution losses over time

Table 3 shows our overall BCF excluding distribution losses for the regulatory years 2014/15 (our baseline year as set by Ofgem) and 2020/21. Details of the individual components of our BCF excluding losses are also reported below.

Licensee	2014/15 (tCO_2e)	2020/21 (tCO_2e)	% change
EPN	32,539.49	23,651.32	-27.3%
LPN	19,776.50	13,978.56	-29.3%
SPN	25,025.12	15,774.97	-37.0%
Total	**77,341.11**	**53,404.86**	**-30.9%**

Table 3: Our 2014/15 and 2020/21 BCF excluding losses

To check progress against our RIIO-ED1 target we prepare monthly BCF reports, at a company-wide as opposed to an individual DNO level, using data received from internal and external sources. Any anomalies in the data are closely examined and corrective actions implemented where necessary.

Monthly reports are received from various sources and cover:

- Fleet fuel usage
- Business mileage, transport expense claims and transport credit card expenditure
- SF_6 top-ups
- Headcount
- Electricity and gas meter readings
- Generator and bowser fuel usage

Key operational contractors supply details of their own fuel usage for fleet, plant and equipment and provide business mileage on UK Power Networks contracts. In this report, the values representing UK Power Networks' and contractors' emissions are shown both separately and as a combined figure.

Our income management function compiles an annual report on non-technical distribution losses; please see section 2.4.3.

For elements such as the purchase of fuel for temporary generation, SF_6 top-ups, substation energy use and some of our building energy, data is apportioned directly to each of our three DNOs where possible. The use of common systems in all three of our licence areas means that some data is captured centrally. Where this is the case, we apportion the data between the DNOs on a headcount basis.

The individual elements of our BCF

There has been a shift in the relative proportions of the elements of our BCF since 2014/15, with the most significant change being the proportional decrease of 21% (from 46% to 25%) in building and substation energy usage. A contributing factor is the UK's grid decarbonisation. The closure of coal fired power stations and increasing amounts of renewable energy connected to the UK electricity network have led to a marked reduction in the carbon intensity factor for UK electricity.

Our challenge going forward is that nearly 70% of our BCF is based on transport or diesel fuelled generation. The carbon intensity of diesel is not likely to decrease so ultimately a switch to an alternative fuel source for our operational fleet will be required. Currently, there is not an electric alternative with sufficient range and weight carrying capacity for the large vans which make up the majority of our operational fleet. However, there are a number of car derived vans which are suitable to replace smaller vans. UK Power Networks is also trialling alternatively fuelled and hybrid generation.

Operational transport

This element of our BCF represents the fuel used by our fleet of vans, trucks and specialist vehicles which work directly on our electricity networks. We also report on the fuel used by our contractors' operational vehicles when working on our behalf. Fuel purchased for UK Power Networks' fleet vehicles is captured centrally using fuel cards. Contractor transport data is obtained from contractor fuel cards submitted via a manual reporting process. A small quantity of diesel for temporary generation is also purchased using fuel cards, but this is recorded separately and reported later in this section as part of our temporary generation carbon footprint.

Table 4 shows the levels of tCO_2e emitted by UK Power Networks' operational fleet and contractors when working on our networks. As previously mentioned, we apportion fuel usage on a headcount basis, as we believe this is a more accurate method than geographical apportionment, which is based on square kilometres.

Licensee	Direct operational staff	% of staff	2014/15 total (tCO_2e)	2020/21 – UK Power Networks' fleet (tCO_2e)	2020/21 – contractor (tCO_2e)	2020/21 – combined (tCO_2e)	% change
EPN	1,184.3	43.7%	11,450.84	7,492.20	3,406.77	10,898.97	-4.8%
LPN	784.3	28.9%	9,284.47	4,961.76	2,256.16	7,217.92	-22.3%
SPN	741.3	27.4%	10,212.92	4,689.74	2,132.46	6,822.2	-33.2%
Total	**2,710**	**100%**	**30,948.23**	**17,143.71**	**7,795.39**	**24,939.09**	**-19.4%**

Table 4: Levels of tCO_2e emitted by our operational fleet and contractors working on our networks

Overall, operational transport emissions have reduced from 30,948.23 tCO_2e in 2014/15 to 24,939.09 tCO_2e in 2020/21. This represents a 19.4% reduction and is due to the modernisation of our operational fleet and the roll-out of more sophisticated communications technology enabling staff to access cable plans and other documents in the field.

There is a slight increase of 2.95% compared to the previous year in terms of UK Power Networks' own operational transport footprint, which is attributed to the COVID-19 pandemic. During the three nationwide lockdowns UK Power Networks' employees were classified as key workers. Mindful of the requirements for social distancing, as an alternative to sharing vans we hired extra vehicles so that field operatives could travel to jobs individually. This increase is offset by reductions in contractor fuel use.

Building and substation energy usage

We collate data on building and substation energy usage from the electricity and gas bills received for each of our sites. Gas and electricity usage is billed in kWh then converted into tCO_2e using the appropriate carbon factors. In most cases, geographical location determines the apportionment of energy usage per licensee. For shared buildings, apportionment is determined by overall UK Power Networks headcount.

Savings have been introduced through consolidation of staff into fewer buildings and energy saving initiatives such as the introduction of LED lighting in many offices.

Under the GHG Protocol, we are able to use both location-based and market-based methodologies to report our scope 2 emissions. We follow a location-based method of reporting using the UK's annual electricity conversion factor, regardless of the type of tariff purchased. Since 1 January 2018 all of UK Power Networks' purchased electricity has been on a 100% renewable tariff. Under a market-based reporting methodology, all of our electricity could therefore be discounted from our BCF.

Using a location-based methodology, our electricity footprint represents a 56.5% reduction on our baseline year, while our gas footprint has reduced by 36.8%.

Table 5 shows the levels of tCO_2e emitted from energy usage at our sites.

Licensee	2014/15 – total (tCO_2e)	2020/21 – total (tCO_2e)	% change
EPN	13,574.67	6,325.60	-53.4%
LPN	6,942.63	3,922.08	-43.5%
SPN	6,648.78	3,050.25	-54.1%
Total	**27,166.08**	**13,297.93**	**-51.0%**

Table 5: Energy usage at our sites

Temporary generation

This element of our BCF covers emissions from plant and equipment, such as temporary generators used during fault repairs and planned work on our networks. Data for such emissions is captured from three different sources:

1. Monthly fuel usage reports from external providers of standby diesel generators (though provided on an as needed basis, these generators are in direct use on our networks and under our operational control and are therefore classified as scope 1 rather than scope 3 emissions)
2. Fuel cards capturing the amount of fuel used by company owned plant and equipment
3. Invoices submitted by the tanker company that fills the bowsers at several of the sites used to fuel our own generators

With the exception of contractor generation, no headcount conversion needs to be applied to the above as the source data is captured by region.

We utilise temporary generation to minimise the time customers are off supply. Severe weather can add significantly to this element of our BCF as we restore customers' power supplies as quickly as possible, often using temporary generation whilst repairing storm damage. The LPN network is least affected by bad weather as it is almost entirely underground.

Table 6 shows the levels of tCO_2e emitted from temporary generators and plant and equipment used on our networks. Across all three networks, 2020/21 represents a 27.7% reduction on our baseline year.

Licensee	2014/15 total (tCO_2e)	2020/21 – UK Power Networks (tCO_2e)	2020/21 – contractor (tCO_2e)	2020/21 – combined (tCO_2e)	% change
EPN	4,321.55	3,472.32	164.29	3,636.61	-15.8%
LPN	1,717.71	492.57	108.80	601.38	-65.0%
SPN	6,328.58	4,598.64	102.84	4,701.47	-25.7%
Total	**12,367.84**	**8,563.53**	**375.93**	**8,939.46**	**-27.7%**

Table 6: tCO_2e emitted from temporary generators and plant and equipment used on our networks

Business transport

This section refers primarily to employees' mileage and public transport (attending meetings, etc.), which constitute indirect operational emissions. Some of these emissions will be directly related to operational work (e.g. visits to project sites), due to the data being combined. We convert source data available as costs only into kilometres or litres using the best available methodologies before applying the Defra conversion factors.

Transport records for shared services (IT, HR, etc.) related to our unregulated business, UK Power Networks Services, are not recorded separately and therefore all data is included within the calculations. This is consistent with previous submissions.

The data is captured from four sources:

1. Our financial management system, which enables us to determine business mileage and travel claimed through staff expenses
2. Our external travel provider
3. Corporate credit cards
4. Fuel cards

The data is recorded by type of travel (e.g. air, rail and road). With the exception of company car fuel cards, business travel data is not recorded by licence area. For all other modes of transport, total business mileage is apportioned based on the number of indirect staff employed per area. Vehicles owned by UK Power Networks or bought through the business needs self-purchase scheme use the actual CO_2 rating to improve the quality and accuracy of data. For privately owned vehicles, the Defra unknown vehicle average conversion factor has been used.

2020/21 was an exceptional year due to the COVID-19 pandemic, with many non-operational staff working from home. Business mileage in company cars increased by 55.39%, due to the non-availability of public transport or reluctance to use public transport, but business mileage in privately owned vehicles decreased by 45.8%. Rail use declined by 95.6% while the only air travel was two domestic return flights from London to Glasgow, a reduction of 99.49% on the previous year.

Contractor mileage was included in our baseline year footprint for business transport. Combining these elements for 2020/21 represents a 27.1% reduction on our baseline year.

Table 7 shows the levels of tCO_2e emitted by our staff and contractors when travelling on company business.

Licensee	Indirect staff	% of staff	2014/15 – total (tCO_2e)	2020/21 – UK Power Networks (tCO_2e)	2020/21 – contractor (tCO_2e)	2020/21 – combined (tCO_2e)	% change
EPN	1,313	43.3%	1,651.60	1,383.03	81.27	1,464.31	-11.3%
LPN	860	28.4%	1,339.13	761.10	53.82	814.92	-39.1%
SPN	860	28.4%	1,473.05	923.77	50.87	974.64	-33.8%
Total	**3,033**	**100%**	**4,463.78**	**3,067.90**	**185.97**	**3,253.87**	**-27.1%**

Table 7: Business mileage summary showing the levels of tCO_2e emitted by UK Power Networks' staff and contractors when travelling on company business

Fugitive emissions

SF_6 is an electrical insulating gas which is commonly found in modern electrical switchgear. It can have a significant impact on the environment, being 22,800 times more harmful to global warming than CO_2.

SF_6 can leak following faults or from old equipment. We continue to actively monitor our assets and have a number of procedures to minimise the escape of SF_6 to the environment. We measure the SF_6 that is lost in terms of top-ups required.

From a BCF perspective, we measure and record the quantities of SF_6 lost as fugitive emissions. Table 8 shows the levels of SF_6 emissions reported by our three licensees in 2014/15 (our baseline year) and 2020/21. The current year represents a 24.2% increase on our baseline year. In 2020/21 over 40% of LPN's SF_6 emissions were due to leaks from circuit breakers at our 132kV West Ham Super Grid and Brimsdown substations.

Licensee	2014/15 – total (tCO_2e)	2020/21 – total (tCO_2e)	% change
EPN	1,540.83	1,325.84	-13.95%
LPN	492.56	1,422.26	+188.8%
SPN	361.80	226.40	-37.4%
Total	**2,395.19**	**2,974.51**	**+24.2%**

Table 8: Levels of tCO_2e emitted from leakage of SF_6 from switchgear

For more detailed information about our procedures and annual performance, please see section 2.4.2.

Distribution losses

These calculations measure units exiting our distribution network compared to units entering from Grid Supply Points and any other sources.

The COVID-19 pandemic appears to have had a considerable impact on network losses with an increase on the previous year of 1.36% across all three networks and a 35.4% increase in the EPN licence area. This is believed to have been largely due to the shift from office working to home working. Offices have half-hourly meters and electricity exiting the distribution network is quickly reconciled. Customers who do not have smart meters require their meters to be read and in the absence of readings, are billed on estimated data. These estimates are based on historical data which does not allow for home working and therefore will generally be underestimates of electricity consumption. Until they are accounted for, the additional units used are regarded as network losses.

Our results for the 2020/21 regulatory year are shown in our E4 – Losses Snapshot worksheet (please see the Annexes and Appendices). The figures were correct at the time of submitting our E4 figures (30 July 2021), but may be subject to further updates given the standard reconciliation cycle in the settlements process.

Table 9 and Table 10 present overall losses performance for the 2020/21 regulatory year. The footprint across all three networks represents a 51.3% reduction on our baseline year of 2014/15.

Licensee	2014/15 – total (tCO_2e)	2020/21 – total (tCO_2e)	% change
EPN	1,178,315.84	607,329.70	-48.5%
LPN	913,866.74	407,761.86	-55.4%
SPN	663,791.18	328,261.12	-50.5%
Total	**2,755,973.76**	**1,343,352.68**	**-51.3%**

Table 9: Levels of tCO_2e emitted from direct losses as the electricity travels through our networks

Licensee	2014/15 (tCO_2e)	2020/21 (tCO_2e)	% change
EPN	1,210,855.33	630,981.02	-47.9%
LPN	933,663.24	421,740.42	-54.8%
SPN	688,816.30	344,036.09	-50.1%
Total	**2,833,334.87**	**1,396,757.54**	**-50.7%**

Table 10: Our overall BCF including distribution losses in tCO_2e

Distribution losses are covered in detail in section 2.4.3 of this report.

2.4.2 Sulphur hexafluoride (SF_6) emissions

Reducing SF_6 leakage from our network assets is key to our vision of being a Respected and Trusted Corporate Citizen. In our RIIO-ED1 Business Plan we signalled our commitment to maintain SF_6 leakage at less than 0.2% as a proportion of SF_6 in service throughout the RIIO-ED1 price control period in all three of our licence areas.

We use SF_6 in our switchgear as an insulation medium, an arc extinction method or for both functions, from 6.6kV up to 132kV. SF_6 leakage is measured in kilogrammes as the amount of SF_6 that is used to top-up our gas filled switchgear. The total capacity of SF_6 utilised in electrical assets on our network is just under 123,000 kilogrammes across our three licence areas; please see the corresponding breakdown in Table 11 below.

Licensee	SF_6 bank (kg)
EPN	48,944
LPN	48,518
SPN	25,218
Total	**122,680**

Table 11: SF_6 bank per licensee

In Table 11 the SF_6 bank for each licence area is a summation of the amount of SF_6 in the assets on the network and the stock of SF_6 cylinders kept for topping up any leaking circuit breakers. The measurement of SF_6 leakage as a percentage of installed capacity is more reflective of the performance of the assets. By omitting the SF_6 stock from the calculation, we eliminate the diluting effect that high stock levels may have on the perception of leak performance. The SF_6 bank figures have been included here because they are the figures we report to Ofgem.

We anticipate a slowdown in the replacement of oil switchgear with SF_6 filled switchgear on our network. This is due to three factors:

1. UK Power Networks' commitment to limit SF_6 emissions involves adopting SF_6 alternatives when they become technically feasible
2. The development and trialling of alternative gases by equipment manufacturers is gathering pace
3. The European Commission is reviewing the use of SF_6 in MV switchgear with a view to potentially curtailing its future use. At the 132kV voltage level, where SF_6 is the industry standard arc extinction method for circuit breakers, alternative gases and technologies such as Clean Air insulation combined with vacuum interruption have been successfully developed. It remains to be seen if alternative gases can be used in our LPN licence area or in any other licence area where space constraints might be an issue, because SF_6 filled switchgear offers space-saving advantages at installation, due to its compact nature. Where alternatives can be used in such circumstances, the transition will be managed in a safe and cost-effective manner

Although a slowdown in the use of SF_6 filled switchgear is anticipated, the timeline for widespread adoption is dependent on the technical approval of SF_6 alternative switchgear. This is a meticulous process and SF_6 switchgear will need to be used in the medium term. As a result, due to the replacement of oil and air-blast circuit breakers, the expected trajectory of the SF_6 capacity on our network is forecast to increase by approximately 1,750 kilogrammes from current levels by the end of RIIO-ED1[4]. It should be noted that this trajectory may change due to the potential introduction of SF_6 alternatives before the end of RIIO-ED1.

The decision to install air insulated (AIS) or gas insulated (GIS) switchgear is based primarily on the cost of delivery, available space and project delivery targets.

[4] This is an estimate based on the average kilogrammes of SF_6 in a new GIS bay (F35), the average capacity of an AIS SF_6 circuit breaker (DB145), the average capacity of an SF_6 ring main unit (RMU) and a prediction of the scope of works that will be completed for switchgear projects currently in our RIIO-ED1 plan.

2.4.2.1 Our 2020/21 performance

The figures presented in Table 12 can be found in the E2 – Environmental Reporting worksheets (please see the Annexes and Appendices). They demonstrate that in 2020/21 our three licensees comfortably met the 0.2% target for leakage set out in our RIIO-ED1 Business Plan.

DNO licence area	% SF_6 in service emitted
EPN	0.14
LPN	0.13
SPN	0.04
Total	**0.12**

Table 12: SF_6 emissions per licensee

In our LPN licence area we refurbished three circuit breakers at 132kV substations; one at City Road, one at Brunswick Wharf B and one at West Ham Super Grid. In our SPN licence area we refurbished a circuit breaker at our 132kV Sellindge substation. The refurbishments involved the replacement of seals and any worn parts contributing to the leaks. During the 2020/21 regulatory year over 40% of LPN's SF_6 emissions were due to leaks from circuit breakers at our 132kV West Ham Super Grid and Brimsdown substations.

Going forward, we are prioritising SF_6 leak reduction projects and the evaluation and implementation of innovative measures to expedite the delivery of leak mitigation, to ensure we continue to meet our RIIO-ED1 Business Plan commitment in all three of our licence areas.

2.4.2.2 Our strategy

We are taking action to minimise SF_6 emissions in order to:

- Remain compliant with the EU F-gas Regulations or its UK equivalent
- Minimise our impact on the environment and achieve our vision of being a Respected and Trusted Corporate Citizen
- Minimise the network outages required to top-up leaking circuit breakers, reducing costs associated with the top-up and the period of time the network is at risk
- Reduce the probability of mal-operation or failure, improving network performance
- Minimise the risk of exposure to SF_6 for our operational staff when working on the network or handling this substance

Where SF_6 leaks occur, our current approach is to instruct the manufacturer to carry out leak detection works on the affected unit, scope out the works and complete all refurbishment works required to mitigate the leak. This often constitutes a refurbishment, which is either on-site or factory-based. In these situations, refurbishment generally consists of a strip-down of the circuit breaker, a comprehensive clean and replacement of all worn seals or parts. Where it is not reasonably practicable or cost-effective to complete a refurbishment of the circuit breaker, an immediate replacement will be considered.

Our process for recording top-ups of SF_6 is set out below:

- Low gas pressure alarm automatically received by Network Control
- Top-up work order automatically raised when a low SF_6 gas alarm is detected
- Competent Person (holding a valid SF_6 handling certificate) tops-up the asset to within the manufacturer's recommended pressure range; the magnitude of the top-up is a mandatory input field to close the work order

We have produced three documents specifying the operating constraints that apply to the handling of SF_6 or the operation of any switchgear containing this substance. One of these documents is 'Engineering Design Standard EDS 03-0036 – Management of Switchgear containing SF_6', which offers guidance on the management of switchgear containing SF_6 from voltages of 6.6kV up to 132kV. More specifically, it details the processes followed in identifying and managing SF_6 filled switchgear that may be leaking. This policy applies to all UK Power Networks plant and staff, including contractors who work on the network on our behalf.

In 2020/21 we invested in leak reduction projects such as the refurbishment of circuit breakers at our 132kV City Road, West Ham Super Grid, Brunswick Wharf B and Sellindge substations (see above).

Our 2021/22 plans include investment targeted at further leak reduction work at the 132kV substations Brimsdown (LPN) and Trowse Grid (EPN).

2.4.2.3 Our stakeholders

Our stakeholders include those who have been directly affected by an SF_6 leak, including operational staff and manufacturers. Correspondence is required with operational staff such as field engineers and craftsmen when ascertaining the feasibility of remedial works. For example, information about the precise source of an SF_6 leak will enable the manufacturer to decide whether the proposed remedial action is cost-effective, and will prevent costly and potentially unnecessary leak detection visits. We engage regularly and openly with manufacturers on ways to enhance our SF_6 management approach.

DNOs and TOs (Transmission Operators) in the UK are also stakeholders in a broader sense. UK Power Networks has worked with both of these stakeholder groups to produce a study which summarises the current state of switchgear technology with a view to charting a technological, practical and sustainable path to the reduction and ultimate elimination of SF_6 from electricity networks in the coming decades.

2.4.2.4 Our programme to reduce SF_6 emissions

Our programme adheres to the requirements of the EU F-gas Regulations – to resolve all gas leaks without undue delay. Generally, for primary switchgear and above, a refurbishment will be sought. For secondary switchgear and below, it is generally more prudent to action a replacement than to undertake remedial refurbishment works, due to the associated costs.

SF_6 leakage figures are held on UK Power Networks' asset register and are reported to the senior management team in our asset management function each month. Top-up figures are also submitted to Ofgem each year as part of the commentary accompanying the E2 – Environmental Reporting worksheet (please see the Annexes and Appendices).

2.4.2.5 Looking ahead: our future strategy

Our future strategy is focused on assessing and improving our SF_6 leak monitoring and response process, as well as continuing to assess the viability of SF_6 alternatives with significantly lower greenhouse effects.

The key areas that will be explored as part of our future strategy are:

- Collaborating with research organisations, such as the Electric Power Research Institute (EPRI), and industry partners to develop and implement a quick and easy leak sealing technology which is not dependent on manufacturer availability and which drastically reduces the time between leak detection and repair
- Monitoring innovation space for the development of rapid SF_6 leak detection technologies and adopting them once proven to be safe and technically acceptable
- Researching the practicality and cost-effectiveness of installing SF_6 leak detection sensors on electrical equipment with smaller amounts of gas, such as Ring Main Units (RMUs), to facilitate faster responses to smaller leaks

- Exploring the use of SF_6 alternatives, such as vacuum/clean air, and commissioning these assets on our network where safe and economically viable to do so. This will be accomplished by maintaining contact – partly through the Energy Networks Association (ENA) – with manufacturers, academic institutions and electricity distribution industry participants who are considering or conducting trials in order to be well-positioned to take advantage of any cost-effective breakthrough product that results from such efforts
- Exploring the potential for replacing SF_6 with alternative gases (retro-filling) for carefully specified functions in electrical switchgear

We keep abreast of all innovations related to SF_6 as an insulation medium, including the exploration of SF_6 alternatives. Alstom and National Grid are working together to develop g3 as a viable alternative to SF_6; we remain in contact with both parties and continue to monitor the development of this technology.

Achievements in the 2020/21 regulatory year are shown in the E2 – Environmental Reporting worksheets (please see the Annexes and Appendices).

2.4.3 Distribution losses

2.4.3.1. Technical distribution losses

Distribution losses are either technical or non-technical in nature. Technical distribution losses are a consequence of transferring electricity across the distribution system. Non-technical losses result from the under-recording or non-recording of electricity consumption – for example, when a customer extracts energy from the network illegally. As a proportion of energy lost, non-technical losses represent a much smaller value than those associated with technical losses – approximately 3.7% of overall losses[5]. The remainder of this section examines technical distribution losses. For information about non-technical losses please see section 2.4.3.2.

Technical distribution losses have a significant financial and environmental impact on customers due to the need to generate additional electricity (with the associated infrastructure costs and CO_2 emissions), which is subsequently consumed through losses. These technical losses can never be eliminated completely, but through innovation, research and adoption of a robust losses strategy it is possible to manage them and to establish a variety of cost-effective methods to mitigate their impact.

There is a variety of technical losses but the two principal types are fixed and variable. As energy passes through our network, a small proportion is lost as heat. This is known as a variable loss, as it varies with the flow of energy distributed. Unfortunately, this relationship is not linear and so peaky loads incur proportionately higher losses than those associated with flat load profiles, especially during peak demand periods.

Fixed losses are largely independent of the energy being transferred across the network and mainly relate to energy required to energise transformers. For a typical distribution network, around 30% of technical losses will be of the fixed variety and around 70% will be of the variable type, although we observe regional variations in this ratio.

[5] Ofgem's Energy Efficiency Paper suggested that total system losses in 2012/13 across Great Britain were 27TWh. Of these 19.6TWh related to distribution network technical losses, 6.4TWh to transmission technical losses and 1TWh to non-technical losses.

2.4.3.1.1 Our losses strategy

Our broad strategic objective for managing network technical losses is to control them at a level that is economically justified and to factor appropriate loss mitigation measures into all categories of network investment. We are also working to reduce our technical losses through the introduction of innovative solutions.

Our Losses strategy follows a three-step approach of:

- Understanding losses
- Plan and design
- Build and operate

Our strategy recognises that there are areas that can be tackled with almost immediate effect whilst others require a period of research and learning prior to implementation. Some of the areas/approaches, which rely on new technologies or processes, can only be implemented once a deeper knowledge and understanding has been gained or new technologies are more widely available.

We are currently updating our Losses strategy to reflect our latest developments and plans. The updated version will be made publicly available by the end of December 2021.

2.4.3.1.2 Current assessment of distribution losses

In order to further our understanding and develop methods for mitigating losses, we have, through the Losses Discretionary Reward (LDR) initiative, commissioned Imperial College London's Researchers, Princeton University and other distinguished partners to undertake a variety of studies. For the benefit of our stakeholders, we have published reports and other material of interest that our research produced on our losses website[6], which also contains interactive explanations for the various losses types and causes.

Where the cost can be justified by the benefit, we have embedded various solutions into our business-as-usual activities. We accept that understanding losses is an ongoing process and while some areas of losses are well understood, others pose considerable challenges. For example, historically, LV networks contained relatively few measurement points per circuit and where they did exist, the measurement may have consisted of only a single, static maximum demand value for the total substation load.

Notwithstanding data availability challenges, we have developed robust Cost-Benefit Analyses (CBAs) that justified upsizing LV and HV mains cables. To do this, we used a mixture of engineering, statistical and economic analyses to overcome the challenges presented by data sparsity. We presented our new approach for HV cables to our peers in the ENA's Technical Losses Task Group (TLTG) in April 2019 to ensure it was widely accepted.

During LDR tranche 2 we successfully trialled 50kVA amorphous steel pole-mounted transformers. During tranche 3 we have extended our trialling to include all other sizes from 25kVA to 200kVA. We have placed an initial order for these larger transformers and installed the first batch of 25kVA and 100kVA units in our network.

Table 13 shows a summary of total losses on our networks from data that has been developed from the E3 – BCF worksheets (see the Annexes and Appendices). From this extract, we are able to provide a position on the percentage of total losses on our three networks.

[6] https://www.ukpowernetworks.co.uk/losses/index.html

	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Total losses (tCO_2e)							
EPN	1,178,316	1,034,381	1,016,939	838,822	603,788	448,578	607,329
LPN	913,887	880,009	779,598	644,058	503,865	495,864	407,761
SPN	663,791	559,249	541,021	489,723	379,314	380,844	328,261
Total losses (GWh)							
EPN	2,860	2,238	2,468	2,386	2,133	1,755	2,605
LPN	2,218	1,904	1,892	1,832	1,780	1,940	1,749
SPN	1,611	1,210	1,313	1,393	1,340	1,490	1,408
Total units distributed (GWh)							
EPN	32,882	32,721	33,295	33,106	32,994	31,973	30,657
LPN	27,632	27,442	27,266	27,012	26,864	25,779	22,309
SPN	19,713	19,413	19,468	19,373	19,379	18,763	17,922
Total losses (%)							
EPN	8.70%	6.84%	7.41%	7.21%	6.46%	5.49%	8.49%
LPN	8.03%	6.94%	6.94%	6.78%	6.63%	7.53%	7.83%
SPN	8.17%	6.23%	6.74%	7.19%	6.91%	7.94%	7.85%

Table 13: Summary of losses

Table 14 shows the losses performance reported through the E4 – Losses Snapshot worksheets for the regulatory year 2020/21 (see the Annexes and Appendices). The values in this table should be read in conjunction with the notes below.

Asset	EPN	LPN	SPN
	Saving (MWh)	Saving (MWh)	Saving (MWh)
LV cables	233	248.9	196.3
HV cables	461.7	279.5	309.8
Distribution ground-mounted transformers	468.1	603.5	398.4
Distribution pole-mounted transformers	121.7	0	30.7
Amorphous steel pole-mounted transformers	16.2	0	0.0
Total	**1,300.7**	**1,131.9**	**935.2**

Table 14: Summary of losses performance

Based on the realised benefits reported in the 2020/21 E4 – Losses Snapshot worksheets, a total of 3,367.8 MWh of CBA-justified improvements were made over the 12 month period. This equates to 785.2 tCO_2e in the year.

Beyond CBA-justified activities, we undertake a large number of activities that substantially reduce losses but for which losses are not the primary driver. An example would include replacing an aged distribution transformer with a current specification Ecodesign transformer of the same kVA rating. Ecodesign transformers comply with EU Regulations setting compulsory maximum losses levels for distribution transformers that are substantially more efficient than older specification transformers. Replacement in this example therefore reduces losses, but as the EU transformer specification is a mandatory requirement, the losses benefits are not included in the E4 – Losses Snapshot worksheets. Table 15 provides a summary of losses reduced through the adoption of more efficient transformers not supported by CBAs focused on losses.

Asset	EPN	LPN	SPN
	Saving (MWh)	Saving (MWh)	Saving (MWh)
Secondary transformers	1,443.0	939.4	759.7
Primary and Grid transformers	997.4	0.0	549.0
Totals	**2,440.40**	**939.40**	**1,308.70**

Table 15: Losses reduced through the adoption of more efficient transformers not supported by CBAs focused on losses

The totals in Table 15 add up to 4,688.5 MWh, which equates to 1,093.1 tCO_2e.

Adding all figures together, we estimate that losses on our networks were reduced by 8,056.3 MWh per annum (equivalent to the annual electricity consumption of over 2,100 homes[7]) as a result of the work UK Power Networks has undertaken. Of this 3,367.8 MWh per annum was explicitly driven by losses considerations.

2.4.3.1.3 Activities undertaken in this regulatory reporting year

Current programmes to manage distribution losses

The following activities are CBA-justified and are embedded in our business-as-usual activities to reduce losses:

- **HV cables** – We are installing larger cross-sectional conductors on the main lines of HV underground feeders to reduce resistance and hence variable I^2R losses. We have completed a comprehensive system-wide study which demonstrated that we save 5.94 MWh/annum for every kilometre of HV underground main line that we upsize from 185 to 300 mm^2 aluminium. This study further revealed that the NPV for this change is strongly positive. The methodology developed in this study was presented to our peers in the ENA's TLTG to ensure that our approach is robust.

  Significant volumes have been upgraded following changes to our HV Network Design policy. In total, 1,051 MWh will be saved every year going forward by upsizing main line conductors in the 2020/21 regulatory year. This is reported in the E4 – Losses Snapshot worksheets.

- **LV cables** – We are also installing larger cross-sectional conductors in LV underground feeders to reduce energy losses. Similar to HV cables, we have completed a comprehensive system-wide study which demonstrated that we save 6.35 MWh/annum for every kilometre of underground main line that we upsize from 185 to 300 mm2 aluminium. This study further revealed that the whole-life benefit for this change is strongly positive.

  Significant volumes have been upgraded following changes to our LV Network Design policy. In total, 678.2 MWh per annum is saved every year going forward through upsized main line LV conductors. This is reported in the E4 – Losses Snapshot worksheets.

- **Use of larger distribution transformers** – We continue to replace existing distribution transformers with larger units where the saving in copper losses (variable) outweighs the increases in iron losses (fixed). Over the last 12 months we have increased the transformer size at 306 sites where the CBA demonstrated a positive NPV, yielding an annual improvement of 1,622.4 MWh. This is reported in the E4 – Losses Snapshot worksheets.

- **Use of amorphous steel transformers** – During LDR tranche 1, we collaborated with a transformer manufacturer to develop a pole-mounted amorphous steel transformer, recognising that fixed losses in distribution transformers account for a significant percentage of overall technical losses. During the 2020/21 regulatory year we installed nine of these units on our networks, collectively delivering an energy loss reduction of 16.2 MWh per annum for their entire lifespan.

[7] Average annual electricity consumption per home obtained from this website: https://www.ovoenergy.com/guides/energy-guides/how-much-electricity-does-a-home-use.html#:~:text=How%20much%20electricity%20does%20a%20UK%20home%20use%3F,very%20large%20amounts%20of%20electricity.

- **Detection of contact voltage losses** – Also during LDR tranche 1, through our work with Princeton University, we discovered a new losses category that does not fit into the standard definition of either technical or non-technical losses – contact voltage losses (CVLs). We have invested in a Mobile Asset Assessment Vehicle (MAAV) and developed a programme to assess CVLs. Unlike any other category of technical losses, these are almost entirely avoidable with sufficient investment. In LDR tranche 3, we are working towards detecting these losses using our Active Network Management System (ANM) to enhance the success rate at which our MAAV detects CVLs.

  For the 2020/21 financial year, the use of this vehicle realised an energy loss reduction of 2,871.2 MWh. We did not include this saving in the tables for this section on the basis that MAAV-related figures are reported in our E6 – Innovative Solutions worksheets (see the Annexes and Appendices).

The following activities were not driven primarily by network losses considerations but were undertaken as part of our business-as-usual activities and have had a positive impact on energy loss reduction:

- **Replacement of distribution and power transformers** – We continue to replace existing transformers with Ecodesign specification units that reduce fixed and variable energy losses. This year we replaced a total of 1,090 distribution transformers, which reduced losses by 3,142.1 MWh per annum. In addition, we replaced 11 primary and grid transformers, further reducing losses by 1,546.4 MWh per annum. These energy loss reductions were not declared in our E4 – Losses Snapshot worksheets because the investments were not driven by energy efficiency considerations.

- **Ongoing review of design standards** – We are continuously developing new business cases to support further losses reductions. Once we have established a positive CBA in favour of an intervention, we amend associated Engineering Design Standards to ensure that our recommendations are implemented swiftly and effectively. In this way, we ensure that losses are minimised for the entire lifespan of our new assets.

2.4.3.1.4 Forthcoming programmes to manage distribution losses

During the next regulatory year we will continue to broaden our understanding of distribution losses, further develop our tools and processes, and embed these into our business-as-usual activities. For example, we will be trialling further sizes of amorphous steel pole-mounted transformers. We will also continue our collaboration with manufacturers and disseminate our findings to other DNOs who might benefit from this activity. Looking ahead, we will continue to consider the impact our developing DSO capabilities are likely to have on network losses.

We will continue to investigate how new approaches and technologies such as flexibility and our ANM interact with network losses. Broadly speaking, these technologies are being developed to maximise network utilisation, which delivers financial and societal benefits to our customers by reducing the need to invest in network upgrades – but they will, as a side effect, increase technical losses. We therefore work towards making energy losses a part of every CBA that we develop to assess the economic merits of using new technologies.

We will also keep abreast of new technologies coming to the market that may be used to minimise losses. Technological developments may also highlight new areas that we can focus on to target losses.

2.4.3.1.5 Summary of losses activities and benefits during this regulatory reporting year

Table 16 provides a summary of the costs and benefits from our CBA-justified losses activities and has been developed from the E4 – Losses Snapshot worksheets (please see the Annexes and Appendices). From this extract, we are able to present the cumulative effect of our CBA-justified losses activities during the whole of the RIIO-ED1 period to date.

Programme/ project title	Regulatory reporting year (2020/21)			RIIO-ED1
	Distributed losses – justified cost	Reduced losses	Reduced emissions associated with losses	Cumulative reduced losses to date
	£m	MWh	tCO_2e	MWh
LV cable	0.292	678.3	158.14	6,283.36
HV cable	0.419	1,051	245.03	2,918.65
Distribution transformers	0.338	1,622.38	378.24	6,943.33
Amorphous steel transformers	0.001	16.19	3.77	47.69
Totals	**1.048**	**3,367.87**	**785.19**	**16,193.03**

Table 16: Summary of losses costs and benefits from activities in RIIO-ED1 (technical losses)

Table 17 shows a summary of the volumes of CBA-justified losses activities during this regulatory reporting year and has been developed from the E4 – Losses Snapshot worksheets (please see the Annexes and Appendices).

Programme/project title	Description of unit	Volumes in regulatory reporting year (2020/21)	Forecast volumes for following regulatory year (2021/22)
LV cable	km	106.8	100-200
HV cable	km	176.9	100-200
Distribution transformers	ea	303	200-300
Amorphous steel transformers	ea	9	20-100
Primary and Grid transformers	ea	N/A	N/A

Table 17: Summary of amount of losses activities in the regulatory reporting year and estimate for the following regulatory year (technical losses)

2.4.3.2. Non-technical distribution losses

Non-technical losses occur through failures to correctly record electricity consumption within industry settlement systems. The primary responsibility lies with electricity suppliers who must ensure that they accurately read meters, set the correct energisation status against each metering point, and detect and investigate situations where people tamper with their supplies. Separately, there is that element of electricity theft committed by persons who make unauthorised connections to the distribution system and do not register with a supplier. This is known as theft in conveyance and it falls to the DNO to resolve.

Tackling theft in conveyance is important as a licence obligation and as mandated by industry codes but there is also a broader societal element. Reducing ongoing theft is crucial but our operations serve to identify and remedy the dangerous situations associated with unauthorised connections. Our investigators will frequently encounter overloaded connections, substandard wiring and exposed conductors presenting both fire and electrocution risks. UK Power Networks is helping to protect the occupiers of these premises, their neighbours and the wider general public.

As shown in Table 18, our 2020/21 programme of work led to 333 cases of theft in conveyance being resolved across our three licence areas. A further 321 cases investigated during 2020/21 remained 'in progress' and UK Power Networks is either working with property owners to facilitate appropriate connection arrangements or awaiting meter point registration by the customer's chosen supplier. Whilst domestic sites represented the largest component, significant commercial and industrial sites also featured. Among the highest-consuming sites resolved in the year were mobile phone and radio transmission masts, a sewage works, a train station and a large children's nursery.

The overwhelming majority of cases are resolved through the customer registering their metering point with a supplier in accordance with normal industry processes. Nevertheless, in a small number of cases UK Power Networks may need to consider disconnection of the unauthorised supply. In the absence of serious safety concerns we seek to avoid enforced disconnections but our policy recognises this as a last resort to avoid the indefinite continuation of electricity theft.

In 2020/21 UK Power Networks continued to work with other DNOs and suppliers to promote more effective electricity theft reduction. We remain active members of the Theft Issues Group, which operates under the industry's Distribution, Connection & Use of System Agreement (DCUSA). We have also been engaging with the Retail Energy Code Company (RECCo), who will be taking over governance responsibilities later in 2021. As members of the UK Revenue Protection Association, we have shared best practice and operational approaches that have allowed field investigations to safely continue during the COVID-19 pandemic.

Table 18 and Table 19 summarise key figures in respect of non-technical losses activities. Table 19 shows projected savings in megawatt-hours as a result of resolved instances of theft in conveyance. It also shows a calculation of the tonnes of CO_2 associated with this volume of electricity losses.

Programme/project title	Description of unit	Volumes in 2020/21 reporting year[8]
Countering Theft in Conveyance	Resolved theft in conveyance cases	333
	'In Progress' cases	321

Table 18: Summary of theft in conveyance losses activities in the 2020/21 regulatory reporting year

Programme/ project title	Regulatory reporting year (2020/21)			RIIO-ED1
	Distribution losses- justified costs	Estimated reduced losses	Reduced emissions associated with losses	Cumulative reduced losses to date
	£m	MWh	tCO_2e	MWh
Countering Theft in Conveyance	0.27	11,062	2,579	34,984

Table 19: Summary of losses costs and benefits from resolved theft in conveyance cases in the RIIO-ED1 reporting year

[8] Given that activities are driven by theft in conveyance being reported to, or identified by UK Power Networks, these volumes cannot be accurately forecast. In essence, the volume of work undertaken during the year will be driven principally by the quantity and quality of leads received from numerous industry parties and supplemented by self-generated leads. We estimate total leads to be broadly in line with the previous year's figures.

2.5 Other environment-related activities

2.5.1 Flood preparedness

In 2020/21 we continued to invest in the flood protection programme to ensure that customer supplies are protected from flood risk and to achieve our commitment of protecting 78 substations from the impact of flooding during the RIIO-ED1 price control period. This commitment typically takes the form of investing in physical asset protection at substations to ensure that customer supplies are not interrupted during an extreme flooding event.

In 2020/21 we successfully flood-protected 11 substations serving in excess of 86,000 customers, bringing the total number of mitigations so far in RIIO-ED1 to 60. Protection will usually be achieved by protecting or raising critical equipment above the 1:1,000 year flood level, allowing for a climate change factor and 300mm freeboard to ensure that mitigations remain effective for the lifetime of our substations.

Investment has also taken the form of research, monitoring and ongoing analysis of flood risk across our operating areas. We are continuously investing to assess flood risk and to develop further capability in dynamic flood risk analysis and response across all three of our licence areas. Improved data supports our intervention strategy for both RIIO-ED1 and RIIO-ED2.

Alongside the typical approach of protection from fluvial and tidal flooding, we ensure that supplies and critical assets are fully flood-protected from all sources. Assessments and projects also consider localised surface water flooding and groundwater flooding. In densely populated areas, such as central London, infrastructure failure of water mains can cause devastation to critical subterranean substation assets and must also be considered. We work closely with water infrastructure owners and implement flood-protection measures where required.

We have sought to provide flood-protection measures that are cost-efficient over the lifetime of the asset and deliver the maximum risk reduction to improve the number of customers protected in a worst-case scenario. Overall resilience in the network means that customers can often be very quickly reconnected at minimal inconvenience following flooding of critical equipment through automated switching. River levels and Environment Agency guidance are monitored during extreme weather events to inform the potential deployment of 1,000 metres of demountable flood barriers.

Aside from our targeted flood mitigation programme, we have implemented improvements in business-as-usual processes to ensure that flood resilience is at the forefront of all project planning and major investment in the network. Increasingly, plant and equipment is specified or modified to ensure a greater clearance from ground level and building designs have been adapted to ensure additional resilience from flooding. We are actively working with equipment suppliers to help design and bring new products to the market that improve overall flood resilience throughout the network.

Our flood protection programme complies with two key documents: UK Power Networks' policy and design guidance document EDS 07-0106 – Substation Flood Protection and the industry best practice document ETR 138 – Resilience to Flooding of Grid and Primary Substations. UK Power Networks is an active participant in Energy Networks Association flooding and climate change groups to ensure consistency, industry best practice and compliance to the most up-to-date regulation and standards.

We recognise that in addition to protecting customer supplies and our own assets we have a responsibility to both stakeholders and neighbouring communities to be an active participant in local flooding forums and proposed third-party projects to protect both property and business. Often, a reliable electricity supply is vital to operate third-party pumps or automated flood-protection systems. UK Power Networks was an active and willing participant in a number of public meetings, forums and consultations in 2020/21, including proposals in Tilbury, Yalding and East Peckham.

UK Power Networks records and reports its flood related costs, volumes, protected sites and customer numbers to Ofgem each year. For more information please refer to the Annexes and Appendices, which contain a link to the worksheets CV16 and M1 (Flood Mitigation) for our three licensees.

2.5.2 Green Action Plan

Our Green Action Plan (GAP) was launched in 2019 as a suite of additional stretch targets on our existing RIIO-ED1 commitments and to lay the foundations for the work needed to develop our Environmental Action Plan (EAP) for RIIO-ED2. We continue to align our plans to the UN Sustainable Development Goals and have made significant commitments in our EAP for RIIO-ED2. The social, economic and environmental concerns around protecting the environment, addressing our environmental impacts and protecting ourselves from environmental/climate change continue to grow in urgency.

The core GAP targets are outlined in Table 20 and will largely be subsumed into the EAP, with preparatory work taking place in the final year of RIIO-ED1. Progress against these targets is outlined in the following sections and in our commentary on our BCF; please see section 2.4.1.

Aim	Objectives	Targets
Energy	Reduce energy use in our top six buildings	10% reduction by 2021
Carbon	Business Carbon Footprint (BCF) reduction	20% reduction by 2021
Biodiversity	Promote net gain, minimise species decline	Increase biodiversity potential by 20-30% at 100 of our sites by December 2021
Pollution	Reduce nitrogen oxide (NOx) emissions from our fleet and generators	33% reduction by 2030
Noise	Identify future potential developments and noise issues	Contact 100% of all local authorities to review their development plans by 2021
Water	Reduce water consumption at our top six largest sites	10-15% reduction by December 2021
Waste	Divert waste from landfill and increase recycling at our top six largest sites	90% of waste diverted from landfill and 80% of waste recycled from our top six largest sites by December 2021

Table 20: Core GAP targets

2.5.3 Energy Management

On the back of audits completed for the Energy Savings Opportunities Scheme (ESOS), we have continued to address energy saving initiatives. These have ranged from reducing plant run times to better reflect occupational needs to upgrading lighting to LED, improving insulation and upgrading plant. We have also assessed opportunities for our sites to have on-site generation in the form of solar PV and considered how we might occupy sites going forward, including the amount of space we might need post pandemic. One example of a positive change is that we moved into a new site at Borehamwood which has an Energy Performance Certificate (EPC) rating of A, relinquishing two sites with poorer EPC ratings of D.

We are likely to achieve our energy reduction targets but these have been distorted slightly by the COVID-19 pandemic, although our buildings did remain open for staff. For more information on the carbon impact and additional measures taken, please see section 2.4.

2.5.4 Carbon management and science-based targets

In April 2021 UK Power Networks became the first DNO to have its targets verified by the Science Based Targets initiative (SBTi). Targets in the SBTi framework align with the climate science and Paris Agreement to limit global warming to well below 2°C (WB2D) above pre-industrial levels and pursue efforts to limit warming to 1.5°C.

Our baseline SBTi carbon footprint for 2018/19 determined that 73% of the footprint was down to network losses, 24% to our supply chain and the remaining 3% to our directly controlled emissions. While the actions we take on network losses will help to reduce emissions, we anticipate that the bulk of carbon reductions will be achieved through grid decarbonisation, as the share of generating power increasingly moves to renewables. UK Power Networks has a significant role to play in facilitating net zero for society at large by preparing distribution networks to accommodate distributed generation, low carbon heat and EV infrastructure.

We have applied the BEIS average grid carbon forecasts in our carbon reduction models, which are based on existing policy and committed interventions rather than potential future policy and actions that have yet to come to fruition. As a consequence, we have a verified target for all our emissions at the WB2D level, but have set an internal stretch target of 1.5 degrees for our directly controllable emissions (fleet, temporary generators, buildings and depots, etc.).

Importantly, we have elected to voluntarily include our scope 3 supply chain emissions in the verified SBTi WB2D target. Under the SBTi rules, we are permitted to exclude these emissions as they make up less than 40% of our total footprint. This would not be acceptable to us as we believe that the influence we have across the supply chain is an important factor in the wider decarbonisation of the economy and the trajectory to net zero.

2.5.5 Biodiversity

Natural resources underpin every aspect of business and society. One element of this 'natural capital' is biodiversity, which provides ecosystem goods and services including food and materials, soil and habitat formation, climate regulation, water purification and pollination.

The introduction of the Environment Bill will provide a framework to implement the ambitions of the government's 25 year environment plan, which aims to set out a comprehensive long-term approach to protecting and enhancing natural landscapes and habitats in England for future generations. These include Biodiversity Net Gain requirements on new development sites to protect habitat, mitigate any damage done and increase the potential for biodiversity on the site, nearby or elsewhere by at least 10%. In our 2019/20 Environment Report we explained that we had committed to increasing the biodiversity potential of 100 of our larger sites by 20-30% by December 2021 as part of our GAP. Site surveys of the targeted 100 sites have continued throughout 2020/21, with Biodiversity Net Gain being assessed and plans being drawn up to implement the ecologists' management recommendations, some of which are illustrated below as case studies.

As shown in Figure 4, the pond at Ilketshall substation underwent restoration funded by Natural England as part of the District Level Licensing scheme. This is a strategic approach to mitigating for the effects of development by making more new and restored ponds available in the wider countryside than will be lost to development, allowing great crested newt populations to recover to healthy levels. The pond had become overgrown with reeds with almost no open water. A digger cleared the pond and re-profiled the bed to create deeper areas. Once the pond has refilled naturally and some broadleaf plants suitable for newts to lay eggs in have re-emerged, we hope the newts will use it for breeding.

Figure 4: The restored pond at Ilketshall substation

The biodiversity project has identified nationally scarce or threatened plants at several substations, notably Maiden Pink at Icklingham substation. This site is part of a Site of Special Scientific Interest, designated for its Acid Grassland habitat.

Where possible, enhancements will be implemented by staff volunteers, creating opportunities to spend time in nature which is known to support mental wellbeing, another of the ecosystems services provided by biodiversity.

2.5.6 Minimising pollution

The work we are pursuing for our carbon reduction plans has a direct impact on air pollution caused by the burning of diesel in our road vehicles, fleet and temporary generators.

As part of our SBTi work we will:

- Introduce EVs and remove the oldest diesels from the fleet
- Ensure there are options for employees to select EVs and hybrids for our grey fleet
- Work with our suppliers to provide cleaner fuels where available and hybrid or battery temporary generators under our contracts and hire agreements
- Commence a trial in 2021/22 on hybrid temporary generators

These initiatives will help to reduce NOx and particulate matter as well as our carbon emissions.

2.5.7 Noise and local authority engagement

Our environment team continues to engage with local authorities to raise awareness of the need to consider our grid and primary substation sites in the planning process and to incorporate suitable planning conditions where necessary. Working with a specialist acoustic consultant, the business has developed contours that can be applied to our geospatial mapping system to highlight locations where there is potential for future noise nuisance (Figure 5 provides an example). The map will show where the noise contours intersect with areas identified for residential use by local authorities in their Strategic Housing Land Availability Assessments.

We are also working to develop a universal planning condition which could be applied to ensure that the agent of change (i.e. the developer), not our customers, meets the cost of mitigation in accordance with section 182 of the National Planning Policy Framework.

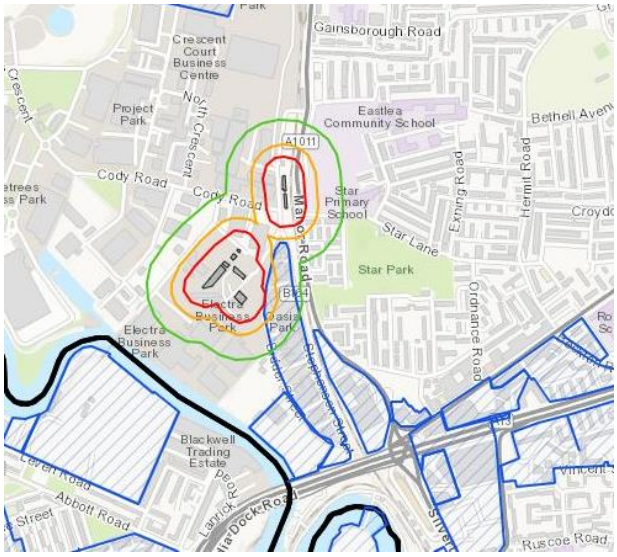


Figure 5: An example of noise contours highlighting a location where there is potential for future noise nuisance

During 2020/21 we received an unprecedented number of enquiries – 80 versus the average over the previous five years of 38. We believe this increase was due to the COVID-19 pandemic. Ambient noise was greatly reduced during periods of lockdown, which may have made the hum from transformers more noticeable, coupled with the fact that many people were working from home and likely to be more aware of and more sensitive to external sounds.

When customers contact us about noise, our environment team conduct an initial desktop assessment to determine the likelihood that our equipment is causing a noise nuisance. When appropriate they will either visit to take noise measurements or engage a specialist acoustic consultant to conduct a survey and make recommendations. Findings are assessed against the procedure for assessment of low frequency noise complaints which was developed by Salford University (NANR 45) on behalf of Defra to determine whether a low frequency noise would be considered a Statutory Nuisance under the Environmental Protection Act.

It is important to note that the overwhelming majority of complaints prove to be not justified because the noise is either below the level of nuisance or is not attributed to UK Power Networks' equipment or operations. In the past year we have surveyed 27 sites and made interventions at six sites where the noise was directly attributable to our equipment. These were anti-vibration pads at three sites, an acoustic curtain for one site, a noise enclosure for another and a transformer replacement for the remaining site.

2.5.8 Water management

As part of our GAP objectives we have committed to achieving the Carbon Trust Water Standard by December 2021. This standard provides industry recognition to the organisations that take a best-practice approach to measuring and managing their water use and achieve real reductions year on year.

We received the Carbon Trust recommendations from our gap analysis for our top six sites in February 2020 and since then we have prioritised delivering on these recommendations and developing reporting processes to manage our water usage effectively across all our occupied and operational sites. This provides the opportunity to identify, investigate and resolve high water usage anomalies in a timelier manner.

To date we have significantly improved the monitoring and targeting of water consumption by working in partnership with our supplier and our facilities management teams. This has identified leaks and billing anomalies, saving significant volumes of water and costs. Our next practical steps are to review the costs and implementation of smart metering to see if this intervention warrants the cost of installation.

We have also assessed water consumption and identified key priority sites based on volume consumed, site capacity and water scarcity for that region.

2.5.9 Office and depot waste

In 2020/21 UK Power Networks generated 4,448 tonnes of office and depot waste, a reduction of 732 tonnes on the previous year. Of this 531 tonnes (12%) ended up in landfill. The remaining 3,917 tonnes (88%) were diverted from landfill and either recycled or used for energy recovery. This is significantly ahead of our existing target for the current price control period of 70% diversion from landfill, but just short of the new target of 90% which has been set as part of our GAP.

2.5.10 Carbon Trust Waste Standard

In line with our GAP objectives, we have committed to reducing our waste and achieving the Carbon Trust Waste Standard. This standard is internationally recognised and awarded to organisations that manage and successfully reduce their waste output.

We completed a gap analysis of all our waste streams with the Carbon Trust in early 2020 and have been working on the recommended actions that will enable us to better measure, monitor and analyse our data to understand our waste footprint and impact. We are finalising our submission to the Carbon Trust with the aim of achieving the certification in 2021/22. This will also enable us to develop our circular economy approach to managing the material coming into our business and disposal/reuse routes.

We have implemented some initiatives alongside circular economy principles; for example, ensuring as much as possible of the furniture (desks, breakout furniture and meeting desks) at our new site in Borehamwood was high quality second hand. We have introduced precast low carbon concrete into the designs for our transformer bases and also now offer precast bases for new distribution substations which include ground granulated blast furnace slag (GGBS) in the concrete mix. This reduces carbon emissions by over 34%, as well as significantly lowering emissions through reduced materials, labour and deliveries to site.

2.5.11 Environmental awareness

Although face-to-face training became a challenge during the past year, we have continued to evolve our RoSPA accredited Working within the Environment training course by delivering it online. Due to the social distancing requirements and limitations of COVID-19, our environment team have continued to deliver training to enhance environmental awareness within the business. This has included ad hoc calls and training with customer advisers dealing with enquiries on topics from noise to foxes; providing them with knowledge and sources of information to address the immediate need and help them respond to future enquiries.

2.5.12 Alliance Contractor Forum

We continue to strive for environmental best practice through knowledge sharing and our long-established Alliance meetings act as a platform to share information regarding environmental issues. These monthly meetings are attended by UK Power Networks' environmental and sustainability business lead experts, our third-party ecologists and our key contractors' environmental experts. The contractors involved include Morrison Utility Services, Clancy Docwra, Kier and ADAS. The objective of this forum is to drive forward UK Power Networks' GAP commitments, review action point recommendations, and review current initiatives and new technologies. Terms of reference are established to provide a clear framework for ownership, responsibility and expectations of these meetings.

The objectives of these meetings are:

- Review and resolution of points raised in the Alliance Action Plan to support the GAP
- Challenge ourselves to deliver carbon neutral projects, and support the net zero aspirations of UK Power Networks and the industry
- Provide a positive impact on the environment and improving biodiversity
- Eliminate waste to landfill
- Suggest, investigate and establish best practice innovation techniques
- Embed environmental consideration into design and pre-construction
- Integrate supply chain partners and promote their involvement and ideas; increasing awareness, knowledge and engagement

This engagement is essential and assists us in the ongoing identification of greenspace sites. It also enables us to identify new opportunities for improving biodiversity at such sites; for example, we can identify where a construction project is coming to an end and reseed the ground with a more diverse species. Recent discussions of low carbon technologies include net zero concrete, solar pods for our construction sites (particularly to support the rising numbers of EVs on-site), and planned biodiversity assessment visits.

2.5.13 Critical Friends Panel (CFP)

As part of our engagement with stakeholders for RIIO-ED2 we created a subject matter expert panel to review our high-level targets and plans. The panel members represented other utility operators, environmental, energy and carbon consultants, the Institute of Environmental Management and Assessment (IEMA), the Carbon Trust, Wildlife Trusts, the Energy Savings Trust, our supporting contractors and key representatives from our supply chain.

These sessions were used to test our key targets and provide expert challenge and opinion on areas of weakness and strategic direction focusing on:

- Third-party verification and transparency for carbon targets
- Net zero targets, carbon offsetting options and appropriate hierarchies for offsetting
- Supply chain and procurement strategies
- Inclusion and importance of scope 3 carbon emissions in our supply chain
- Biodiversity net gain and improvements to habitat we manage
- Fleet improvement and opportunities to transition to EVs
- Pollution, air quality and symbiosis with carbon reduction and noise
- Proactive approaches to noise issues at substations
- Resource use, circular economy and embedded carbon

2.5.14 Environmental reporting: civil sanctions

We report on any cautions, notices, warnings, penalties, prosecutions and reportable environmental incidents. Our 2020/21 results are reported in our E2 – Environmental Reporting worksheets (please see the Annexes and Appendices).

The majority of civil sanctions in 2020/21 related to actual or potential pollution that was reported to the Environment Agency. Most of these were due to leaks from fluid filled cables, with the remainder linked to transformers. We received seven warning letters from local authorities regarding fly-tipping and other waste issues. We removed the waste from three sites but rejected four warnings because the affected land was not owned by UK Power Networks. There was one incident relating to damage of tree roots and a warning letter about noise was rejected because the source was not owned by UK Power Networks.

2.5.15 Environmental benchmarking: Hang Seng and Dow Jones Sustainability Indexes

UK Power Networks contributes to its shareholder Power Assets Holdings Limited's Hang Seng Sustainability Index and Dow Jones Sustainability Index submissions on an annual basis. Our responses provide information from our in-business experts aligned to our strategies, corporate governance, policies, innovation programmes, initiatives and performance associated to environmental matters. This covers a variety of topics such as carbon reduction and new low carbon technologies, energy reduction, biodiversity improvement, waste reduction and circular economy. Other elements include how we manage environmental risks and comply with legislative and regulatory requirements.

These submissions and their results provide assurance to our stakeholders that UK Power Networks operates in an environmentally sustainable and corporately responsible manner. With UK Power Networks' input, Power Assets Holdings Limited continues to retain a position on the Dow Jones Sustainability Index and an AA high score rating for the Hang Seng Sustainability Index.

2.5.16 Community engagement: Tree planting to combat poor air quality

We have partnered with Trees for Cities to tackle poor air quality in deprived areas and help boost biodiversity and green space. After an initial delay due to the COVID-19 pandemic, Trees for Cities has successfully planted 2,669 trees on our behalf to partially offset some of the NOx emissions from our vehicle fleet and temporary generators. The estimated tonnage of pollutants over the lifetime of the project is 126 tonnes. We will review the scheme and consider next steps for 2021/22 and into RIIO-ED2, as projects like this have social and environmental benefits.

The tree species planted have been chosen for multiple functions. They have good carbon sequestration capabilities, are able to absorb pollutants and blend well with the natural urban surroundings. The combination of species includes a varied list to help ensure resilience across the woodland as a whole. Follow-up inspections and maintenance are provided as part of the scheme to ensure the trees become established. The vast majority of species are expected to live well in excess of 100 years.

To ensure transparency, this project has been verified by a third party in line with the requirements of ISO 14064-3. Avieco conducted a limited verification assessment on the trees planted by Trees for Cities to offset the air pollutants produced by UK Power Networks.

2.5.17 Streetworks waste classification

The Environment Agency's Regulatory Position Statement (RPS) 211 has allowed utility companies to classify small volumes of excavated waste as non-hazardous, without the need for extensive classification. However, the Environment Agency plans to withdraw the RPS (currently scheduled for June 2022), which will mean that companies will be required to assess and classify all their waste to determine whether it is hazardous or non-hazardous.

UK Power Networks is working alongside Street Works UK to develop a sampling protocol that will be trialled and tested prior to submission to the Environment Agency for approval. The sampling plan has moved into phase two with sampling works and surveys planned to take place in the next few months. The results will inform the final sampling protocol.

3 Smart Grids, Innovation and Our Role in the Low Carbon Transition

3.1 Introduction

Great Britain is in the midst of a decarbonisation, decentralisation and digitisation change as significant for the electricity industry as the advent of broadband was for the communications sector. The carbon intensity of producing electricity in the UK fell 55% from 2008 to 2018[9]. The rise of commercial energy storage heralds a new era of renewable energy. We have connected over 2,500 large generators and over 46,000 small solar PV systems to our network in the last six years alone. We are putting in place a future-ready grid for a zero carbon world, while continuing to recognise the financial, social and security of supply impacts of that change.

Our comprehensive Innovation Strategy is informed by stakeholders. It aims to prepare us for future worlds as they emerge and to support and facilitate the transition, both for our most ambitious stakeholders and those most at risk of being left behind. Our DSO and flexibility roadmaps and our EV readiness programme are examples of how our business activities are guided by our strategic focus to provide a secure, reliable and ultimately net zero carbon system that addresses our customers' evolving needs.

The world has changed this past year but the target to bring all greenhouse gas emissions in the UK to net zero by 2050 has not. Climate change remains the greatest challenge facing our generation and the generations to come. Rapid decarbonisation of the heating, transport and energy sectors is needed to overcome this – all of which depend on the electricity network.

This section highlights the changing policy context, low carbon technology (LCT) uptake, our innovation portfolio, innovation benefits delivered into business as usual and our strategy for maximising the benefits of smart metering.

3.1.1 Changing policy context and the developing DNO role in low carbon transition

The government released the ten point plan in November 2020, shortly followed by the Energy White Paper in December 2020. £12 billion of government investment in renewable electricity, low carbon heating and transport will follow. Sales of new petrol and diesel cars will end in 2030. Schemes like our Green Recovery programme, launched in February 2021, are seeking to kick-start the low carbon economy.

Many have gone further than the UK government targets. Regional and local authorities and communities have set themselves even more ambitious targets. Some, like London, are targeting 2030 to reach net zero. Car manufacturers are committing to stopping sales and the manufacture of petrol and diesel cars sooner than 2030. Rapid divestment in fossil fuels has mirrored increased investment in renewables.

[9] https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Electricity-generation.pdf

Technologies such as renewable energy, EVs and low carbon heating are all at different levels of maturity and are evolving at different speeds. We must keep pace as we seek to be an enabler of change rather than be seen as a blocker. Given this key objective to facilitate net zero, we have made a commitment to share our baseline and outlook for both electricity demand and LCT uptake within an annual publication of Distribution Future Energy Scenarios (DFES). Built on stakeholder input, and leveraging multiple datasets, we have updated our DFES for 2020/21. The outlook is now framed around four potential 'scenario worlds' that closely align with the narrative presented by National Grid in its Future Energy Scenarios, as shown in Figure 6 below.

Parameter	Steady Progression	System Transformation	Consumer Transformation	Leading the Way
Net-Zero by 2050?	No	Yes	Yes	Yes
Low-carbon gas grid?	No	Yes	No	Yes
Electric cars and vans in 2030	2.6 million	4.5 million	4.5 million	4 million[2]
Homes with heat pumps in 2030	320,000	445,000	712,000	1,245,000
Homes with solar panels in 2030	195,000	248,000	397,000	248,000
Battery capacity in 2030	1.3 GW	2.7 GW	4.8 GW	4.1 GW
Total renewable generation in 2030	6.1 GW	7.2 GW	8.1 GW	8.6 GW

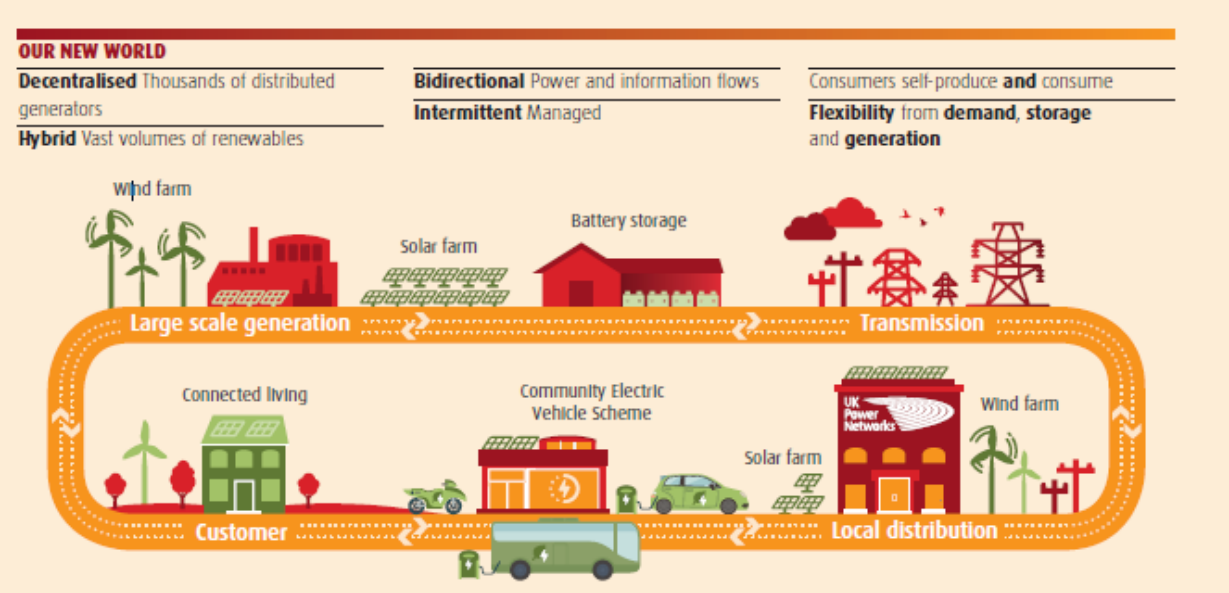
Figure 6: DFES scenario worlds

The LCT uptake scenarios – just one of the datasets we have made available on our Open Data page in the past year – are shared at high geographic granularity (MLSOA and LLSOA, middle and lower level super output layers). The DFES and its datasets will be the foundation for innovation and planning of the networks, including the development of a Strategic Forecasting System to underpin development for the next regulatory period. Accurate modelling within the DFES is key to cost-effective network delivery.

We recognise that our role in delivering a new zero carbon electricity system brings the following key challenges:

- Significant volumes of decentralised generation
- Bidirectional power and information flows
- Significant volumes of renewables with managed intermittency
- Customer sites that both produce and consume electricity

We are able to provide flexibility services to the networks to meet these challenges, guided by the five Smart Grid priorities set out in our DSO strategy (see Figure 7). Alongside this, we are seeing increasing complexity and heterogeneity in demand – with the addition of decarbonised heat, cooling and EV load on the electricity networks, as well as increasing cost and environmental pressure towards energy efficiency of demand.



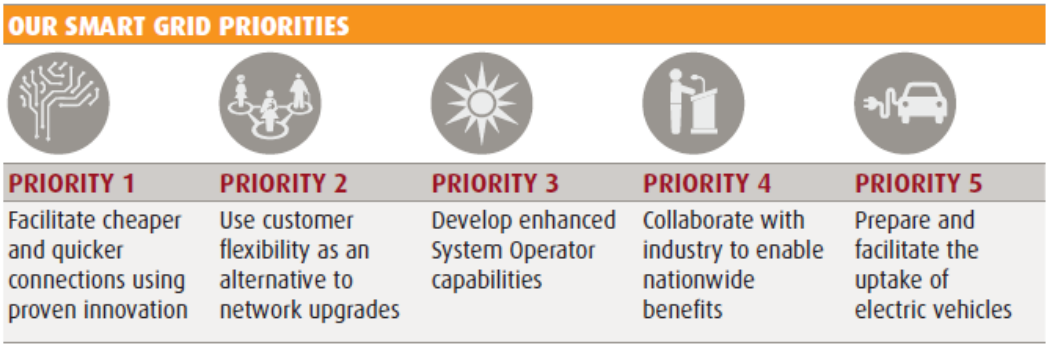


Figure 7: Our five Smart Grid priorities

Over the last regulatory year we have focused on delivering outcomes against our DSO strategy. Examples include:

- **Priority 1** – Building on past innovation projects, we launched Smart Connect, a new platform that will give many technology companies an instant decision on whether they can connect domestic EV charge points, heat pumps, battery storage or solar PV. It streamlines the process by removing the need for multiple paper forms and will automatically refer customers if their electricity supply needs to be upgraded to manage the additional power. Installers will also be able to see the current status of multiple applications at the click of a button

- **Priority 2** – As set out in our November 2019 Flexibility Roadmap, we delivered a round of flexibility tenders in April 2020 and February 2021 via the Piclo platform, fulfilling our commitment to transparently market-test against requirements for load-related reinforcement

- **Priority 3** – Our Power Potential innovation project completed its live trials. The project delivered a live DERMS (Distributed Energy Resources Management System) system integrated with four distributed energy resource (DER) customer sites. The project successfully proved the ability of distribution connected DER to deliver reactive power services with the transmission system operator. The learning from the project has been used to support a business plan commitment to roll out this service in other parts of our operating area during the RIIO-ED2 period (2023-2028)

- **Priority 4** – We continued to disseminate innovation project learning and work collaboratively with other network licensees via the ENA's Open Networks project

- **Priority 5** – We continued to implement our Electric Vehicle Strategy and launched a number of innovative projects to facilitate uptake of EVs, in particular looking at public on-street (Charge Collective, White Van Plan) and en-route (Voyage) charging. This is described further in section 3.2.2.

3.1.2 Low carbon technology (LCT) uptake in the E7 tables – DG, EV charge points and heat pumps

Since 2015 we have monitored yearly uptakes of distributed generation, EV charge points and heat pumps and reported these values to Ofgem. The values presented in Table 21 and Table 22 are for the 2020/21 regulatory year and are reported in the E7 – LCTs worksheets (please see the Annexes and Appendices) for the three licence areas. They show the combined values for the primary and secondary networks.

	EPN	LPN	SPN	Total
Heat Pumps	1,405	52	408	1,865
EV slow charge	416	1,619	314	2,349
EV fast charge	4,608	1,267	2,986	8,861
PVs (G83)	1,737	403	1,070	3,210
Other DG (G83)	0	0	0	0
DG (non-G83)	3	1	2	6
Total	**8,169**	**3,342**	**4,780**	**16,291**

Table 21: Number of LCTs connected in the last regulatory year (not including storage)

	EPN	LPN	SPN	Total
Heat Pumps	20	0	2	22
EV slow charge	2	6	1	9
EV fast charge	60	24	35	119
PVs (G83)	6	1	4	11
Other DG (G83)	0	0	0	0
DG (non-G83)	7	1	62	70
Total	**94**	**33**	**103**	**231**

Table 22: Additional megawatts of LCTs connected in the last regulatory year (not including storage)

The tables above and the E7 – LCTs worksheets do not include information on storage assets; however, as noted in our supporting commentary for these worksheets, the significant growth of storage connections is useful context. We currently have over 310MW of grid scale storage connected to our network; almost two-thirds of this is in EPN, one-third is in SPN and a very small amount is in LPN. Decarbonisation of the energy system is best achieved if renewable energy generated can be stored; as such, we believe it is key that growth of this technology is visible in this report.

Our supporting commentary for the E7 – LCTs worksheets confirms that the added LCT volumes were smaller than those predicted for 2020/21 in our RIIO-ED1 Business Plan – as detailed below with additional policy context. Our specific strategies for EVs and heat are detailed in section 3.2.2.

Generation

In the last year 3,210 small PV systems were connected under the G83 and G98[10] Engineering recommendations, as well as six larger generators. The former equated to 11MW of generation connected, compared to 4MW in the previous year; while the latter equated to 70MW of generation connected, compared to 62 MW last year.

We highlighted in previous years that changes in both the Feed-in Tariff (FiT) and Renewables Obligation schemes could result in lower volumes. With the Smart Export Guarantee being mandated from 1 January 2020, despite the impact of the COVID-19 pandemic, we observed a slight upward trend in PV units from the low number of installations in the last regulatory year (an increase of 880 units on the 2019/20 total of 2,330). For 2021/22, the outlook for distributed generation installations is positive as there are now various policies and systems to facilitate the development of local flexibility services, along with a national call for post-pandemic green recovery in meeting the 2050 net zero target.

The removal of the FiT and associated database represents a loss of a key data source for small (<50kW) embedded generation installations. In recent years we have seen an improvement in terms of installers notifying us of the installation of small generation. However, there is very low correlation to the FiT data and the notification data and as such, we are not able to simply rely on this dataset.

Low carbon electrified heat

Decarbonisation of heat has lagged expectations throughout the RIIO-ED1 period. In 2015 we expected over 45,000 heat pumps to connect in 2020/21, whereas 1,865 actually connected and even this was 13% less than the previous year. In the last couple of years there has been a shift in the focus and attention placed on this subject, including a number of movements in the policy space that we expect will drive uptake in future years. As we highlighted previously, the assumption at the start of RIIO-ED1 was that the Zero Carbon Homes policy would have been implemented in 2016, kick-starting heat pump deployment. In reality, the Future Homes Standard went out to consultation in October 2019 and closed in February 2020. The proposed plans include a requirement for new build homes to use low carbon heating from 2025 alongside 'world-leading' levels of energy efficiency. We are expecting publication of a Heat and Building Strategy from BEIS later in 2021.

The Renewable Heat Incentive (RHI), which drove the bulk of heat pump installations, had been due to close in 2021, but the domestic RHI has been extended until 2022 and will be replaced by the Clean Heat Grant (CHG) thereafter. Although there was a decline in applications under the domestic RHI for approximately six months, due to impacts associated with the COVID-19 pandemic, from October 2020 RHI installations were surpassing pre-pandemic numbers. It is too early to say whether the Green Homes Grant was a contributing factor.

The Committee on Climate Change has highlighted that UK heat decarbonisation policy needs to be rethought if the 2050 heat decarbonisation targets are to be achieved. As outlined in the government's Clean Growth Strategy, there are proposals to take homes off the gas grid during the 2020s. The CHG is expected to support heat pump uptake from April 2022. The government has recognised that the upfront capital cost of a renewable heat source is the largest barrier to uptake for many people who might otherwise consider converting to renewable heat, which is why the CHG will move away from a tariff-based mechanism towards an upfront grant mechanism. The proposed form of the grant is a flat rate of £4,000 for all technologies eligible under the CHG (although clarification from government is still pending). The onus would be on the market to identify the most cost-effective LCT for each property. For a large proportion of UK Power Networks' stakeholders, this is likely to be heat pumps, as highlighted in the Carbon Trust report for the GLA: Heat pump retrofit in London.

In addition, there are a number of district heating schemes that have received funding from the government's Public Sector Decarbonisation Scheme, and four projects were successful in our Green Recovery scheme. We expect this to be an area of growth in the coming years, although volumes remain low at the moment.

[10] From 27 April 2019, type-tested generation of ≤16 A per phase was connected under Engineering Recommendation G98 instead of G83, to comply with European Network Codes Requirements for Generators (RfG). On the same date, larger generation connections under G59 had to comply with G99 instead.

Our modelling and other industry reports have indicated that energy efficiency will go hand in hand with the electrification of heat. This is becoming an inextricable part of the heat conversation and will be part of our 'flexibility and energy efficiency first' approach going forward.

EV charge points

In our RIIO-ED1 Business Plan we predicted over 48,000 charge points connecting in 2020/21, whereas our records show that 11,210 actually connected; 18% less than in 2019/20. Nearly 80% of these were fast charge points with slow chargers making up the remaining 20%. For the purpose of Table 21 and Table 22, the fast chargers category includes chargers greater than 3.7kW.

There are signs of an upcoming acceleration, however. The volume of EVs registered in UK Power Networks' operating area in 2020/21 is estimated at 60,000 – more than six times the 2015/16 value of 9,500. This growth is being driven by a focus on air quality in urban areas, as demonstrated by the introduction of London's Ultra Low Emission Zone (ULEZ), as well as increasing popularity and affordability of EVs. In fact, despite the impacts of the COVID-19 pandemic, 2020 saw the biggest annual increase in the number of EV registrations, with almost 190,000 EVs registered nationally. Furthermore, as charge points become more visible, it reduces perceived range anxiety in prospective EV owners, making EVs more viable.

We expect numbers of off- and on-street EV charge points to increase in the next regulatory year for a number of reasons. Most obviously, as a direct result of the increase in the number of EVs on the road, for the reasons stated above. While the majority of early adopters have likely had access to off-street parking spaces in which to charge their EVs – as adoption becomes more mainstream, a greater proportion of charging will happen on-street (or at other public destinations).

In addition, the policy environment is better aligned to strong EV uptake and we expect this to further incentivise EV ownership. As part of the government's ten point plan sales of new petrol and diesel vehicles will now end in 2030; 10 years earlier than planned. To support this, a number of government funding streams are in place to encourage EV uptake and charging infrastructure, including £1.3 billion committed to accelerate the roll-out of charging infrastructure and £582 million to extend the Plug-in Car, Van, Taxi and Motorcycle grants until 2022/23. As well as the UK government's legally binding commitment to achieving net zero by 2050, 74% of local councils have declared climate emergencies[11] with a number setting more ambitious net zero target dates. This has resulted in local environment and transport strategies that prioritise the electrification of transport and the infrastructure required to facilitate this.

Finally, the Green Recovery programme aims to unlock over £300 million[12] of investment in network capacity for LCTs – with much of this targeted at EV charging. 61% of the applications received by UK Power Networks were for EV schemes. Among the approved applications are a number of charging schemes including significant capacity at 11 motorway service areas to enable more than 600 ultrafast 150kW chargers and a range of local authority and commercially operated local charging hubs to enable 500 rapid 50kW chargers. This work will be delivered over the next two regulatory years.

[11] https://www.climateemergency.uk/blog/list-of-councils/
[12] https://www.ofgem.gov.uk/sites/default/files/docs/2021/05/dno_green_recovery_scheme_decision.pdf

3.2 Progress of the Innovation Strategy

Our approach reflects feedback from stakeholders who engage with us for idea and project development, and the changing industry context. Most recently, as part of our Draft Business Plan submission we published our RIIO-ED2 innovation strategy which sets out our approach to idea sourcing and selection/prioritisation of ideas to take forward in our innovation portfolio. We are now focussing on collaboration, adopting the shared ENA network innovation themes: consumer vulnerability; net zero and the energy system transition; proactive optimised assets and practices; flexibility and commercial evolution; data and digitalisation; and whole energy system.

One of our key objectives is to make it easier and more accessible for customers, companies, innovators and general stakeholders to engage and collaborate with us. Our strategy covers aspects such as how stakeholders are embedded in the selection and delivery of innovation projects and continues to guide our innovation work in RIIO-ED1. Our primary selection criteria are 'effort to deliver', 'potential benefits' and 'strategic fit'. At the same time we are transitioning towards our RIIO-ED2 focus, increasingly taking the risk of asset-based innovation upon our business and focussing stimulus funding on wider societal challenges, demonstrating our maturity in this space.

To ensure we consistently provide transparency of the benefits innovation delivers to our customers, we have co-developed a common benefits measurement process with the gas and electricity network operator members of the Energy Industries Council (EIC) which includes measuring Social Return on Investment (SROI).

Innovation is a key component of our corporate vision. In particular, within our objective to be a respected and trusted corporate citizen, a key success indicator in delivering our vision is to be classed as the 'most innovative' DNO.

We continue to focus on three areas (see Figure 8). While we are committed to enabling LCTs like EVs, we will never lose sight of the fact that our primary responsibility is to keep the lights on.

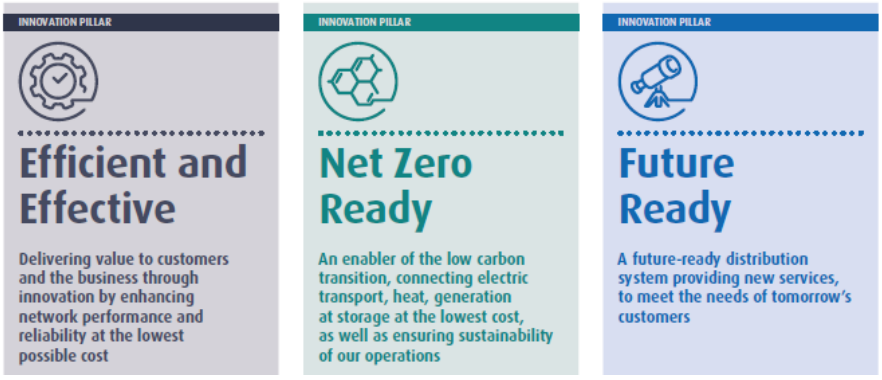


Figure 8: Areas of focus in our Innovation Strategy

The overall portfolio of innovation projects – both those funded under the Network Innovation Allowance (NIA) and beyond – is summarised in the NIA annual summary report for this year[13]. The final page of the NIA summary report shows how projects are spread across the Efficient and Effective, Net Zero Ready, and Future Ready innovation themes. During the 2020/21 regulatory year there were 55 live innovation projects in delivery with a total value of £71 million. 51 of these projects were under the NIA (as listed in the CV36 tables in the Cost and Volumes worksheets, of which over one-fifth are in collaboration and led by other DNOs). Four larger projects were under the Network Innovation Competition (NIC) (see Table 23). The end dates shown below include the impact of COVID-19 on project delivery timescales. The table also includes information on Constellation, a new NIC project launched just after the end of the 2020/21 regulatory year, in May 2021.

[13] https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2021/07/NIA-Annual-Report-2021.pdf

Project	Licence area where trialled	Start date	Planned end date	Total budget	Area	Innovation theme
Optimise Prime	EPN, LPN and SPN	January 2019	February 2023	£18,449,810	Facilitate EV fleet charging	Net Zero Ready
Active Response	EPN, LPN and SPN	January 2018	November 2023	£17,023,824	Automated reconfiguration of network capacity	Efficient and Effective/ Net Zero Ready
TDI 2.0 (Power Potential)	SPN	January 2017	July 2021	NGESO-led but two-thirds is UK Power Networks	Reactive power services from DER to transmission network	Future Ready
Powerful-CB	LPN	January 2017	August 2022	£3,859,499	Fault-current limiting circuit breaker to enable more generation connection	Net Zero Ready
Constellation	SPN	May 2021	September 2025	£17,823,924	Distributed control and wide area protection to increase resilience of smart services and unlock capacity for more generation	Net Zero Ready/ Future Ready

Table 23: NIC projects

3.2.1 Stakeholder engagement within our Innovation Strategy

We actively engage with stakeholders in order to meet three key objectives:

- Access to **great ideas**, responding to real challenges
- Collaborate with **partners to take an idea forward** and innovate
- **Communicate our findings** and explain the benefits from our innovation projects

We believe that collaboration is key to successful innovation, and successful innovation leads to benefits for customers. That belief forms a key part of our innovation journey and ensures we have the right people and the required skill sets in each project, delivering the greatest opportunity for success.

In 2020/21 we conducted more than 60 external innovation sessions to connect with stakeholders. This allowed us to work on a variety of projects with a variety of stakeholders – traditional technology vendors, software start-ups, energy suppliers, vehicle and fleet operators, local public bodies and BEIS to name a few.

Figure 9 shows our stakeholder map. Further information on our approach to stakeholder engagement can be found in the NIA annual summary report[14] for the year and in our Innovation Strategy.

[14] https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2021/07/NIA-Annual-Report-2021.pdf

Figure 9: Our stakeholders

The 'Collaboration is more than words' section of the NIA summary report highlights the scale of innovation work in collaboration with other organisations. Since the beginning of RIIO-ED1 75% of our NIA funding has funnelled to third parties, with 38% of our total projects happening in direct collaboration with other DNOs[15]. This collaborative approach ensures we have the right people and the required skill set in each project, delivering the highest value in the most cost-effective way.

External engagement and collaboration is evidenced throughout our innovation portfolio. We are working with owners of distributed generation such as wind and solar farms on our Power Potential, Energy Exchange and Network Vision innovation projects. On Charge Collective, we are collaborating with a number of local authorities to help facilitate public charging for customers without access to off-street parking. We are also partnering with the community organisation Ovesco and the engineering firm Buro Happold to develop a blueprint for the electrification of heat for off-gas grid communities.

3.2.2 Specific strategies for net zero – EVs and heat

Within our overall innovation portfolio we work extensively on facilitating the net zero transition by supporting decarbonisation in strategic areas. Our whole systems strategy was an element of our RIIO-ED2 Draft Business Plan submission. It outlines our approach to facilitating net zero at lowest cost, with an in-depth description of our proactive approach to enable the transition in bought transport and heat.

[15] https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2021/07/NIA-Annual-Report-2021.pdf

EVs

Since 2015 we have developed and continuously improved our EV readiness strategy that aims to establish the key areas of focus to facilitate EV uptake. We are leading several innovation projects investigating how to optimise utilisation of the network and deploy smart solutions to facilitate electrification of transport in the most cost-efficient way for our customers. Our innovation projects cover everything from Vehicle-to-Grid technology to the first UK market-led approach to smart charging where we aim to procure flexibility from EVs.

Our TransPower V2G project portfolio has seen us partner with over 20 organisations – including local authorities, suppliers, technology providers and academics – to develop a vast cross-sector initiative involving the likes of Octopus, Nissan and Innovate UK. As part of this portfolio we have focused on streamlining the connection process for EVs by simplifying the application process through an automated connections portal: Smart Connect.

In Charge Collective, we are working collaboratively with local authorities to ensure a fair and equitable roll-out of on-street EV chargers, so that those without access to off-street parking are not left behind in the EV transition. We received approval from Ofgem's Regulatory Sandbox[16] to trial an innovative approach as part of this project, reducing the upfront capital hurdle for charge point investors.

In White Van Plan, we have engaged with over 1,200 small and medium-sized enterprises (SMEs) to develop an action plan to ensure we are supporting them in transitioning to EVs.

We are also continuing our work on Optimise Prime, the world's largest commercial EV trial, in partnership with Hitachi, British Gas, Royal Mail and Uber.

Collaboration is also at the heart of our Shift project. We are working with Octopus Energy, intelligent energy platform Kaluza and EV charging platform provider ev.energy to offer EV owners the opportunity to take part in the economic, environmental and social benefits of smart charging. The trial is already gathering vital results which we can share across the industry, generating further ideas. As a result, we have provided feedback to Ofgem to inform its Targeted Charging Review, which has led to new business-as-usual supplier tariffs for consumers, such as Octopus Go Faster. In 2020/21 we co-developed smart-charging products to incentivise domestic flexibility and improve use of existing network capacity.

All of these initiatives are cementing our position as the leading GB DNO in preparing for EV uptake. We use this suite of EV innovation projects and stakeholder collaboration to support three objectives in our EV strategy, shown in Figure 10.

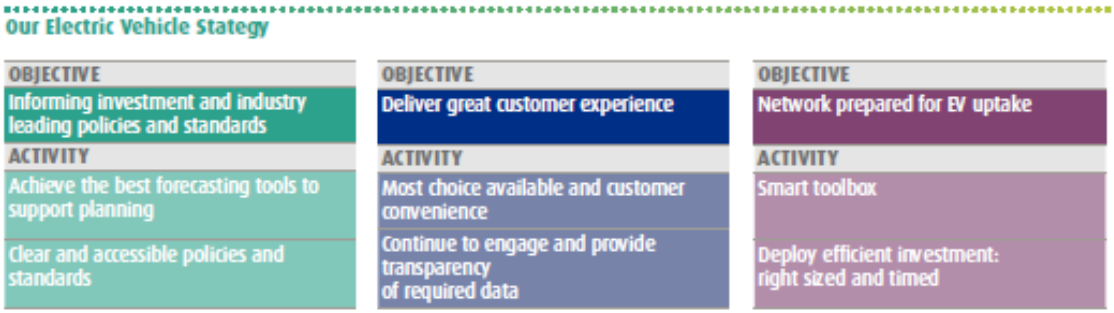


Figure 10: Our EV strategy

[16] https://www.ofgem.gov.uk/sites/default/files/2021-06/UKPN%20Confirmation%20of%20Consent.pdf

Heat

Our industry-first Heat Strategy outlines our key objectives for decarbonising heat. Like our EV strategy, it was set out as a consultation to ensure we gather feedback throughout the lifetime of the strategy, acknowledging this fast-changing and dynamic sector. We believe that such collaboration is critical to facilitating more innovation.

In 2020/21 we launched a number of heating-focused projects to deepen our understanding of the electrification of heat and our role, including:

- Heat Street: to forecast where and when electrification of heat is likely to occur and how we should facilitate this
- Communiheat: to trial a roadmap for electrification of heat in off-gas grid communities
- HyCompact: to trial a compact hybrid gas and electric heating system

3.3 Roll-out of smart grids and innovation into business as usual

3.3.1 Rolling out innovative solutions into business as usual

UK Power Networks has a process for monitoring the progress of innovation solutions to ensure that when they are ready they are deployed by the business to achieve benefits and these benefits are quantified. This is detailed on pages 21-22 of our Innovation Strategy, which sets out how we deploy and track benefits of innovative solutions in the current regulatory period and our thinking on a common measurement framework for the next regulatory period.

We now have 50 business-as-usual smart solutions deployed, categorised into seven distinct areas:

1. **Improve network capacity** – These solutions are focused on increasing capacity within the existing infrastructure. They include our London network interconnection, any demand side response procurement, load sharing across assets, and deployment of load blinding relays

2. **Improve asset lifecycle** – These solutions are derived from our Efficient and Effective innovation portfolio and their purpose is to extend the lifecycle of our existing assets. They include devices such as the joint shell; techniques for managing oil, such as oil regeneration or the Perfluorocarbon Tracer (PFT) fluid filled cable to help locate leaks; tools to assess our overhead lines; and improving maintenance of our poles, such as the use of woodpecker filler

3. **Improve network performance** – These solutions are focused on improving the quality of supply of our networks. They include devices such as LV re-closers, the automated power restoration system, and our contingency analysis tools that help us plan outages

4. **Improve vegetation** – These solutions are focused on improving the way we manage the vegetation around our assets – for example, any technique that will help us target our tree cutting practices more efficiently

5. **Improve safety** – These solutions are focused on improving safety for our employees and anyone who comes into contact with our assets. They include 3D laser surveying, a new condensed aerosol fire suppression system and the Mobile Asset Assessment Vehicle (MAAV) that helps us assess the voltage of the network on the move

6. **Improve environmental impact** – These solutions are focused on reducing the impact our assets have on the surrounding environment. They include the use of polymer-based bundling equipment, which replaces the traditional concrete/brickwork for transformers

7. **Improve connections performance** – These solutions target benefits for our connections customers. They allow customers to connect to our network quicker and more cheaply and include flexible distributed generation and timed connections

Table 24 lists all 50 innovation projects that have transitioned into business as usual, the applicable voltage level and the associated RIIO output area. The first column indicates the Environment Report where further information describing the project can be found, with colour coding to distinguish between regulatory years. Ten additional projects were deployed as business as usual during 2020/21. These are described in the next section.

The financial benefits assessment approach followed by UK Power Networks in preparing the E6 – Innovative Solutions worksheets on the impact of innovative solutions is to identify:

+ Avoided costs due to the solution
- Costs of deploying the solution
+ CI and CML saving (interruption incentive)
+ Losses saving
+ Estimated Impact on Fatality (£ million)
+ Estimated Impact on Serious Injury (£ million)

These benefits are calculated consistent with the RIIO-ED1 CBA guidance and the total of these items demonstrates the financial benefits. The tables also indicate MVA capacity released, but this is not given a financial equivalent. In total, our 50 business-as-usual solutions have delivered approximately £284 million of savings since 2015. This year we saved £51.64 million by deploying the smart solutions reported in the E6 – Innovative Solutions worksheets. The values are calculated based on the detailed E6 submission, but this financial summary is not included in the E6 worksheets.

Solution described in Environment Report	Solution	Voltage level of issue	RIIO Output	Benefits (£m)	
				2019/20	ED1 to date
Increase Network Capacity/Optimise Utilisation					
2017/18	Dynamic Transformer Rating (RTTR)	33kV	Load Indices	0.000	4.95
2017/18	Flexible DG Connections	LV, 11kV, 33kV	Connections Service	22.1	94.67
2017/18	LPN Interconnection	11kV	Totex	1.23	8.4
2017/18	Energy Storage	33kV	Load Indices	0.05	4.66
2017/18	Demand Side Response	33kV	Load Indices	0.68	1.87
2017/18	FUN-LV	LV	Totex	0.00	0.26
2017/18	Load Blinding Relays	33kV	Connections Service	0.00	11.18
2018/19	Kent Active System Management	33kV, 132kV	Load Indices	0.00	0.00
2019/20	Recharge the Future	11kV	Availability	0.00	0.00
2019/20	Load Blinding Relays for Busbar Protection	11kV, 33kV	Totex	0.00	0.18
2019/20	HaysysPIU	LV	Totex	0.05	0.12
2020/21	N-3 with NGESO ICCP	132kV	Connections Service	1.23	1.23
2020/21	LV Flexibility	LV	CI, CML	0.00	0.00
Improve Asset Life Cycle Management					
2017/18	Joint Shell	LV	Health Indices	0.05	0.81
2017/18	Oil Regeneration	33kV, 132kV	Health Indices	0.000	-0.25
2017/18	PFT (Fluid filled cable leak location)	33kV/66kV/ 132kV	Environment	0.90	6.33
2017/18	CNAIM Modelling	All	Health Indices	5.83	68.46
2017/18	Woodpecker Filler	All	Health Indices	0.06	0.29
2018/19	OHL Assessment Tool	HV, EHV	Health Indices	6.12	8.02
2018/19	Pressurised Cable Active Management	132-33kV	Environment	0.00	0.22
2019/20	Load Share	132kV	Totex	-0.01	12.05
2020/21	Advanced Analytics Cable Length Estimation	EHV	CI, CML	0.13	0.13
2020/21	Engineered Poles	All	Environment	0.00	0.00

Solution described in Environment Report	Solution	Voltage level of issue	RIIO Output	Benefits (£m)	
				2019/20	ED1 to date
Improve Network Performance					
2017/18	LV Re-energising Devices	LV	CI, CML	0.86	3.79
2017/18	Automated Power Restoration System	11kV	CI, CML	10.05	40.98
2017/18	Mobile Asset Assessment Vehicle	LV	CI, CML, Losses, Safety	-1.64	-5.08
2018/19	OHL Assessment using Panoramic Images	11kV	Health Indices	0.00	0.00
2018/19	Primary Outage Restoration Tool PORT	11kV	CI, CML	0.83	2.25
2018/19	Directional Earth Fault Passage Indicator	11kV	CI, CML	-0.01	-0.01
2019/20	Infrared Imaging Camera	LV	CI, CML	-0.09	0.14
2019/20	OHL FPIs	11kV	CI, CML	-0.27	-0.25
2019/20	Remote Portable Switch	HV	CI, CML	1.91	3.42
2019/20	Fusesaver	HV	CI, CML	0.00	-0.56
2020/21	Jumper Cutter	11kV	CI, CML	0.67	0.67
2020/21	Network Vision	11kV	Customer Satisfaction	-0.04	-0.04
2020/21	Storm Joint	11kV	CI, CML	0.00	0.00
2020/21	VisNet Fault Location	0.4kV	CI, CML	0.03	0.03
Improve Vegetation Management					
2017/18	LIDAR Vegetation Management	11kV, 33kV, 132kV	Totex	0.00	12.20
Improve Safety					
2017/18	Public Safety	All	Safety	-0.19	-1.10
2017/18	3D Laser Surveying	EHV	Safety	0.03	0.10
2018/19	Fire Pro Fire Suppression System	HV, EHV	Guaranteed Standards (ATTC/Q)	0.00	0.14
2020/21	Detection of Broken or Low Hanging OHL	11kV	Safety	0.00	0.00
Improve Environmental Impact					
2017/18	Innovative Bunding	HV, EHV	Environment	0.00	0.05
Improve Connection Performance					
2017/18	Distribution Network Visibility (DNV) Application	HV, EHV	Guaranteed Standards (ATTC/Q)	-0.01	0.03
2017/18	Point of Connection (POC) Mast	33kV	Connections Service	0.00	0.48
2017/18	Timed Connection	HV, EHV	Connections Service	1.09	2.77
2019/20	Global Earthing System	11kV	Connections	0.00	0.00
2019/20	Smart Traffic Lights Kent	LV, 11kV	Safety	0.03	0.03
2019/20	Timed Connection Assessment Tool	HV, EHV	Connections Service	0.00	0.00
2020/21	Smart Connect (Transpower)	LV	Connections	0.00	0.00

Table 24: Our 50 business-as-usual innovative solutions by type, voltage level, related RIIO output table, and benefits delivered in £ million, in 2020/21 and to date in RIIO-ED1

3.3.1.1 Solutions that changed from last year

Last year we forecast £17.2 million of savings for 2020/21, based on the 40 E6 solutions reported in 2019/20. We significantly exceeded these expectations. In 2020/21 our 50 E6 solutions delivered £51.64 million of financial savings as itemised in the E6 tables, alongside additional intangible safety, customer service and efficiency benefits.

While there were some projects with lower than expected benefits, the significant increase in these figures is due to several factors:

- Significant benefits realised from Flexible DG Connections
- Significantly increased value from CNAIM modelling to improve the targeting of interventions for asset health
- Increased value from Automated Power Restoration, Demand Side Response and Remote Portable Switch
- The inclusion of new solutions (shown in blue in Table 24) in the following portfolios: Improve Network Capacity/Optimise Utilisation, Improve Network Performance, Improve Asset Life Cycle Management, Improve Safety, and Improve Connection Performance
- Continued benefits from further deployment of our Perfluorocarbon Tracer (PFT) for fluid filled cable leak location

3.3.1.2 New solutions rolled out

Our innovative solutions are at various stages of roll-out. Throughout their life cycle they undergo a process of assessment, development and monitoring through to a completed roll-out to business as usual. The process is described in our 2017/18 Environment Report (see section 3.3 of that document) and the updated Innovation Strategy.

As previously mentioned, in 2020/21 we added 10 solutions to the 40 already deployed to business as usual. Table 25 describes these solutions, which innovation project they originate from, and the key assumptions and calculations made for the achieved benefits. Links are provided to further information on the trials, for example on the ENA Smarter Networks portal. Further detail and a CBA assessment for these solutions can be found in the Annexes and Appendices.

Solution	Description	Innovation project/source of solution	Benefit calculation
N-3 with NGESO ICCP	An 'Inter Control Centre Protocol' or ICCP link was established in 2017 between National Grid's and UK Power Networks' control systems. This secure link shares monitoring information between National Grid ESO and UK Power Networks for the SPN region and the enhanced visibility facilitates coordination between the two control rooms to manage DER resources. The ICCP link provides a real-time view of total volume of generation under each GSP, enabling ESO control engineers to make cost-effective technical decisions for managing the constraints on the transmission system, ultimately reducing the cost of balancing the energy system during transmission outages.	The ICCP link was designed and created as part of the Kent Active System Management project (KASM, LCNF Tier 2) and then updated and used as part of the subsequent Power Potential project (NIC with National Grid ESO).	• The benefit is gross avoided costs – without an ICCP solution for sharing visibility of metering at the GSP boundary for a generation control scheme, each GSP requiring the solution would require expensive works with National Grid ESO to provide additional metering of the super grid transformers at the substation and return this to UK Power Networks' control systems. • It is expected that implementing a substation metering approach would also take longer than adding National Grid's existing data via the ICCP link.
LV Flexibility Procurement	LV Flexibility Procurement is a Flexibility Service that can be delivered either from a reduction in import from demand customers or by generators increasing export for a contracted period. It can address capacity constraints on the network and thereby defer reinforcement and increase the security of the network in cases where reinforcement is already under way. The product was developed for the NIA project, Shift, as a mechanism to incentivise EV smart charging and has been implemented as a technology agnostic product.	The LV flexibility procurement product was developed and trialled under the Shift NIA project.	Although contracts have been placed to provide LV flexibility, the services are not yet operational. Therefore there are no benefits to claim in 2020/21. The LV flexibility services are expected to be deployed towards the end of 2021, when benefits are expected to be realised.
Advanced Analytics Cable Length Estimation	A new and innovative way of estimating the cable lengths on the network, using Google Maps API and advanced analytics. By repurposing Google Maps software to work out distances combined with geospatial and other data, advanced analytics models have been created that significantly reduce the time and resource needed to estimate cable lengths.	Developed by the analytics team	• The solution is delivering benefits by significantly reducing the cost of estimating the cable lengths of EPN's EHV network. This scheme of work needed to be completed as a health index for this part of the network is required by Ofgem for RIIO-ED2. • Using the new estimating method, this work could be carried out in-house at a significantly reduced cost.

Solution	Description	Innovation project/source of solution	Benefit calculation
Engineered Poles	Engineered poles are used as an alternative to creosote impregnated wood poles where, for environmental reasons, a wood pole is no longer desirable, e.g. a customer's back garden where a stay is to be moved.	The Engineered Pole Products project (NIA_UKPN0039) was a collaboration with the ENA overhead line forum to develop an industry standard for Engineered Poles.	Environmental benefits will be realised when engineered poles are used as alternatives to creosote impregnated wood poles.
Jumper Cutter	A jumper cutter can be used to cut an overhead line (OHL) from the ground, which means the procedure can be performed by any operational staff trained to use a dead stick with a jumper cutter attachment. The jumper cutter can be used to disconnect faulty or suspect apparatus from ground level to improve fault restoration times. For example, the jumper cutter might be used when there is a fault on the overhead line between two air break switch disconnectors (ABSD) that supply multiple transformers.	The use of jumper cutters to isolate faults is a new process that has significantly increased in use since 2020.	Jumper cutters enable a fault to be isolated as soon as an engineer attends site and this means power supplies can be restored quicker than where a linesman is required to isolate the fault. As a result, there is a direct reduction in Customer Minutes Lost (CML) – improving the customer experience.
Network Vision	Network Vision is a cloud-based software solution used to plan and manage outages on the EHV network. It has a customer-facing portal to provide information about generation customer curtailments and shutdowns to our customers, and also provides an interface for customers to engage with outage planners. Compared to the incumbent outage planning tools, Network Vision is improving UK Power Networks' outage tracking – increasing the level of customer interaction and self-service, improving consistency across the three licence areas and reducing the requirement of manual intervention for tracking.	NIA project Energy Exchange: Market-Based Curtailment Management	• Network Vision reduces the time required for outage planners and control engineers to manage planned network outages. The improved visibility and more flexible scheduling are reducing the number of delays to large capital projects, and reduced overall outages leads to additional revenue for generators connected to the network.

Solution	Description	Innovation project/source of solution	Benefit calculation
Storm Joint	In order to minimise the impact storms have on customers, a new temporary OHL repair process that can be performed fully from the ground is to be trialled as part of the Storm Joint technical project.	NIA project Storm Joint	• The use of Storm Joint directly replaces the need to connect customers to a generator for particular OHL faults and this provides a direct cost saving for incidents where Storm Joint is used. • Storm Joint is used in widespread adverse weather conditions when the volume of faults is very high. Without Storm Joint, customers would be off supply for longer periods whilst linesman resources progressed the high volume of fault jobs. Storm Joint is able to provide a reduction in CML, which improves the customer experience.
VisNet Fault Location	A VisNet® Hub is a real-time monitoring device connected to current and voltage sensors that operates in low voltage distribution substations. VisNet® Hub checks voltage and current data on every LV feeder in the group, giving insight into load, faults and condition information across the network.	VisNets were only approved for use on the network in 2020 and trials began that year to create a new process involving VisNet hubs to locate faults.	The VisNet® Hub allows for more accurate fault location, which means less time and resources are spent on repairing the fault. In particular, the use of VisNet® Hub avoids multiple excavations to locate and repair LV underground faults. The reduction in repair time means there is an added benefit of a reduction in CML, which improves the customer experience.
Detection of Broken or Low Hanging OHL	The Detection of Broken or Low Hanging OHL solution is implemented through a protection setting for High Impedance Earth Fault (HIF). It can be deployed on UK Power Networks' overhead distribution network in areas where fallen or low hanging conductors are likely to cause the greatest hazard to the general public and other stakeholders. Testing and trials showed that this provided the required level of sensitivity to detect such faults.	NIA project Detection of Broken/Low Hanging OHL Conductors	Once implemented, the solution will provide a cheaper method of detecting broken and low hanging OHL, as well as safety benefits (cost of workplace fatal accidents, injuries and livestock injuries/fatalities).

Solution	Description	Innovation project/source of solution	Benefit calculation
Smart Connect (TransPower)	Smart Connect is an online connections portal for domestic LCTs. The system automates a number of tasks and assessments, reducing and in some cases eliminating the labour required to manually process these applications. Further information about Smart Connect and links to the site can be found here: https://www.ukpowernetworks.co.uk/smart-connect	NIA project Transpower	LCT connections processed via Smart Connect require fewer resources, thus saving resources internally and reducing connection times for customers.

Table 25: Innovative solutions added in 2020/21

3.3.1.3 Innovative solutions for connections

There are 10 solutions which support our connections customers, as shown below. The last two are new for 2020/21.

1. Flexible DG Connections
2. Load Blinding Relays
3. Distribution Network Visibility (DNV) Application
4. Point of Connection (POC) Mast
5. Timed Connections
6. Global Earthing System
7. Smart Traffic Lights Kent
8. Timed Connection Assessment Tool
9. N-3 with NGESO ICCP
10. Smart Connect

Table 26 presents the savings delivered by these projects to date in the first five years of the RIIO-ED1 price control period. The majority of savings come from our flexible DG connections project. These are likely to increase towards the end of RIIO-ED1 as our flexible connections approach (reducing cost and time to connect) is rolled into our new Active Network Management solution, which is being deployed across our three licence areas.

Innovative solutions for connections	RIIO-ED1 savings to date
Flexible DG Connections	£94,670,365
Load Blinding Relays	£11,180,000
Distribution Network Visibility (DNV) Application	£15,817
Point of Connection (POC) Mast	£477,846
Timed Connection	£2,770,000
Global Earthing System	£0
Smart Traffic Lights Kent	£32,875
Timed Connection Assessment Tool	£0
N-3 with NGESO ICCP	£1,230,000
Smart Connect	£0

Table 26: RIIO-ED1 savings to date from innovative solutions for connections

3.3.1.4 New solutions being considered for business-as-usual deployment

The 14 NIA projects shown in Table 27 are expected to close down in the 2021/22 regulatory year. Via our innovation gate process (as described in our Innovation Strategy and NIA report), at the closedown of each project we assess its potential and plans to successfully transition into business as usual to become part of our E6 solutions going forward.

Project name	End date
NIA – Heat Street: Local System Planning	1 May 2021
NIA – Shift	1 May 2021
NIA – Line Search	1 July 2021
NIA – Underground Fault Predictive Model and Earthing Assessments	1 August 2021
NIA – Transformer Care	1 September 2021
NIA – Arc Aid	1 November 2021
NIA – Urban Energy Club	1 November 2021
NIA – Storm Resilience	1 December 2021
NIA – 3D Printing of Network Assets	1 December 2021
NIA – Mobile Field Control	1 December 2021
NIA – Voyage	1 February 2022
NIA – HV Feeder Monitoring to Pre-empt Faults	1 February 2022
NIA – Enable	1 March 2022
NIA – Unified Protection	31 March 2022

Table 27: NIA projects due to complete in the 2021/22 regulatory year

3.3.1.5 Forecast of number of times solutions are expected to be deployed in the next regulatory year

Table 28 indicates the number of times our current innovation solutions were deployed in this regulatory year, as indicated in the E6 – Innovative Solutions worksheets. This is supplemented by our forecast for additions next year, which does not form part of the E6 table. Total forecast benefits for the regulatory year 2021/22 are estimated at £47 million. The table does not include forecast benefits from projects which are yet to complete and transfer into business as usual and would be expected to deliver additional value.

Solution	Additional deployments	
	2020/21	2021/22 estimate
Increase Network Capacity/Optimise Utilisation		
Dynamic Transformer Rating (RTTR)	0	0
Flexible DG Connections	1	0
LPN Interconnection	29	30
Energy Storage	0	0
Demand Side Response	3	3
FUN-LV	0	0
Load Blinding Relays	0	13
Kent Active System Management	0	1
Recharge the Future	0	0
Load Blinding Relays for Busbar Protection	0	1
HaysysPIU	4	0
N-3 with NGESO ICCP	1	0
LV Flexibility	0	0
Improve Asset Life Cycle Management		
Joint Shell	111	111
Oil Regeneration	0	0

Solution	Additional deployments	
	2020/21	2021/22 estimate
PFT	21	20
CNAIM Modelling	156	156
Woodpecker Filler	23	22
OHL Assessment Tool	47	102
Pressurised Cable Active Management	0	11
Load Share	0	0
Advanced Analytics Cable Length Estimation	1	0
Engineered Poles	0	100
Improve Network Performance		
LV Re-energising Devices	2,058	3,366
Automated Power Restoration System	9,556	0
OHL Assessment using Panoramic Images	0	0
Primary Outage Restoration Tool PORT	604	0
Directional Earth Fault Passage Indicator	21	0
Infrared Imaging Camera	0	0
OHL FPIs	535	0
Remote Portable Switch	117	0
Fusesaver	25	0
Jumper Cutter	0	0
Network Vision	2,827	0
Storm Joint	0	0
VisNet Fault Location	0	0
Improve Vegetation Management		
LIDAR Vegetation Management	0	0
Improve Safety		
Public Safety	173,145	0
3D Laser Surveying	11	0
Fire Pro Fire Suppression System	12	7
Detection of Broken or Low Hanging OHL	0	0
Improve Environmental Impact		
Innovative Bunding	0	1
Improve Connection Performance		
Distribution Network Visibility (DNV) Application	0	0
Point of Connection (POC) Mast	0	0
Timed Connection	2	1
Global Earthing System	0	400
Smart Traffic Lights Kent	0	1
Timed Connection Assessment Tool	9	13
Smart Connect (Transpower)	0	0

Table 28: Expected solution deployments in the next regulatory year

Looking ahead to 2021/22, across our portfolio of deployed innovative solutions we would expect that:

- Our innovative solutions for improving network performance (including LV re-energising devices and remote portable switches) will continue to be deployed
- Our innovative solutions for improving the asset life cycle (including our CNAIM solution) will continue to provide benefits
- Our innovative solutions for improving network capacity and utilisation (Flexible DG connections and Demand Side Response) will also continue
- Overall, benefits delivered to customers through reduced connection times and costs will continue if further developers connect their projects to flexible distributed generation (FDG) zones
- Our new solution in vegetation management – 'Detection of broken or low hanging OHL' – will deliver benefits

3.3.1.6 Additional information, methodology and CBAs

The complete methodology and CBAs can be found in our Annexes and Appendices.

3.3.2 Smart metering

Our strategy for maximising the net benefits of smart metering

On 20 April 2021 the government announced that it would "set the world's most ambitious climate change target" to reduce emissions by 78% by 2035 compared to 1990 levels and with a net zero target by 2050.[17] As discussed below, smart meters are an important element in Great Britain's transition to meeting the government's net zero target.

Smart meters allow active management of electricity distribution networks. Using data from these assets, a smart energy system can more quickly identify and respond to power outages, better balance supply with demand, and support suppliers in utilising more sources of local and renewable energy.

Smart meters can also be cost-effective. Innovative products and services which rely on smart metering, such as time of use tariffs, will reward consumers for using energy when cheap renewable generation is available.

Under the new smart meter regulatory framework, effective from July 2021, energy suppliers must comply with binding annual smart meter installation targets that will run until mid-2025[18]. Failure to achieve the targets will be a breach of a supplier's licence. The new framework gives us confidence in our ability to deliver benefits to customers where our strategy can be aligned to suppliers' smart meter installation targets.

Smart meters help to provide greater visibility of the network, which in turn supports cost-efficient investment decision making. Increasing numbers of solar panels, EVs, battery storage and other LCTs place further demands on the distribution system, and on the LV network in particular. It is therefore essential that we manage our networks to cope with the increasing demand in an efficient, coordinated and economical way. Smart meters have the capability to record energisation status, voltage measurements and energy consumption, and to communicate with energy suppliers and network operators. Data obtained from these assets will be used to provide a much clearer view of loads on the LV network that is not available from traditional meters. With better visibility in this area, we will enhance our practices to deliver the benefits set out in our RIIO-ED1 Business Plan and support delivery of the government's net zero commitment.

[17] UK enshrines new target in law to slash emissions by 78% by 2035 - GOV.UK (www.gov.uk)

[18] New smart meter rollout obligations in GB (smart-energy.com)

Our RIIO-ED1 Business Plan sets out three key areas in which benefits from smart meter data will be realised. These are shown in Table 29.

Benefit	Description
Improved real-time data Customer service enhancements Fault management	Smart meters providing real-time data for fault management via the 'last gasp' facility and the capability to remotely test the meter to ascertain the energisation status of the supply to a customer's premises, can significantly improve fault management performance and customer service. It will be possible to identify and target faults more quickly and to provide the customer with significantly enhanced information and a faster response.
Improved asset and performance data Network condition and planning	Having accurate information regarding the loading of assets (i.e. visibility of real load profiles at each substation and the LV network) will allow utilisation of these assets to be maximised whilst ensuring they are not overloaded. In turn, this may lead to a reduction in the number of faults on the network, helping to reduce overall operational expenditure and keep charges low for customers The availability of detailed consumption data across the network offers the opportunity to significantly improve network planning. For example, consumption data will support the identification of specific areas of the LV network that may need reinforcement and allow informed decisions to be made to defer network reinforcement.
Improved real-time control Supporting the future network	The combination of smart meter data and asset data with greater real-time control will pave the way for the network of the future. It will provide the information and capability to support expansion of LCTs and time of use tariffs. There will be the ability to undertake active network management on the LV network and to defer the need for further network reinforcement and new investment, paving the way for a full smart grid using smart meter data.

Table 29: Key areas in which benefits from smart meter data will be realised

Since submitting our RIIO-ED1 Business Plan we have continued to explore and evaluate information available from smart meters to leverage further benefits, and the best way to realise them. These discussions have continued to inform our Smart Meter Benefits Realisation Strategy.

Our strategy continues to be guided by three principles that reflect our ambition to make effective use of smart meter data – both in the current RIIO-ED1 period and in our business plan for RIIO-ED2. These are:

1. We will continually take the learnings from other roll-outs and experiences from our own smart meter system to accelerate our ability to realise and leverage further benefits
2. We will ensure that we have the right levels of ownership and accountability across our business for realising smart metering benefits, and to develop expertise and insight into our smart meter data
3. We will ensure that our investment in realising the benefits of smart metering aligns with our plans to develop DSO capabilities

To realise the benefits from smart metering, we recognise that we must continually learn from the data provided from SMETS1 and SMETS2 meters whilst being mindful of the requirements of our Smart Meter Data Privacy Plan (DPP)[19].

[19] https://www.ofgem.gov.uk/publications-and-updates/approval-letter-ukpns-data-privacy-plan-access-household-electricity-smart-metering-data

We have two teams working on our smart meters programme to deliver a system that will enable us to realise benefits from these assets:

- Our Smart Meters Programme team, which is designing and developing the technical solution that will deliver smart meter benefits to the business from the utilisation of energisation check, power outage and restore alerts, voltage threshold violation alerts, energy consumption data and voltage measurements
- Our Smart Meter Operations team, which is the business owner of the Data Communications Company (DCC) adaptor that allows us to connect to smart meters through the DCC's infrastructure

Combining data expertise, technological capability and business knowledge, these teams have the following responsibilities:

- To act as UK Power Networks' key point of contact with the DCC and other relevant industry partners
- To deliver UK Power Networks' benefits realisation plan
- To develop understanding and insight into smart meter data within the business, to support other functions on how best to embed smart meter data into their day-to-day activities to deliver business benefits

Smart meter installation volumes

Table 30 shows the volumes of cumulative smart meter installations reported by our three licensees for the 2020/21 regulatory year in the Cost and Volumes Reporting Pack worksheet CV34 – Smart Meters.

During the year installation volumes increased such that 44% of UK Power Networks' domestic customers now have a smart meter installed. This compares to 38% in the previous regulatory year.

Licensee	2017/18 smart meter volumes	2018/19 smart meter volumes	2019/20 smart meter volumes	2020/21 smart meter volumes	2020/21 percentage penetration of smart meters
EPN	302,478	1,000,437	1,340,557	1,576,018	46%
LPN	153,186	494,187	667,376	782,911	37%
SPN	200,416	652,697	877,245	1,025,896	48%
Total	**656,080**	**2,147,321**	**2,885,178**	**3,384,825**	**44%**

Table 30: Smart meter installations

At the end of the 2020/21 regulatory year a total of 3.38 million smart meters had been installed in our operating area. The proportions of SMETS1 and SMETS2 meters installed were 62% and 38% respectively.

Current status of IT and communications investments

Our DCC adaptor has been developed with a strong security framework for our smart metering systems, in accordance with the Smart Energy Code (SEC) security obligations. The adaptor is the interface to the DCC infrastructure and provides a landing point for smart meter data within our business.

We work closely with the DCC adaptor vendor and other network operators who share the same DCC adaptor platform. Through the ENA, we also work with other DNO member companies to coordinate queries with the DCC to leverage challenges related to infrastructure and data quality issues, and collectively achieve the successful resolution of issues.

We have maintained our commitment to realise benefits from smart meter data through the introduction of changes and enhancements to our IT systems. Developments during the 2020/21 regulatory year enabled us to deliver customer service-related benefits from the energisation status check of smart meters, because the energisation check is not affected by the known data quality issues (see below).

We highlighted in our previous Environment Report that there are known ongoing industry-wide data quality issues and challenges associated with the accuracy of power outage and restore alerts received from smart meters. During 2020/21 we continued to work with the DCC and another DNO to support the industry in finding a resolution to these issues. The DCC launched a consultation inviting customers' feedback on its proposals to resolve some of the issues with power outage and power restore alerts. The DCC is now considering the responses received and will review with BEIS prior to announcing its chosen option for any potential enhancements to its infrastructure.

Delays to the programme and work to resolve the above issues and data quality challenges have resulted in additional costs which have included changes to our IT systems, delaying the delivery of benefits to customers. We have aligned the timelines of our programme to the smart meter roll-out plans in order to avoid the risk of stranded investment from the changing requirements or other issues outside our control.

Actions taken in 2020/21 to maximise the value of smart meter data

Our Smart Meter Operations team has continued to work closely with the DCC and other DNOs (including through the ENA) to support the delivery of improvements within the DCC infrastructure and data communications systems. The work to leverage improvements has included the testing of meters with combinations of different communications hubs using the recently commissioned DCC meter test laboratory[20].

During 2020/21 we integrated our DCC adaptor into our business systems and applications, providing users with the capability to carry out smart meter energisation status checks. We also worked with our customer services teams to embed the use of smart meter data in accordance with our digital strategy; developing our power cut webpage, contact centre automation and Interactive Voice Response (IVR) telephony capabilities. Customers with smart meters benefit from our ability to swiftly and accurately identify issues with their power supply without firstly having to despatch an engineer to their property to determine whether or not the cause is network-related.

Our DCC gateway is operational and is receiving data from SMETS2 smart meters. We have upgraded our DCC adaptor to receive data from SMETS1 smart meters as they are adopted into the DCC system, where this process is managed by suppliers. We have also maintained our gateway adaptor with upgrades to ensure that the UK Power Networks platform is aligned to the DCC's version of the system and remains compliant with SEC security standards.

We continue to support the supplier-led roll-out of smart meters, addressing any required interventions identified within our network on supply termination equipment that could prevent a smart meter from being installed. Our approach to this work complies with all the industry defined Smart Meter Intervention performance Service Level Agreements.

Our Smart Meter Interventions team performs a coordinating role to help our engineers support energy suppliers' installations. Within this team a continuous improvement capability has been established, helping to realise further outperformance of the industry-defined metrics. This provides an enhanced installation experience for our customers and for the energy suppliers who require our support at the point of meter installation.

[20] Testing services | Smart DCC

Summary of estimated smart meter benefits realised to date

Our project to provide capability for use of the smart meter energisation status (ping) check was completed at the end of the 2020/21 regulatory year and will allow us to start realising benefits from these assets.

The industry-wide power outage and restore alerts and data quality issues have enabled us to better understand the SMETS2 data and functionality. We are now developing a solution to leverage benefits from the proportion of good quality data available, so that we can start to deliver benefits to customers from the 1.29 million SMETS smart meters we communicate with through the DCC gateway.

Our plans for realising smart meter benefits in 2021/22 and in future years

During the 2021/22 regulatory year we will develop our smart metering system to collect and process consumption data from all smart meters in accordance with the requirements of our Ofgem-approved DPP[21] for managing energy usage data, to ensure we deliver benefits to our customers and business.

We will develop an interface between the smart meter data and the Network Modelling toolsets used within our licence areas, to leverage benefits from the use of smart meter data for network analysis. We will also implement the capability to analyse smart meter data for active, reactive, import and export power, to support our management of network losses and planning decisions.

The quality of smart meter data continues to be discussed at an industry level, with network operators, the DCC and BEIS working together to identify a solution to address the issues and improve the timeliness of data received by network operators. Our Smart Meter Operations team works closely with other DNOs through the ENA to support the delivery of improvements within the DCC infrastructure and data communications systems. Work to leverage improvements is ongoing and includes the testing of meters, timely delivery of power outage alerts, accuracy of power outage and restore alerts, quality of voltage violation alerts and, more recently, discussions around the testing of polyphase meters.

Until an industry level solution is found to address the data quality issues, we have a number of projects under way to maximise our capability to deliver benefits from smart metering. We will further analyse the data to better understand the quality of information and will utilise the proportion of good quality power outage, power restoration and voltage data available to leverage benefits for our customers and business.

The above highlights our goals for 2021/22 and onwards, with key investments that will enable benefits to be realised from the data received from the significant volumes of SMETS2 smart meters now installed in our regions, which will be further enhanced as SMETS1 meters are adopted into the DCC system. The SMETS1 smart meter adoption programme between suppliers and the DCC was due to be completed at the end of the 2021 calendar year, but this date has been revised to the end of 2022.

Our realisation of smart meter benefits is dependent on the wider roll-out of SMETS2 compliant meters and establishing access to smart meter data, including from SMETS1 meters. We continue to support the industry roll-out of smart meters and are preparing our systems to receive their data. Table 31 presents our expenditure (including IT expenditure) in this regard for the 2020/21 regulatory year. For more information please see the worksheets E5 – Smart Metering and CV34 – Smart Meter Interventions in the Annexes and Appendices.

[21] https://www.ofgem.gov.uk/publications-and-updates/approval-letter-ukpns-data-privacy-plan-access-household-electricity-smart-metering-data

Source	Category	EPN	LPN	SPN	Total
E5	Smart Meter Communication Licensee Costs	3.66	2.35	2.35	8.36
E5	Smart Meter Information Technology Costs	0.67	0.44	0.44	1.55
CV34	Smart Meter Interventions – On-site/Physical Activities (including prior year restatement)	2.14	1.13	1.13	4.40
CV34	Smart Meter Interventions – Extra Scheduling & Call Centre	0.49	0.50	0.18	1.17
CV34	Smart Meter Interventions – Smart Meter Registration	-	-	-	-

Table 31: Summary of 2020/21 smart metering-related expenditure in £ million

4 Annexes and Appendices

4.1 EPN

Environment and Innovation Pack – tabs E1-E8 – 2020/21

4.2 LPN

Environment and Innovation Pack – tabs E1-E8 – 2020/21

4.3 SPN

Environment and Innovation Pack – tabs E1-E8 – 2020/21

4.4 UK Power Networks

CV16 and M1 Flooding Mitigation – 2020/21

Environment and Innovation Commentary – 2020/21

RIGs E6 CBA – 2020/21

Generic CBA RIIO-ED1 – GMTs – 2020/21

Generic CBA RIIO-ED1 – PMTs – 2020/21

UK Power Networks
Delivering your electricity

UK Power Networks (Operations) Limited

Registered office: Newington House, 237 Southwark Bridge Road, SE1 6NP
Registered number: 3870728 registered in England and Wales