SP Energy Networks

Distribution Environmental & Innovation Report

April 2020 – March 2021

SP ENERGY NETWORKS

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Executive summary

In this, our sixth Environmental and Innovation Report, we provide an overview of our environmental and innovation performance and give progress on our ED1 commitments.

In 2020/21, COVID-19 continued to impact every part of our society and the UK economy. It has had a profound effect on the ways we live, work and socialise.

The service we provide is critical, and at the height of the COVID-19 pandemic, our top priority was keeping the power flowing for our 3.5 million customers, keeping them safe and warm while also ensuring critical national infrastructure like hospitals received the vital electricity supply they needed.

Since the start of the pandemic, our commitment to ensuring our employees stay safe, healthy and have the tools and equipment to remain productive has been the driving force behind our business decisions. We made decisions early to contribute to containing the spread of the virus in the workplace. We instituted a Working from Home Policy and issued updated hygiene and social-distancing protocols along with enhanced guidance and support for critical workers. It is vital that we protect the health of our employees while also ensuring that the essential service we provide to the public continues uninterrupted.

Our role is also critical to delivering the UK's green energy revolution. Our networks are at the heart of the transition to enable the Net Zero future our customers and stakeholders are striving for.

In December 2020, the long-awaited UK Government Energy White Paper, together with the Climate Change Committee's Sixth Carbon Budget and the Scottish Government's updated Climate Change Plan 2018-2032 were published, giving a clear roadmap to achieving Net Zero and securing a green recovery for the UK.

SP Energy Networks are now in the process of aligning carbon reduction targets to the Science-Based Target initiative, reducing emissions across all scopes, at the reductions consistent with limiting global warming to 1.5°C above pre-industrial temperatures.

This report highlights our work to manage the network and its impacts, deliver network improvements and enable the connection of low carbon technologies, whilst demonstrating how our progress is driven by our six Sustainability Drivers (see **Figure 1** below).

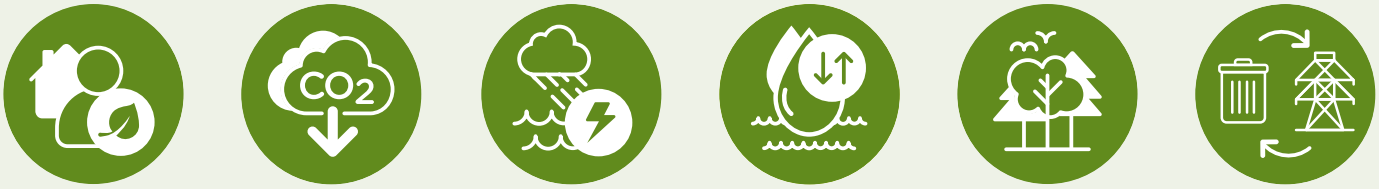
By reporting year 2015/16 we had reached our 2023 target of a 15% reduction in business carbon footprint (excluding losses) against our 2013/14 baseline year. This reporting year, our distribution licences have jointly achieved a reduction of 21% compared to 2019/20, bringing our total reduction to 57% since 2013/14.

During the 2020/21 reporting year, we installed 14 double charge points at our offices and have introduced another 19 electric vehicles to our fleet of pool cars. This brings the total to 53 charging points installed and 48 new electric fleet vehicles introduced since the start of ED1.

Since the start of ED1 we have reduced our business travel carbon emissions by 65%. In the last year alone, we have seen a dramatic decrease of 51% from emissions in travel across SPM and SPD combined, due in part to the impacts of COVID-19. The introduction of new company travel and teleworking policies during the 2020/21 reporting year will allow us to continue to target this area for sustained and further reductions in the coming years.

We welcome your feedback on the information presented within this report, which is invaluable as we deliver our vision of a sustainable networks business.

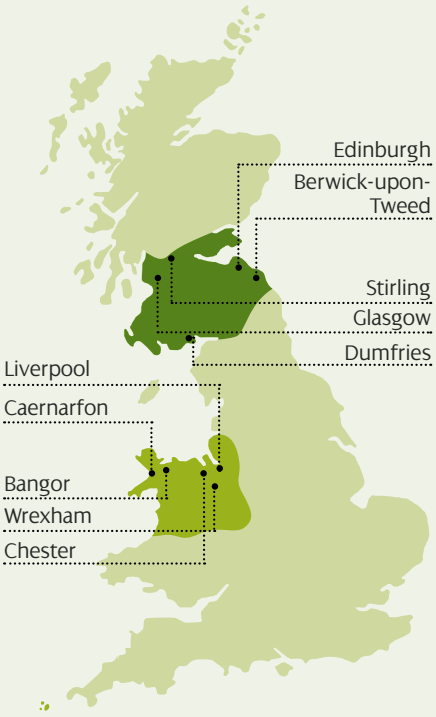
Figure 1 – Our Sustainability Drivers



Who we are

SP Energy Networks (SPEN) own and operate three regulated electricity network businesses in the UK: SP Transmission plc (SPT), SP Distribution plc (SPD) and SP Manweb plc (SPM).

Figure 2 – SP Energy Networks Distribution Licence Areas



SP Manweb
1.5 million customers

SP Distribution
2 million customers

This report focusses on our two distribution licences, SPD and SPM only. Further information on our Transmission licence, SPT is available on our website[1]. The SP Distribution network area in central and southern Scotland covers an area of almost 23,000km, whilst the distribution network SPM, in North Wales, Merseyside, Cheshire, and North Shropshire covers approximately 12,000km. SP Energy Networks is part of the Iberdrola Group – a Dow Jones Sustainability Index and Global 100 listed company.

As a Distribution Network Operator (DNO) our role is to maintain, operate and invest in our Distribution Network to secure a safe, reliable and economic service to 3.5 million homes and businesses in our licence areas, regardless of who they pay their bill to (please see **Figure 3** overleaf). In our licence areas, we are the point of contact for all enquires relating to the electricity network. The safety and security of electricity supply is paramount to our operations.

Within this context of maintaining existing assets, we are continually expanding our network to support the connection of new low carbon generation as part of the transition to the low carbon economy whilst also reducing our environmental impact. We are undertaking a network renewal programme involving the renovation or creation of new substations and the rebuilding of hundreds of kilometres of overhead lines and underground cables.

During planning and completion of these works, our activities must meet the requirements of Government policies and legislation. We also have a responsibility to stakeholders to ensure a consistent and secure supply of electricity as we deliver our vision of sustainability. We have been continuously certified to ISO 14001 since 1997 and successfully achieved recertification to ISO14001:2015 in October 2018.

We recognise that in the undertaking of our role as distributors of electricity we will impact upon the environment in a variety of ways, from the energy losses that occur in our equipment to the visual impact of our assets in the landscape. In fulfilling our ambition to be a sustainable networks business, we strive to integrate fair and responsible environmental practices with socio-economic considerations. As a company, our reputation for excellence is valued and respected among stakeholders.

SPEN employs approximately 3,000 people directly, around 2,500 contractors, and supports tens of thousands more jobs in our supply chain. By working together, we are delivering our goals to reduce our environmental impact in areas such as Carbon, Waste and Water (see **Table 1** overleaf). SPEN recognises the importance of acting responsibly towards the environment and we strive to maintain our reputation for doing so, enhancing it wherever we go.

[1] https://www.spenergynetworks.co.uk/pages/our_transmission_network.aspx

Who we are
continued

Figure 3 – Our Business

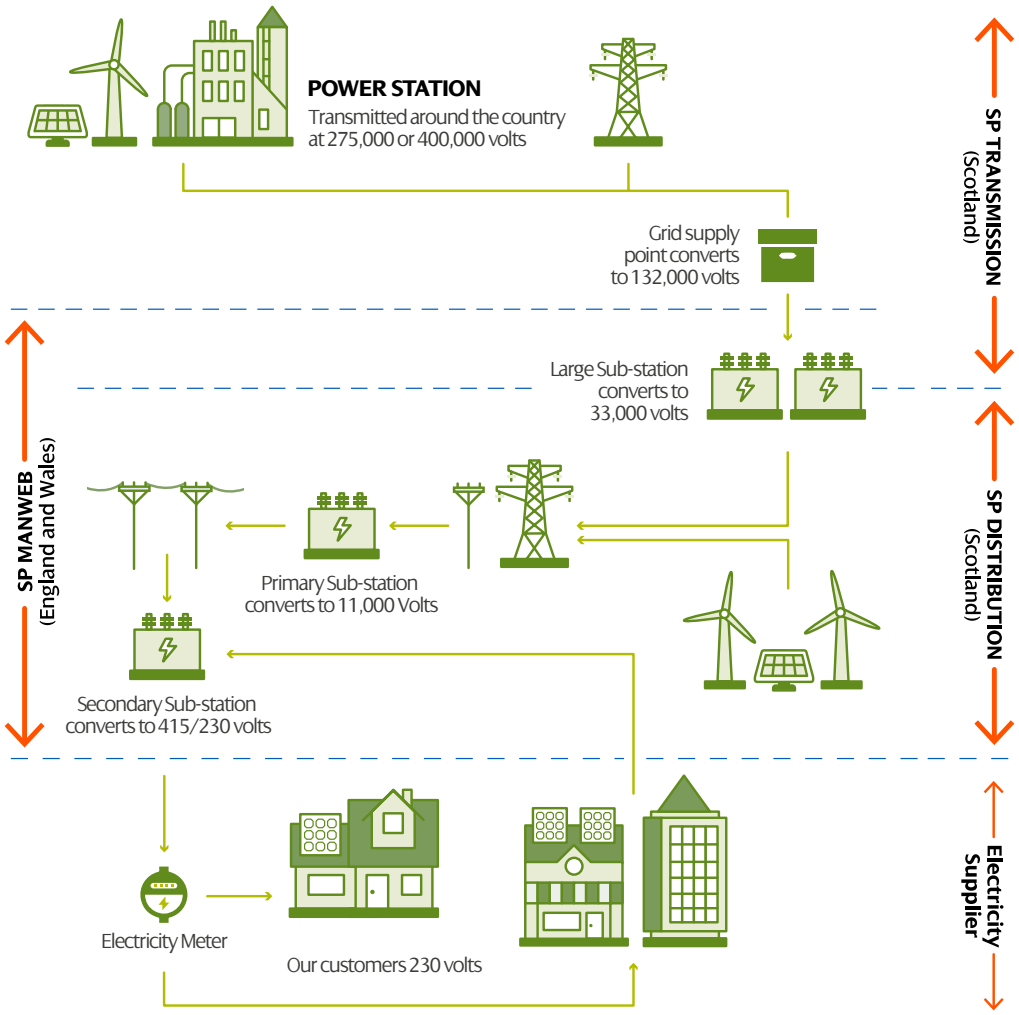


Table 1 – Key Goals and their Rationale

	Carbon and Energy Reduction	Sustainable Resource Use	Water Efficiency and Protection
2023	*-15% carbon footprint**	*Divert 95% of waste from landfill*	*-10% in water use**
2030	*-80% carbon footprint**	*100% waste recycled or re-used*	*-25% in water use**
2050	*Carbon neutral**	*Zero waste*	*-50% in water use**
Rationale	Essential to meeting global and national CO_2 reduction targets.	Essential to meeting landfill diversion targets particularly in Scotland where the Scottish Government has Zero Waste Strategy target of 5% to landfill by 2025.	Climate change models forecast reduced summer rainfall putting pressure on scarce water resources. Treating water to potable standards and transportation of water is costly and uses energy.

*Targets from a 2013/14 baseline (carbon footprint target excluding losses).

Purpose of this Report

We play a critical role in the Low Carbon Transition, efficiently managing and developing our network to support our stakeholders in meeting UK and devolved Government carbon reduction targets.

We also seek to reduce our own impacts, aiming to achieve neutral or positive environmental and social impacts from our direct operations.

Our RIIO-ED1 Business Plan for 2015–2023 set out our goals and targets to reduce the impacts of our network in these key areas (please see **Table 2** below). The delivery of these commitments is realised primarily through capital investment and innovation activity.

This report provides stakeholders with a transparent account of our commitment to environmental matters and a progress update on the delivery of these commitments. The report also updates stakeholders on the continuing development of our Sustainable Business Strategy and the other progressive changes we are making in pursuit of becoming a sustainable networks business (please also see Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary).

Table 2 – Business Plan Commitments

Managing our Environmental Impact	Reducing Carbon Impact and Climate Change and associated environmental improvements	Our role in the Low Carbon Transition
Underground 85km of Overhead Lines in Areas of Outstanding Natural Beauty.	Reduce our carbon footprint (excluding network losses) by 15% by 2023.	Connect 4.5GW of Distributed Generation by 2018 with 5.5GW of generation connected to our network by 2023.
Reduce oil leaks by 50% through replacement of poorly performing 132kV cable in SPM.	Use electronic vehicle management system to optimise our vehicle utilisation keeping vehicle numbers, broadly similar in ED1.	Identify Low Carbon Technology hotspots using network monitoring data from Smart Meters and Stakeholder Engagement.
Install oil containment around all new and high risk plant containing high volumes of oil.	Utilise low carbon alternatives to travel, through the use of technology and smarter ways of working.	Utilise Smart technology to ensure all generation sources are supported quickly.
Engage on the environmental impacts of our developments from a very early stage.	Increase the use of electric vehicles and charging points.	Reduce costs to customers by developing modern "Smart Grid" network solutions.
	Monitor and reduce energy used within our substations, invest in lower carbon buildings and reduce energy use in existing buildings.	
	Install lower loss transformers to reduce losses by 50% at more than 1,100 of our secondary substations.	
	Carry out "Smart" asset replacement – using future proofed assets where justified.	
	Exceed the IEC international standards for SF_6 switchgear by specifying a maximum leakage rate five times more stringent for 33kV and below, and twice as stringent for higher voltages.	

Stakeholder Engagement

Stakeholder engagement is central to everything we do. Our inclusive and proactive approach means we have a broad range of stakeholder contributions to our business plans, strategies and projects from the outset and throughout.

We first implemented a dedicated stakeholder engagement strategy in 2013 and since then have made significant changes, through improvements and a desire to continuously evolve. Our strategy is driven by our CEO and Executive Team, supported by the Central Stakeholder Engagement Team and embedded across our entire organisation, regardless of the engagement topic.

Engaging in an effective and meaningful way means stakeholder feedback shapes our business decisions from Board level to our operational teams, with every decision we make aligning to our overarching strategic goals as guided by our customers and stakeholders. Together, we will ensure our efforts and investments are producing meaningful outcomes for a sustainable network and a better future, quicker.

Our strategic priorities as a business are developed through extensive engagement with our customers and stakeholders to ensure we are delivering a business in line with their needs and preferences. These priorities flow through everything we do, providing key focus and strategic direction to all our activities and business decisions and are directly embedded across our entire organisation.

We continue to align our stakeholder engagement strategy with the Stakeholder Engagement Standard AA1000 set by AccountAbility, the owners of the global standard. Every year, we are audited against this standard supporting our efforts to assess, design and implement our integrated approach to stakeholder engagement. It involves providing material evidence and detailed interviews with employees across 10 areas of the business from Directors to external stakeholders. This year we scored 81%, moving us up the maturity ladder to 'Advanced', the highest categorisation phase possible. This demonstrates our strong commitment to stakeholder engagement and our efforts to embed engagement into our organisational strategy, governance and operations.

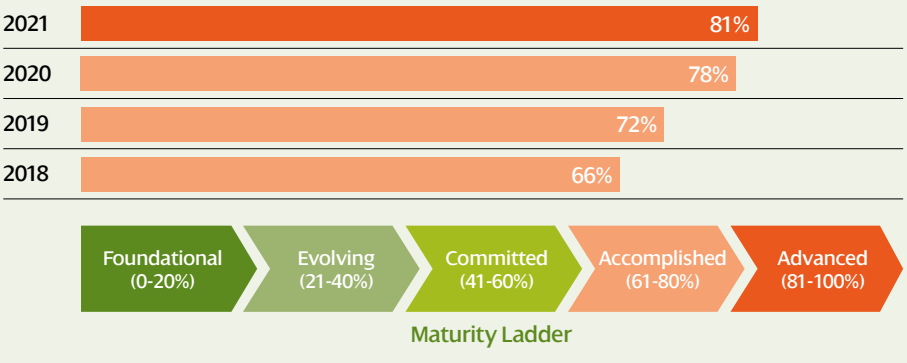
This year we further enhanced our stakeholder engagement strategy to maximise the value of our engagement activities whilst adapting to new online methods ensuring our engagement programme continued throughout the pandemic. Our strategy was agile enough to overcome a number of challenges, helping us shape new ways of working to ensure the pandemic didn't halt our commitment to proactive engagement with our stakeholders.

For full details of our stakeholder engagement strategy, see: https://www.spenergynetworks.co.uk/userfiles/file/SPEN_Stakeholder_Engagement_Strategy.pdf

Our robust embedded engagement model enables every team in our business to identify and engage with stakeholders to understand their needs and preferences. This is underpinned by a strong annual programme of core engagement that looks at the strategic issues facing our stakeholders and legitimises top-down changes in our strategic approach.

For a summary of past and upcoming events, see: https://www.spenergynetworks.co.uk/pages/stakeholder_events.aspx

AccountAbility Healthcheck Progress



Managing Our Environmental Impact

Managing Our Environmental Impact

Introduction

Our vision is to be a sustainable networks business, embedding the principles of sustainability in our decision making to efficiently manage and develop our network in support of the low carbon transition and to achieve neutral or positive environmental and social impacts.

Key to this is our robust Sustainable Business Strategy, which supports our progression towards:

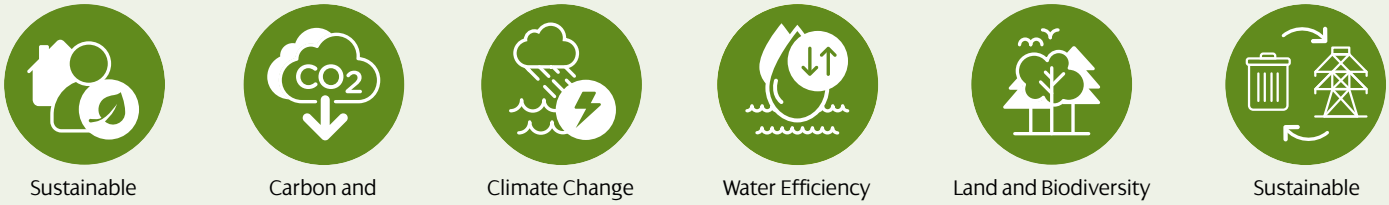
- Net positive impact on the environment and the communities in which we operate;
- Protecting and continually enhancing the biodiversity around our assets, and in support of national and local strategies; and
- Incorporating the principles of Natural Capital Assessment in our decision making processes to ensure that levels of natural assets are at least protected, if not enhanced.

Environmental compliance underpins the delivery of all of our strategic aims. We have held continuous compliance with ISO14001 since 1997 and in October 2021 we achieved recertification to ISO14001:2015. To achieve this we continued to focus on our Environmental Aspects and Impacts and improved the controls for the environmental risks from our activities. These measures allow us to continuously improve our environmental performance and to meet our targets. In 2021 and 2022, our Depots are being reviewed for the pollution prevention arrangements in place, ensuring that we have the necessary controls and resources available for day to day operations and for responding to incidents. We continue to use the reporting tool, Cintellate/EHS360 to assist in measuring and driving compliance for Health, Safety and Environmental issues. Cintellate/EHS360 is used to record environmental incidents and to track the actions taken to resolve issues, such as actions arising from audits, together with details of any intervention by an environmental regulator, where relevant. The data is then collated by our central Sustainability Team and provided to the relevant business areas in easy to read graphs and pie charts. The data is further used to present and discuss specific trends at monthly director-level meetings to ensure lessons learned can be shared across the business.

Since their introduction in 2014, our Sustainability Drivers have underpinned our strategy for managing our environmental impact and delivering wider sustainability. The introduction of Driver Icons in 2016 has enabled us to communicate the drivers and their associated objectives to a broad audience, enabling improved understanding and greater recognition of environmental and sustainability successes.

The Driver Icons are presented in Figure 5. Several of our Drivers are connected to reducing our environmental impacts, helping us to focus on key biodiversity, land, waste minimisation and water outcomes and driving our progress year on year. In this first section of the report, we will focus on how we manage our environmental impact through visual amenity initiatives and the management of oil leakage. For more information on enhancing biodiversity, please see Biodiversity within Other Environment Related Activities. We have continued to provide environmental training courses, either in electronic form or trainer led, on the key environmental topics for our workforce. New courses have been added in the past year and we continue to review our training needs and expand our course content as required. As these courses are key environmental activities, we track the completion of the planned training and report it to our colleagues throughout the business along with the other environmental metrics that as track and report on. In the past year we have also reinforced our training by including environmental personal goals and producing an environmental roles and responsibilities document to further guide staff on their environmental responsibilities.

Figure 5 – Sustainability Drivers



Visual Amenity

Historically, distribution networks in the UK have been constructed using overhead lines, taking the most expedient route towards electricity consumers.

We have over 38,000km of overhead lines supported on over 607,000 poles and towers across our operating area. Some of these assets are located in or adjacent to protected sites such as National Parks, Areas of Outstanding Natural Beauty (AONB) and National Scenic Areas (NSA) as these areas have become designated in the passage of time. These overhead lines may impact upon the visual amenity of the sites and users enjoyment of them.

A fund is available to network operators for mitigating visual impacts associated with pre-existing electricity distribution infrastructure by removing selected overhead lines and replacing them with underground cables.

Using this fund, our approach is to proactively underground overhead lines that have the greatest level of impact in nationally designated and protected landscapes, using the five stage process:

1. Develop approach to initiation and identification of distribution infrastructure.
2. Meet with relevant stakeholders.
3. Review nominations from relevant stakeholders.
4. Develop and implement undergrounding proposals.
5. Review undergrounding work.

Using this process, we are engaging with stakeholders to consider and prioritise the undergrounding of lines located in AONBs, National Parks and NSAs during the ED1 period, assessing lines in the following locations:

In our SPM licence Area

- Snowdonia National Park
- Shropshire Hills
- Bryniau Clwyd A Dyffryn Dyfrdw
- Llŷn Peninsula
- Ynys Mon/Anglesey

In our SPD licence Area

- Loch Lomond & Trossachs
- Nith Estuary
- Eildon & Leaderfoot
- Upper Tweedale
- Fleet Valley
- East Stewartry Coast
- Northumberland Coast

This prioritised list has resulted in the completion of 3 SPM projects in 2020/21, shown in **Table 3**.

Our process enables key stakeholders to play a crucial role in the identification, planning and delivery of visual amenity enhancing projects, recognising their close relationship with the local landscape.

Local stakeholders including Local Authorities nominate potential projects, and work together with us to determine the best route forward based upon local expertise and knowledge with regard to these protected landscapes. The assessment of nominated projects is supported by SPEN and by experienced chartered landscape architects to ensure that proposed projects provide the maximum visual amenity benefit whilst continuing to ensure acceptable network safety, operability, fault rate and security of supply.

Table 3 – Progress of Visual Amenity Mitigation Projects SPM & SPD in 2020/21

Location of OHL	Designated Site	Licence Area	Lines removed	Underground lines installed
Aberdaron	Llyn Peninsula	SPM	0.2km	0.27km
Sarn Bach	Llyn Peninsula	SPM	0.8km	0.9km
Plas Tan Y Bwlch	Snowdonia National Park	SPM	0.47km	0.46km

Visual Amenity
continued

This collaborative activity results in a priority list agreed by the local community. SPEN staff then proactively meet with local authority planning teams to understand local opinion and to facilitate further engagement as projects are developed and delivered. Further information can be found in Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary.

All sites benefiting from visual amenity programmes had intrinsic values including remote tranquil settings, high altitude exposure, and high visitor numbers due in part to their inclusions in national trails.

Figures 6 and **7** show before and after 0.2km of overhead lines were removed in Aberdaron, a picturesque coastal village situated within the Llyn Peninsula AONB.

Figures 8 and **9** show the views before and after 0.47km of overhead lines were replaced with 0.46km of underground cable in Plas Tan Y Bwlch near Maentwrog within the Snowdonia National Park.

Figure 6 – Aberdaron before OHL removed

Figure 7 – Aberdaron after OHL removed

Figure 8 – Plas Tan Y Blwch before OHL removed

Figure 9 – Plas Tan y Blwch after OHL removed

Oil Leakage

Oil is traditionally used as an insulating medium for assets employed in the distribution of electricity, including transformers, circuit breakers and underground cables.

Though great care is taken to ensure oil does not leak from equipment through regular site visits and maintenance activity, some oil has historically escaped from equipment. This has the potential to cause pollution of nearby soils or watercourses or cause other related environmental damage.

To limit the release of oil in the environment we are undertaking a civil asset review in conjunction with the planned modernisation of our network. Based on the condition of the asset and nearby environmental receptors, the assets that pose the greatest risk of environmental harm are prioritised for replacement or mitigation works.

The modernisation or replacement of our transformers includes aspects of environmental mitigation such as building on low permeability concrete plinths and constructing reinforced concrete bunds to surround the oil containing equipment. Bund enclosures are designed to retain aqueous liquids to a volume of 125% of the oil contained in the equipment. A sump with a proprietary waterproof lining detects if oil is contained within liquids. The sump sounds an alarm to allow a staff member to arrive on site and assess what action to take on the oil leak.

Projects are presented in **Table 4**. Works are underway for the 10 SPD sites and at 10 SPM sites listed. Transformer bunding replacement projects may take place over a number of years. The table (right) shows work carried out in 2020/21 reporting year.

Table 4 – Summary of Oil Mitigation Schemes in 2020/21

Site Name	Licence Area
Holmes Chape	SPM
Singleton Ave.	SPM
Carmel	SPM
Wrenbury Frith	SPM
Barnston	SPM
Nant-Y-Gamar	SPM
Chowley	SPM
Cadburys	SPM
Palco	SPM
Conwy	SPM
Barrhead	SPD
Burnpark	SPD
Craigendoran	SPD
Crookston	SPD
Foxbar	SPD
Hamilton	SPD
Kennishead	SPD
Kirkbank	SPD
Paulville	SPD
Sherwood	SPD
Total costs	**£1,726,859.51**

Oil Leakage
continued

In addition to carrying out the works detailed in **Table 4**, we also make use of MIDEL 7131 Synthetic Ester transformer oil at sensitive sites. Midel oil is fire safe and non-toxic but is more expensive than traditional transformer oil. We use Midel oil at sites with sensitive health and safety or environment factors, such as substations located near watercourses or those substations providing electricity at locations with an increased impact of fire.

SPEN owns and operates a number of underground fluid filled cables, which were historically installed as an alternative to overhead lines. There are 28.9km of fluid filled cables within SPD and 158.91km within SPM. Fluid Filled cables have been part of the network since the 1930's and were traditionally filled with a heavy mineral fluid with low biodegradability. The fluid used has been improved and since 1986 tops to cables have been made using a light synthetic biodegradable fluid.

Fluid filled cables are monitored by pressure alarm systems. An alarm from one of these systems indicates a drop-in pressure and a potential leak from the cable. Once the alarm is triggered, detecting the exact point of the leakage can prove difficult, especially when the leaks are small. Traditionally, fluid leak location has been conducted via freezing the cable fluid with liquid nitrogen and then monitoring the cable pressure either side of the freeze or by tagging with Perfluorocarbon PFT tracer.

At the start of ED1 we identified several small leaks within SPM which resulted in a 2% leakage rate. To combat this, we set ourselves an ambitious ED1 commitment to reduce leakage by 50% and adopted an ongoing policy of strategic leak repair management alongside targeted asset replacement.

The afore mentioned methods were adopted with success as can be seen in the continuous reduction of leaks shown in **Graph 1** below. (In 2018/19 we had a catastrophic failure due to third party damage to our cable that increased our leakage in that period significantly).

As a direct result of strategic repair and targeted asset replacement we have reduced leaks by 85% since reporting year 2015/16.

Graph 1 – Annual litres of leakage from Fluid Filled Cables

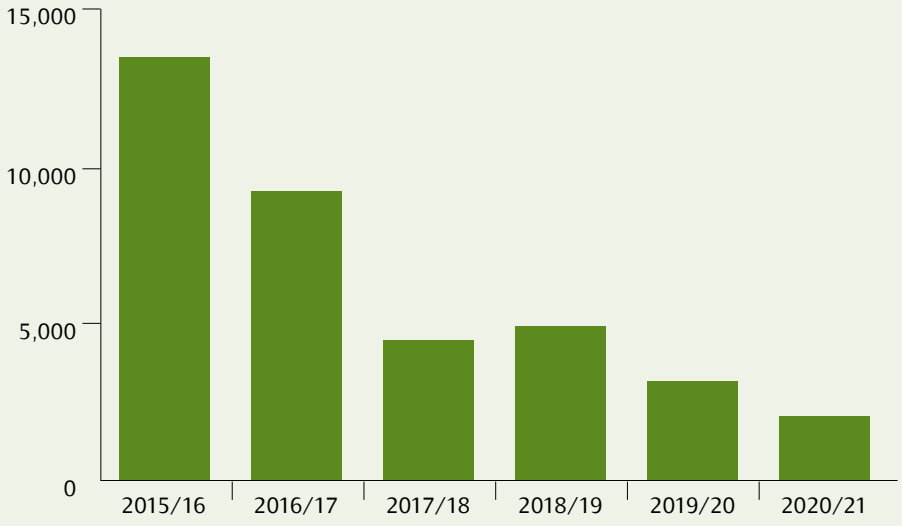


Figure 10 – The coastal village of Aberdaron

Carbon Impact and Climate Change

Introduction

Our Sustainable Business Strategy describes our aim to be a carbon neutral company throughout our value and supply chains, and the ways in which we actively support our customers and local communities towards achieving this goal.

Our ambitious carbon impact and climate change targets are aligned with international agreements to restrict global temperature increases to less than 1.5°C across all Scopes. Our goal is to reach 15% reduction on 2013/14 levels by 2023, 80% reduction by 2030 and carbon neutrality by 2050.

In this section we report on our Business Carbon Footprint (BCF) excluding losses. Losses are covered in a separate section in the report. Full details of our BCF reporting can be found in Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary.

Our carbon footprint considers three levels of data, in line with UK Government greenhouse gas reporting requirements:

- **Scope 1** – Activities owned or controlled by our organisation that release emissions straight into the atmosphere – direct emissions. Our Scope 1 emissions include fleet transport, SF_6 gas emissions and red diesel use.
- **Scope 2** – Emissions being released into the atmosphere associated with our consumption of purchased electricity, heat and cooling. These are indirect emissions that are a consequence of our organisation's activities but which occur at sources we do not own or control. Electricity losses, depot and substation energy use sit within this scope.
- **Scope 3** – Emissions that are a consequence of our actions, which occur at sources which we do not own or control and which are not classed as Scope 2 emissions. Business travel and the emissions reported from our contractors' activities sit within this scope.

This year we acheived our 5th year of certification with The Planet Mark™ for our Business Carbon Footprint, undertaken by Planet First in accordance with ISO 14064-3 (2006). The Planet Mark™ Code of Practice adheres to the highest of recognised standards and is administered by an independent Advisory Panel composed of leading academic and industry experts.

The Planet Mark™ is partnered with Cool Earth, the award-winning charity that works to halt rainforest destruction in Central Peru. For every Planet Mark Certification delivered, a pledge is made to protect an acre of rainforest.

Our parent company, Iberdrola, has recently set a Science-Based Target. In 2020/2021, we worked with Carbon Trust to develop a SP Energy Networks specific Science-Based Target aligned with a 1.5°C trajectory and developed a Feasibility Study to better inform our carbon reduction roadmap. This aligns our carbon reduction targets to an internationally recognised methodology.

Table 5 – tCO_2e by scope for SPD 2019/20 and 2020/21 including losses

Year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
2019/20	5,894.79	353,656.24	2,738.95	362,289.98
2020/21	5,533.55	282,317.76	4,328.41	292,179.72

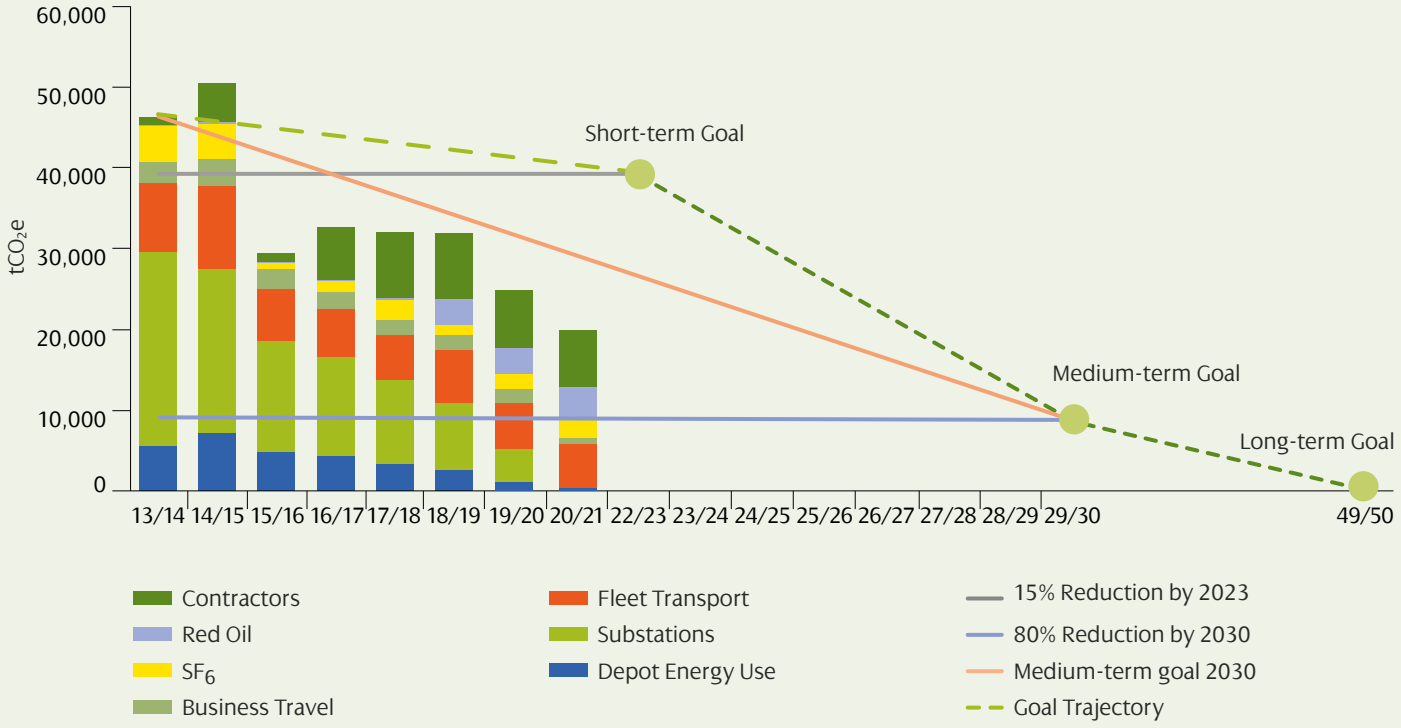
Table 6 – tCO_2e by scope for SPM 2019/20 and 2020/21 including losses

Year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
2019/20	5,135.86	256,772.39	4,159.07	266,067.31
2020/21	6,221.71	222,923.36	3,540.81	232,685.88

Business Carbon Footprint

Since our 2013/14 baseline year SPD & SPM have jointly achieved a 57% reduction in business carbon footprint excluding losses.

Graph 2 – Distribution Controllable Business Carbon Footprint (excl Losses)



In 2020/21 we achieved a 57 % reduction in our combined (SPD & SPM) carbon footprint, excluding losses. The Business Carbon Footprint graph shows our progress through ED1. This represents a 35% reduction in SPM and a 68% reduction in SPD. In comparison to 2019/20 we have reduced our carbon footprint by 21% in SPM and 20% in SPD. Our rate of decarbonisation has significantly exceeded our short-term goal of achieving a 15% reduction in emissions by 2023 excluding losses. We will continue to focus on our medium-term goal of achieving a 80% reduction in emissions by 2030 excluding losses. We will also focus on reducing our carbon footprint in line with our 1.5°C aligned Science-Based Target.

Losses (energy lost or stolen from the network as it travels from source to user), is the largest category of our Business Carbon Footprint and also the most influenced by external factors. We describe this category in detail in the losses section of this report.

After network losses, our largest carbon footprint comes from **contractor fuel use** followed **business transport, red diesel, Sulphur Hexafluoride (SF_6), business travel** and lastly **buildings energy use**.

The biggest reduction in our carbon footprint over the last regulatory year has been in our buildings energy use carbon. In comparison to 2019/20 figures, emissions associated with buildings energy use reduced by more than 90% overall. This is a result of our move to a REGO tariff last year, which provides us with 100% of our electricity usage from guaranteed renewable sources.

Sustainable Reporting Tool

Last year, we began our journey to develop a sustainability reporting tool where details of all activities within SPEN with an environmental or sustainability impact can be stored and measured. During the last year, we have been working towards aggregating all of our available carbon footprint data in the reporting tool from our base line reporting year of 2013/14 onwards. This will allow yearly comparisons and graph creation to more accurately analyse data trends.

We are also continuing to work alongside our internal corporate general services team to upload to the reporting tool accurate quarterly data on business travel, fleet transport and buildings energy. This data will be aggregated down to departments within SPEN allowing us to thoroughly analyse data trends, highlight where improvements and reductions can be made, and ultimately help to reduce our carbon footprint.

Business Carbon Footprint
continued

Building Energy Use

Until this year, energy consumed within our depots and substations was our second biggest emissions contributor after losses, and it was therefore imperative that we work to reduce the carbon emissions related to energy use at our sites. On the 1 September 2019 we amended our tariff to REGO '(Renewable Energy Guaranteed Origin)' which provides us with guaranteed zero emission electricity.

The move to the REGO tariff has reduced our recorded emissions from building energy in SPD from 2,199 tCO_2e in 2019/20 to 298 tCO_2e in 2020/21 and in SPM from 3,034 tCO_2e in 2018/19 to 46 tCO_2e in 2020/21. This is equivalent to a 98% in SPM and 90% in SPD against 2019/20. Energy used at our sites now represents 2% of our total carbon footprint excluding losses, down from 21% in 2019/20.

While we recognise that annual fluctuations in grid carbon intensity and our move to a REGO tariff contribute greatly to the reduction in the carbon footprint of our depots, substations and buildings, we recognise the need to also concentrate on reducing the kWh consumed to free up renewable energy on the grid. In this reporting year we have installed a modern efficient heating, ventilation and air conditioning system at our depot at Berwick. We also upgraded our Kirkintilloch Datahall cooling units for improved reliability and energy efficiency. Lastly, existing lights were replaced with high efficiency LED panels on two floors within our HQ in Glasgow.

The energy used at our depots, substations and radio base stations has marginally increased across both licence areas, by 12,819 kWh, representing an increase of less than 1%. In SPD building energy use decreased by 0.1% from 21,691,240Kwh in 2019/20 to 21,668,719Kwh in 2020/21. In SPM building energy use increased by 0.21% from 16,819,367 in 2019/20 to 16,854,707 in 2020/2021.

SF_6

Following a review of the way we report SF_6 lost to the atmosphere we improved estimations of SF_6 lost to the atmosphere by developing more robust methods for reporting SF_6 emissions lost through equipment disposal.This has resulted in an apparent increase in SF_6 emissions since 2019/20. In 2020/21 we reported a 52% increase in emissions from our SPM license SF_6 emissions and a 113% increase from our SPD license SF_6 emissions. This increase is not directly indicative of extra SF_6 leaking into the atmosphere.

SF_6 remains arguably the most challenging area of our business carbon footprint, especially at voltages lower than 132kV, where SF_6 free solutions remain technically challenging. We will continue to work with our supply chain to drive innovation, piloting SF_6 free solutions where these are market ready and technically compliant, in addition to replacing the worst of our leaking assets.

Diesel

In 2021/21 we also undertook a review to better understand our diesel consumption, particularly associated with hired generators, where consumption may not have historically been accurately accounted. Using available data, we back dated emissions associated with red diesel consumption which has increased the emissions. In 2019/2020 total corrected emissions across distribution licences was 3,403 tCO_2e. This increased by 2% to 3,472 tCO_2e in 2020/201.

In the last regulatory year we explored possibilities of using electric generators for temporary power supply and will continue dialogue with our supply chain to assess low carbon options.

Business Carbon Footprint
continued

Business Travel

In 2020/2021, the effects of Covid-19 resulted in a dramatic decrease in business travel emissions as we moved to a system of remote working and reduced face to face meetings.

Across both our distribution licence areas, business travel has decreased 65% since the start of ED1. In the last year, business travel decreased by more than 50% across both licence areas. In each licence, SPD decreased from 817 tCO_2e in 2019/20 to 407 tCO_2e in 2020/21 and SPM decreased from 907 tCO_2e in 2019/20 to 437 tCO_2e in 2020/21.

As we move out of the pandemic and progress to business as normal, we will look to embedd the efficiencies in business travel which resulted from this adaptation and question the need for business travel where possible,encouraging online meetings where these are practical.

Operational Fuel Use

Our distribution operational fuel use has reduced by 15% since the start of ED1. The carbon impact from operational fuel use has decreased in SPM from 2,920 tCO_2e in 2019/20 to 2,823 tCO_2e in 2020/21. SPD has decreased from 2,825 tCO_2e in 2019/20 to 2,654 tCO_2e in 2020/21.

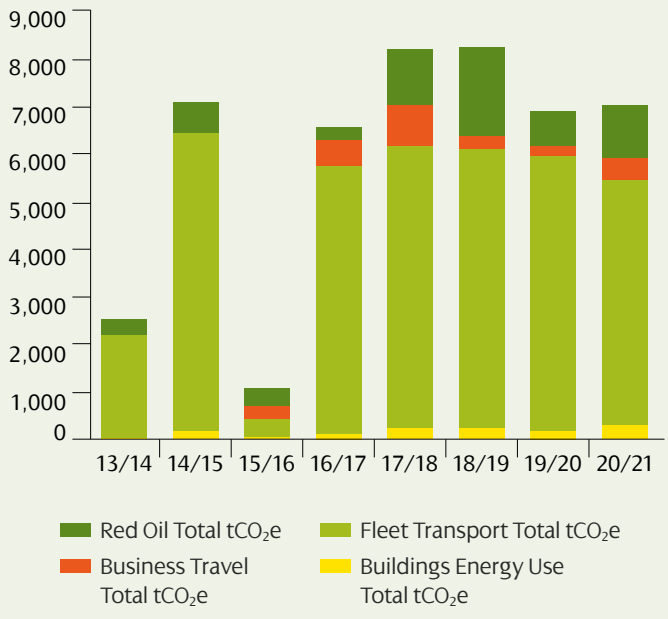
We are committed to decarbonising our fleet vehicles and will see the effect of introducing EVs in our future BCF submissions as we move towards a fully electric fleet. In September 2019, our parent company Iberdrola signed up to The Climate Group's EV100 initiative.

The agreement will see Iberdrola electrify their vehicle fleet (subject to local market conditions) by 2030. SP Energy Networks has been at the forefront of this initiative, focusing our efforts on ensuring we have optimal vehicle charging facilities whilst procuring the most effective electric vehicles to become an essential part of our operational activities.

Since forming a Sustainability Team at the start of ED1, the team has worked to improve data collection by moving away from estimations and providing accurate data. Since the start of ED1, we have worked to increase the number of contractors reporting their emissions and continue to target our top 20 contractors for accurate records of data. In this way, we can record the impacts of our supply chain and continue to work with them to reduce their emissions. **Graph 3** shows contractor data from 2013/14 to 2020/21.

In 2015/16 we moved away from estimated data, and provided actual data as reported by a small number of contractors. From 2016/17 onwards, we have included a greater number of our contractors and reported accurate data, resulting in an increased figure. We have been working to improve data received from our contractors which has included instructing the help of Smart Waste to to collect carbon and waste data from our Distribution contractors in SPD & SPM.

Graph 3 – Contractor Business Carbon Footprint data



Business Carbon Footprint
continued

Summary of 2020/21 carbon and climate change impact reduction initiatives:

Reduce our carbon footprint by 15% on 2013/14 baseline year – This target was achieved in 2015/16. In 2020/21, we reached a 57% reduction in combined SPD and SPM emissions. Our primary focus is now on reaching our stretching target of 80% reduction by 2030 and focusing on reducing carbon in line with our 1.5°C Science-Based Target.

Reduce SF_6 on our network – We are continuing to work with industry to support the implementation of other SF_6 free solutions with a view to adopting suitable alternatives on our network wherever practicable, including tendering exclusively for non-SF_6 equipment where possible. In 2020/21 we continued to drive the supply chain towards developing equipment with reduced SF6 leakage rates, having embedded this requirement in our procurement and specification processes. The International Electro-Technical Commission (IEC), the body responsible for setting international guidance recommends a leakage rate of 0.5% (indoor equipment). Our equipment specifications demand a more stringent maximum leakage rate of 0.1% for all indoor and 0.25% for all outdoor equipment each year.

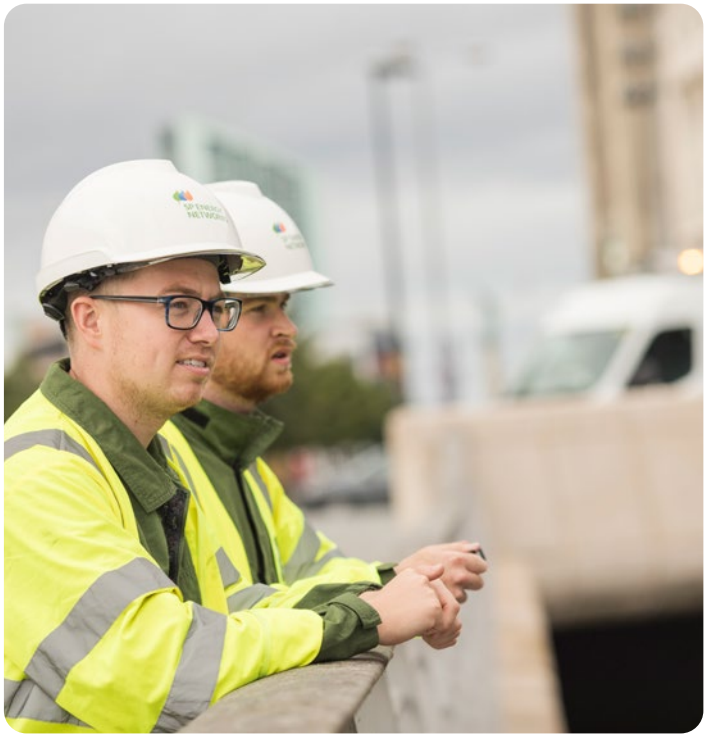
Undertaking planned transformer replacements and installed lower loss Transformers – During the 2020/21 reporting year we have installed 94 lower loss transformers in SPM and 53 lower loss transformers in SPD. We have so far replaced a combined SPD and SPM total of 609 transformers during ED1, saving 18,688 MWh of losses and 7,772 tonnes of CO_2 equivalent.

Incorporating energy efficiency measures in our buildings – Until this year, energy consumed within our depots and substations was our second biggest emissions contributor after losses, and it was therefore imperative that we work to reduce the carbon emissions related to energy use at our sites. Last year, we amended our tariff to REGO '(Renewable Energy Guaranteed Origin)' which provides us with guaranteed zero emission electricity. As a result, energy used at our sites now represents just 2% of our total carbon footprint excluding losses, down from 21% in 2019/20. We have also taken a number of energy improvement measures including installation of a modern efficient heating, ventilation and air conditioning system at our depot at Berwick, upgrading our Kirkintilloch Datahall cooling units and replacing lights with high efficiency LED panels on two floors within our HQ in Glasgow. We estimate that these additions will save 346,000 kWh of energy annually.

Reviewing our data and making improvements where required – This year we continued work on our sustainability reporting tool, allowing us to aggregate down to departments within SPEN to thoroughly analyse data trends, highlight where improvements and reductions can be made, and ultimately reduced our carbon emissions. In addition, we also improved our method for reporting red diesel emissions from generators and SF_6 emissions from equipment disposal.

Encouraging a reduction in business travel – As a combined result of travelling less, competitive rail pricing and increased staff awareness of carbon emissions from travel we have reduced our business travel reduced jointly by 65% since the start of ED1. Since the start of ED1 we have reduced our business travel carbon emissions by 65%. This overall reduction is a result of accurate apportionment between our licenses, travelling less, competitive rail pricing and increased staff awareness of carbon emissions from travel. Additionally, In 2020/21 we have seen a dramatic decrease of 51% in emissions in travel across SPM and SPD combined, due to the global COVID-19 pandemic. The introduction of new travel and teleworking policies during this time will allow us to continue to target this area for sustained and further reductions in the coming years.

Reducing fleet emissions – We have now fully embedded our electronic vehicle management system TrackM8. Our vehicle tracking system continues to allow us to track our mobile assets and their emissions effectively. Vehicle numbers remain the same as we progress towards electrification of our fleet. Since the start of ED1 our carbon emissions from fleet vehicles have increased by 5% in SPM and reduced by 30% in SPD. During the 2020/21 reporting year, we installed 14 double charge points at our offices and have introduced another 19 electric vehicles to our fleet of pool cars. This brings the total to 53 charging points installed and 48 new electric fleet vehicles introduced since the start of ED1.



Sulphur Hexafluoride Emissions

Switchgear filled with SF_6 is one of the predominant solutions offered in the electricity industry for new switchgear applications and the replacement of legacy switchgear, in some applications it is the only viable solution available.

By installing modern SF_6 filled switchgear SPEN have been able to enhance the operational safety of our asset base and reduce ongoing plant maintenance costs. SF_6 is a colourless and odourless gas used for both insulation and arc interruption in switchgear applications. It has exceptional insulating properties which enable safe, compact and low-cost switchgear solutions. Although it causes no detectable impact on the local environment if released, it is a highly potent greenhouse gas with a global warming potential of 22,800 times that of CO_2.

We anticipate that in the short term, the quantity of SF_6 on our network, described as the 'SF_6 bank', will increase as the replacement of end-of-life oil-filled switchgear programmes proceed. Efforts to minimise the escape of SF_6 from equipment to the environment are therefore highly important.

There are many challenges involved in the development of solutions utilising alternative gases and they vary by voltage level and application; there are also no commercially available gases that match the electrical insulation properties of SF_6. We are progressing an industry leading solution using GE Green Gas for Grid (G3) as the insulating medium within a 132kV Gas Insulated Switchboard (GIS) solution at our Lister Drive substation in SP Manweb. We are also continuing to work with industry to support the implementation of other SF_6 free solutions with a view to adopting suitable alternatives on our network wherever practicable, including tendering exclusively for non-SF_6 equipment where possible. We will continue to prioritise works where we can achieve the greatest curtailment of SF_6 volumes to the SF_6 Bank possible wherever this is feasible and in our customers interests.

It is also important that we ensure we capture all possible SF_6 leakage scenarios. The design leakage rates of some SF_6 equipment is such that 'topping up' the asset during its service life may be required. Fugitive emissions are recorded as the volume of gas required to top up the equipment to its original capacity. However, most equipment containing v is hermetically sealed and not designed to require a top-up. Where SF_6 equipment reaches the end of its service life; either due to condition or the presence of leaks, we replace it and capture the volume of gas recovered at end-of-life via approved disposal providers.

Our networks in SPD are all below 132kV, while SPM includes networks up to and including 132kv. This results in SPM managing larger equipment with higher amounts of SF_6. Since the equipment held by SPD is generally smaller and has much of its SF_6 held in sealed containers with no facility to top up, these pieces of equipment must be replaced when SF_6 levels are shown to have dropped below a defined threshold. In SPM, top ups are managed by either routine checking of assets or through alarms that are generated onsite.

In SPM, we have successfully reduced our kg of SF6 from top ups from 32.63kg in 2019/20 to 28.67kg in 2020/21. However, we are now including final disposal emission values which are the value from the nameplate mass (original gas in the item) minus the gas recovered at end of life. The value of these emissions is 40.83kg increasing our emissions to 69.50kg.

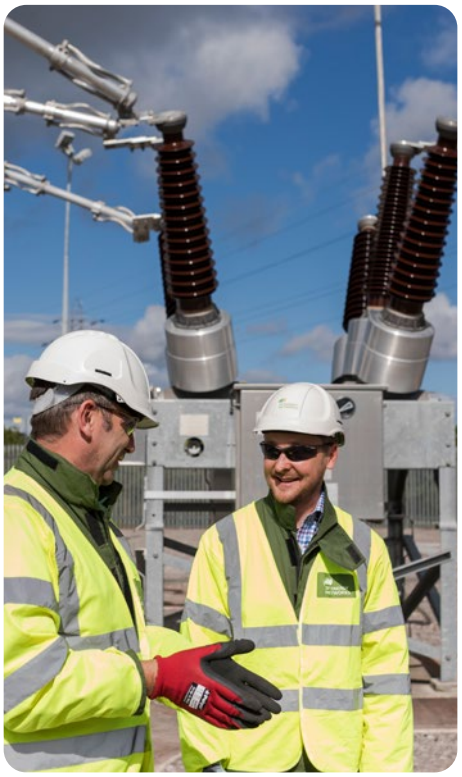


Table 7 – Summary of SF_6 Information

	SF_6 Bank	SF_6 Emitted	Actual Leakage Rate
SPM	20,850.46	69.50	0.333%
SPD	15,866.57	49.92	0.315%

Distribution Losses

About 7% of the energy entering the distribution system is not ultimately billed to customers – this energy is known as distribution losses. Much of this energy is lost in heat and noise as an inherent result of power flowing through network assets.

In addition, a small amount of energy is illegally abstracted, or lost due to inaccuracies in the billing and conveyance process. More detail on the types of losses is given below.

Electricity industry settlement systems charge suppliers for distribution losses and this cost is passed on to all consumers as part of their bill.

Electricity losses are an inevitable consequence of transferring energy across electricity networks, but they carry a financial and environmental impact. Delivering the right, cost-effective loss minimisation activities will lead to a more efficient network, reducing customer energy bills and carbon emissions. Therefore, we have a published Losses Strategy based upon a high-level vision that we will consider all reasonable measures that can be applied to reduce losses and will adopt those measures which provide benefit for customers. Furthermore, in ED1 we have invested in numerous activities that are over and above a return-on-investment basis under our Losses Discretionary Reward programme.

Managing losses is complex: losses are difficult to measure and are influenced by factors outside of DNO control. Furthermore, loss management must be considered within the Net Zero context. The electrification of heat and transport, greater levels of decentralised renewable generation, and the need to operate the network more flexibly will increase network power flows, leading to higher network losses.

Technical losses

Technical losses are those losses that are lost as heat and noise as an inherent result of power flowing through network assets.

Our distribution networks convey energy from the interface with the transmission system to the lower voltage supplies used by our network customers. The system comprises overhead lines, underground cables, switchgear and transformers, and operates at several different voltage levels. The design is based on the principle that as the load to be transferred increases so does the operating voltage. This design ensures that the electric current does not become excessive which would create uneconomic losses. Each of these network components generates heat, noise or both as electricity is transferred, resulting in technical losses. Technical Losses can be described either as Fixed Losses or Variable Losses.

Fixed Losses occur because some parts of the system must be electrically energised at all times. Fixed losses include the energy consumed by the steel in a transformers magnetic core reversing polarity in every AC cycle. This causes the core to mildly pulse (emitting a humming noise) and to heat up. This steel inefficiency is called "Iron Losses". In addition, there is some small level of current flow across electrical insulation used in transformers, lines and cables. Taken together, this energy consumption is the "No Load" or "Fixed Losses" on the system. Energy is also consumed by our equipment to ensure safe and reliable network operation. In our substations, energy is consumed for dehumidification and cooling equipment, oil pumps, air compressors and battery changers to maintain secure network operation and resilience.

Variable losses are those which vary with the current that flows through the system. All conductors, whether coils in transformers, aluminium or copper wires in overhead lines or cables and even in switchgear, have electrical resistance which causes them to heat when carrying electric current. This heat is lost to the environment.

Calculating the value of technical losses is complex because variable losses change with load on the circuit, which also varies with the time of day. Variable losses increase with the square of the electrical current, and therefore if the peak current was 10 times the minimum, peak losses would be 100 times as large as the losses at minimum load. To calculate technical losses with complete accuracy, the detailed power flows of every inch of the network would need to be known in real-time.

Significant progress is being made to make our network smart, and this is helping us learn more about technical losses. We recognise the importance and benefit of collaboration amongst DNOs in this undertaking, and currently chair the Energy Network Association (ENA) Technical Losses Working Group (TLWG), which is aimed at facilitating the sharing of best practice within the industry.

Distribution Losses
continued

Non-technical losses

These are the losses that occur due to unidentified, misallocated or inaccurate energy flows. They can be thought of as electricity that is consumed but not billed. It is important to differentiate this from electricity that is billed but where the bills are not paid. In the case of non-technical losses the end user is unknown or the amount of energy being consumed is uncertain.

The three main types of non-technical losses are:

1. Energy theft – the illegal abstraction of electricity by customers, achieved through tampering with supplier meters or interference with network assets.

2. Unmetered Supplies – not all customer supplies are metered. Typical unmetered loads include communal areas in council owned buildings, street lamps, bus stops and advertising boards. Such consumption is quantified by establishing accurate records for each supply and applying a representative profile. Losses typically arise as a consequence of incorrect or incomplete unmetered supplies records and inaccurate estimated annual consumption information.

3. Conveyance errors – these occur when electricity is delivered but not accurately recorded in energy settlements. Typical reasons for energy not being accurately recorded include missing or unregistered metering points, incorrect recording of metering point energisation and incorrect registration of metering systems, which all result in inaccurate or missing consumption data.

Method to Calculate Losses

Currently, SP Energy Networks use industry settlement data to estimate losses. At Extra-High Voltage (EHV) (33kV) (and 132kV in SP Manweb) site-specific loss adjustment factors are applied to metered units distributed, and for LV and HV estimated loss percentage is derived from the 12-month rolling average models which captures losses at the various stages of settlement reconciliation. The model calculates the average difference between the total energy entering the system minus the EHV purchases and the HV and LV billed sales. The objective of the methodology is to smooth short-term fluctuations in losses which are a natural result of settlement profiling which can obscure actual underlying losses. Settlement takes 14 months from the initial reconciliation where the majority of actual data is estimated to final reconciliation which includes actual data.

The current approach to determining distribution network losses has several limitations:

- It is not possible to distinguish between technical network losses and non-technical losses,
- The process is very sensitive to data quality and accuracy,
- Estimated energy consumption is used to determine energy use from unmetered supplies, and
- Apportionment of losses across customers is reliant on educated estimates.

Therefore, over ED1 we have committed to improving our understanding of losses. Significant progress is being made to make our network smart, and this is helping us learn more about technical and non-technical losses.

Distribution Losses Strategy

In September 2015 we published our ED1 Losses Strategy. This strategy applies throughout the ED1 2015–2023 regulatory period and is subject to regular reviews. Underpinning this losses strategy is our strategic vision to:

Consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers.

Specific actions include:

- **Accelerating the replacement of more than 1,000 higher-loss transformers** that would have otherwise been replaced between 2031 and 2039. Over the last 60 years, advances in transformer core materials and manufacturing techniques have resulted in the significant reduction of fixed losses, such that the cost of early replacement is offset by the reduced losses over that period. The continuing programme led to the replacement of 142 high-loss transformers in 2020/21 – as shown in **Tables 11** and **12**, along with forecasts for 2021/2022. The latest figures bring the estimated total losses benefit to 18,688 MWh or 7,772 tCO_2e so far in ED1 – as shown in **Tables 9** and **10**.

Table 8 – Assessment of Losses (Technical and Non-Technical) 2020/21

	SPD	SPM	Distribution Total
Units Entering (GWh)	16,993	14,433	31,426
Units Exiting (GWh)	15,782	13,477	29,259
Losses (GWh)	1,211	956	2,167
Losses (%)	7%	7%	7%

Distribution Losses
continued

- **HV main line new builds throughout the RIIO-ED1 period will be constructed using larger than usual (100mm^2) conductor.** Furthermore, we will evaluate the installation of larger cross-section cables on new circuits on a project-by-project basis and perform ongoing cost-benefit studies to inform future policy revisions.
- **Increasing our Revenue Protection team by 22% to target illegal abstraction,** and improving the use of HV and LV network metering and smart metering to identify zonal problems. The continuing programme of Revenue Protection services led to the discovery of 1,521 irregularity cases in 2020/21 – as shown in Tables 11 and 12, along with forecasts for 2021/2022. The latest figures bring the estimated total losses benefit to just under 159,000 MWh or almost 66,122 tCO_2e so far in ED1 – as shown in Tables 9 and 10. Meanwhile, our continuing programme of Theft in Conveyance investigations led to the discovery of 139 interferences in 2020/21 – as shown in Tables 11 and 12, along with forecasts for 2021/2022. The latest figures bring the estimated total losses benefit to over 14,000 MWh or 5,874 tCO_2e – as shown in Tables 9 and 10.
- **Proactively improving the accuracy of records** for unmetered supplies by working closely with customers and settlement stakeholders.

Losses Policy

In order to ensure that the strategy is simply and easily communicated, we have developed a Losses Policy that sets out our vision to consider all reasonable measures which can be applied to reduce losses.

We have developed supplementary material to set out the purpose of the Strategy and Policy and articulate the actions we expect our staff to take in the day-to-day activities where they can have an impact on reducing both technical and non-technical losses. In addition to providing a generic methodology for loss assessment, it also provides methods, and examples, where a more detailed assessment may be required, for example:

1. Line loss factor calculations
2. An approach for selecting conductors
3. Transformer loss calculations
4. Practices in Network Operations to control losses, e.g. load balancing, phase imbalance correction and optimising voltage levels

Furthermore, we are updating many of our technical policies and procedure to make specific reference to relevant aspects of the Losses Policy where appropriate.

Losses Discretionary Reward

The Losses Discretionary Reward (LDR) was set up to encourage DNOs to work towards a better understanding of how to manage electricity losses and to identify ways of reducing losses and therefore reduce costs for customers. The LDR has been managed in three tranches during ED1:

- Tranche one – submissions made in 2016
- Tranche two – submissions made in 2018
- Tranche three – submissions made in 2020

The submissions are available here: https://www.spenergynetworks.co.uk/pages/what_are_we_doing_about_network_losses.aspx

Tranche one

We submitted our application for tranche one of the Losses Discretionary Reward in January 2016 and were awarded £770,000 in July 2016.

For this application we established an ambitious portfolio of initiatives. These initiatives went beyond our Losses Strategy and allowed us to explore methods and processes to help improve our understanding and management of losses. Our initiatives recognised that a stakeholder and holistic approach is required when analysing and managing losses.

- Initiative 1: Smart meter data to reduce non-technical losses
- Initiative 2: Smart meter data to reduce technical losses
- Initiative 3: Voltage optimisation to improve network losses
- Initiative 4: Improved modelling of complex networks to consider losses
- Initiative 5: Improved modelling of rural networks to consider losses
- Initiative 6: Assessment of power factor to improve GB Losses
- Initiative 7: Improved detection of theft through Revenue Protection
- Initiative 8: Improved network loading through Stakeholder Engagement
- Initiative 9: Substation efficiency – waste heat recovery
- Initiative 10: Substation efficiency – monitoring and self-sufficiency

In later tranches, three further initiatives were added as follows:

- Initiative 11 Consider case for Mobile Asset Assessment Vehicle (MAAV)
- Initiative 12 Early viability of Loss Adjustment Factors (LAFs)
- Initiative 13 SCADA based near real-time losses calculations

Tranche two

We submitted our application for tranche two of the LDR in February 2018. Ofgem received six submissions for tranche two, one from each of the DNOs. Whilst it was noted that SPENs submission was strong, no DNOs were successful in securing a reward.

Our tranche two submission provided a review of the activities undertaken and their outputs and implementation into the business. Some highlights from the tranche two period are as follows:

Innovative use of smart meter and network data – we extended our understanding of technical losses on networks. We paid particular attention to losses in service cables, which can be calculated using smart meter data combined with our own systems data, through the innovative analysis of smart meter data has included engagement with suppliers via the Theft Risk Assessment Service Expert Group. These new developments will continue throughout RIIO-ED1.

Distribution Losses
continued

Improve substation efficiency – we continued our work on understanding the scale and profile of energy required to operate our substations, and look to reduce our lighting and heating demand wherever possible. We explored recovery waste heat from transformers to reduce substation heating demand, and although no economically viable schemes are currently available, we continue to engage with stakeholders on heat recovery and remain open to proposals where a demonstrable financial and safety benefit to the customers can be realised.

Improved detection of theft through revenue protection – our revenue protection team initiated and hosted a number of awareness sessions for stakeholders who may encounter meter tampering and safety issues during their work. We now have an embedded member of staff with the Merseyside Police force resulting in a significant increase in the detection of energy theft.

HV phase imbalance – Phase imbalance on long rural overhead 11kV circuits is a major contributor to 11kV network losses. We have developed a modelling tool to assess the extent and location of phase imbalance. This modelling tool utilises readily available network metrics to identify feeders which are likely to exhibit high imbalance. This has reduced the need monitoring and informed our understanding of this source of losses.

Tranche three

We submitted our application for tranche three of the LDR in March 2020. Ofgem received five submissions for tranche three, with one DNO choosing not to submit. Although no rewards were given again, it was noted that progress had been made from tranches one and two, as shown by the outputs delivered by both completed and ongoing projects and collaboration with various stakeholders.

In accordance with Ofgem's requirements, we demonstrated progress in the following four areas:

Understanding losses – over RIIO-ED1 to date we have led considerable advances in understanding of network losses in the context of the low carbon energy transition and continued to progress our readiness for smart meter data and advanced modelling tools. In tranche three, we used this new learning to further investigate the effects of Low Carbon Technologies (LCTs) on our own network losses. Our understanding of theft in our network has also improved: through engagement with Smart suppliers, including British Gas and Utilita, we are improving the accuracy of alerts that require further investigation.

Customer and stakeholder engagement, and sharing best practice – by convening and chairing the TLWG since 2016 we have provided an ongoing platform for DNOs to discuss and share best practice. In our revenue protection area, our industry leading approach to working with law enforcement agencies has continued, and wide stakeholder engagement and awareness sessions are ongoing. This has led to higher detection of cannabis farms in our licence areas and is now stretching beyond on own licenced areas with awareness sessions undertaken in Greater Manchester. We continue to engage with specific customers to assist them in understanding their usage patterns and their impacts on losses. Examples include our on-going work with Flintshire County, their supplier and the Welsh Assembly.

We continue to consider losses holistically across the transmission and distribution system, and this includes engaging with NGESO and NGET to understand how to manage conditions at the transmission interfaces caused by transmission-connected generation and provision of reactive power services. Finally, we have continued international engagement and share best practice through presenting at international conferences (including CIRED), which has led to the sharing of best practice with international operators.

Processes to manage losses – one of the key process improvements developed over the LDR programme is work on our network modelling techniques. Prior to the LDR, our losses modelling traditionally used a 'top-down' approach to quantify losses across voltage levels (Losses = Energy In – Energy Out) as described above, which is prone to significant inaccuracies. The new modelling approaches for HV, EHV and 132kV assets give much more detailed information on the losses characteristics of the network, which facilitates the identification of high loss circuits and network components. This enables increasingly complex networks to be designed, leading to opportunities for improved loss management.

As a result, we now have losses information by network group and at an individual asset level. Our ability to consider our planned network throughout all operating periods in a year is delivering a reduction in network losses through our ability to optimise how we operate our assets. This tool is now being used to support the following processes as BAU:

- Reinforcement Schemes: Assessing reinforcement scheme designs
- Load Growth Management: Selection of appropriate solutions to manage load growth whilst considering losses impact.
- Customer Connections: Enabling detailed consideration of losses in customer connection design (load and generation)

Losses innovation and incorporation as BAU – over the course of the LDR we have transitioned innovation from our LDR Initiatives into BAU: e.g. innovative LV losses modelling techniques have been incorporated into our new LV analysis tool. We have also reviewed wider industry innovations ready for adoption in RIIO-ED2: e.g. we have investigated the MAAV, an innovative technology being used by UKPN, to understand the benefit in our own network. Finally, we continue to seek new innovations: e.g. we are in early discussions with manufacturers and generators to investigate power factor correction at the point of connection through innovative new reactive power control technology.

Distribution Losses
continued

Figure 11 – Summary of Losses Initiatives

WORKSTREAM	Understanding	Stakeholder	Processes	Innovation
LOSSES DISCRETIONARY REWARD				
Initiative 1 Smart Meter Data analysis systems to reduce non-technical losses	Used example datasets to estimate LV network usage		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 2 Smart Meter Data analysis systems to reduce technical losses	Used example datasets to estimate LV network usage		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 3 Voltage Optimisation to Improve Network Losses and Load	Better understand potential for voltage optimisation		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 4 Improved Modelling of Complex Networks to Reduce Losses	Stochastic power flows in pockets of the network		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 5 Improved Modelling of Rural Networks to Reduce Losses	Understand suitable equipment upgrades		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 6 Assessment of Power Factor to Improve GB Losses	Initial understanding of level of loss due to power factor was successful. This work is now progressing under Open Networks Workstream 1b.			
Initiative 7 Improved detection of theft through revenue protection	Continually improving understanding of theft patterns with detection	Police, Fire & Rescue, Suppliers, Councils, Housing Associations	Internal process for theft detection is best practice	Innovative methods now incorporated for use as BAU
Initiative 8 Improving Network Loading by Stakeholder Engagement		Proactively engaging across all initiatives		
Initiative 9 Substation Efficiency – Alternative uses for waste heat	Proactively engaging across all initiatives			Improved understanding about the technology
Initiative 10 Substation Efficiency – Monitoring and self-sufficiency	Better understand self-sufficiency measures, but no retrofit PV		Change to processes as a result of business case review	
Initiative 11 Consider case for Mobile Asset Assessment Vehicle (MAAV)	Understand contact voltage faults, further trials to understand loss impact	Learning from UKPN		Relatively new technology in US, very new to UK market
Initiative 12 Early viability of Loss Adjustment Factors (LAFs)		Driven by engagement with generators and Elexon	(Very) early beginnings of future process for site-specific LAFs	Requires cutting edge technology
Initiative 13 SCADA based near real-time losses calculations			In early/preparatory stages	
INDUSTRY COLLABORATION				
ENA Technical Losses Task Group	Used example datasets to estimate LV network usage		Developing processes ready for arrival of smart meter data	
ENGAGEMENT EVENTS				
Engaging with Stakeholders	Ofgem and Industry Teach-In Sessions	Presentations and Workshops; CIRED, CIGRE, LCNI		

Distribution Losses
continued

Preparing for RIIO-ED2

In RIIO-ED2 and beyond, we anticipate that under an efficient Net Zero transition distribution network losses will increase as a result of the electrification of heat and transport, and the increase of low-carbon distributed generation. As the mix of electricity generation in GB becomes increasingly low-carbon, so do the losses. Therefore, whilst losses still have a cost implication to the customer linked to energy prices, the carbon cost of losses is changing. It is crucial any loss management activities do not discentivise the connection of LCTs. Our focus in RIIO-ED2 is to build upon systems that enable a whole system, whole life assessments to be made when making design and operational decisions ranging from domestic service cables to 132kV connections.

In our role as chair of the ENA TLWG we are working collaboratively with the other DNOs and NGET (National Grid electricity transmission) to provide recommendations for a regulatory approach in RIIO-ED2. We are continuing our optioneering, stress-testing and modelling exercises to identify effective and practical potential options. We have led the TLWG to commission independent reports, comparing international regulatory approaches for managing network losses and proposing potential future incentive mechanisms in the context of the low carbon transition.

The tranche three LDR submission also outlined a number of areas where the LDR programme will shape both our Losses Strategy and plans for enhanced losses consideration in RIIO-ED2.

Some examples include:

- Use our complex modelling tools to go beyond what is currently BAU. We will identify the network assets with disproportionately high losses and deliver proactive replacement programmes where they are in our customers' interests.
- Continue to assess the use of network management and nearer-real-time information to improve real-time understanding of losses (levels and locations) and using this understanding to inform operational policies.
- Continue to use our new processes and analytical tools to further our understanding as more smart meter and LV monitoring data becomes available in RIIO-ED2. Specifically, we will use smart meter data to establish voltage pattern recognition algorithms to define phase connectivity and distinguish between technical and non-technical losses in the LV network using network impedance data. This will continually refresh our understanding of the scale of electricity theft.
- Conduct further modelling of specific LV network assets using the new tools, including service cables and LV mains. We will maintain processes for service cable upgrade and replacement setting out exactly how to analyse the network and conduct losses-informed cost benefit analysis. In preparation for RIIO-ED2, we will generate simulated smart meter data where real smart meter data is not available.
- As a DSO responsible for delivering the Net Zero transition we will continue to engage with stakeholders including TOs, NGESO, aggregators and customers to ensure that DG and LCT load growth is accommodated through holistically optimised system design and operation, inclusive of losses.
- Continue to provide clear input to the Open Networks project which provides an additional route to stakeholders who will be impacted by new network solutions. We will incorporate stakeholder views to influence how policies and processes are developed, and ensure losses are appropriately considered as part of this work.
- Reduce technical losses by replacing faulted LV fuses; identified using LV main voltage drop profiling where there is sufficient smart meter data.
- Keep abreast of national and international innovations, and actively investigate and seek to reduce the barriers to adoption of newly discovered losses management innovations. Specifically, Central Voltage Control System technologies, Seasonal Normal Open Points (NOPs) routines, reactive power control technology for distributed generators and continued work into use cases to minimise losses as part of our flagship innovation projects into the use of DC distribution.
- Continue to work with the TLWG and Ofgem to monitor relevant international regulatory mechanisms and to develop future incentive mechanisms for losses management. We will also continue to present on and raise the profile of network losses at key industry events, and with international partners.

We will also continue our key losses management actions and publish an updated RIIO-ED2 losses strategy with an objective of ensuring losses are limited to a lower level than would otherwise be the case during RIIO-ED2. This includes continuing with our early replacement programme of 795 HV transformers and 4 EHV transformer assets, and continued Revenue Protection and Theft in Conveyance activities. Furthermore, we are continuing to actively pursue the MAAV as a Consumer Value Proposition, following review with our Customer Engagement Group. This is based on collaborative support from our customers and stakeholders.

Distribution Losses
continued

Erratum: Please see the link below for corrections to previously published data on Summary of losses Costs and benefits for SPD & SPM 2015 – 2020:
https://www.spenergynetworks.co.uk/userfiles/file/Appendix_4_Amended_Losses_Tables.xlsx

Table 9 – Summary of losses Costs and benefits (SPD) from activities in RIIO-ED1

Programme/Project	Distributed Losses – Justified Costs	Reduced Losses 2020/21	Reduced Emissions Associated with Losses	Cumulative reduced losses to date
Replace high loss transformers	£0.51m	2,252 MWh	969 tCO_2e	7,566 MWh
Internal and External Revenue protection inspections	£0.74m	12,748 MWh	5,486 tCO_2e	73,689 MWh
Theft in conveyance	£0.0m	631 MWh	272 tCO_2e	1,829 MWh
Totals	**£1.25m**	**15,631 MWh**	**6,727 tCO_2e**	**83,084 MWh**

Table 10 – Summary of losses Costs and benefits (SPM) from activities in RIIO-ED1

Programme/Project	Distributed Losses – Justified Costs	Reduced Losses 2019/20	Reduced Emissions Associated with Losses	Cumulative reduced losses to date
Replace high loss transformers	£1.00m	3,804 MWh	1,637 tCO_2e	11,122 MWh
Internal and External Revenue protection inspections	£0.45m	14,132 MWh	6,082 tCO_2e	85,306 MWh
Theft in conveyance	£0.0m	2,391 MWh	1,029 tCO_2e	12,296 MWh
Totals	**£1.45m**	**20,327 MWh**	**8,748 tCO_2e**	**108,724 MWh**

Table 11 – Summary of Amount of Losses Activities (SPD) in Regulatory Reporting Year and Estimate for the Following Regulatory Year

Programme/Project title	Description of unit	Volumes in Regulatory Reporting Year	Forecast volumes for Following Regulatory Year
Replace high loss transformers	Transformer volumes	53	134
Revenue protection inspections	Visits made by revenue (metered supplies)	7,943 visits were conducted resulting in 946 irregularity cases	17,039 visits
Theft in conveyance	Investigations	110 investigations 67 interferences detected	128 Investigations 77 Interferences detected

Table 12 – Summary of Amount of Losses Activities (SPM) in Regulatory Reporting Year and Estimate for the Following Regulatory Year

Programme/Project title	Description of unit	Volumes in Regulatory Reporting Year	Forecast volumes for Following Regulatory Year
Replace high loss transformers	Transformer volumes	94	92
Revenue protection inspections	Visits made by revenue (metered supplies)	3,269 visits were conducted resulting in 575 irregularity cases	9559 visits
Theft in conveyance	Investigations	131 investigations 72 interferences detected	87 Investigations 47 Interferences detected

Other Environment Related Activities

Introduction

We recognise the need to record and monitor our environmental, social and financial impacts and take-action where required to fulfil our ambition to become a Sustainable Networks Business.

This section contains a summary of the works underway in relation to the other Sustainability Drivers identified earlier in this report (please see **Figure 5**). This includes waste management noise and air emissions, climate change adaption ecological enhancement and stakeholder engagement with communities, staff and other key groups to deliver this ambition.

Waste Management

In our Sustainable Business Strategy, we describe a vision where the principles of a circular economy and efficient use of resources will be embedded in our businesses.

The materials required for network construction and operation will come from sustainable sources. We will produce 'zero waste', with the components of all 'end of life' assets being reused or recycled into new products.

Efficient waste management – where we value resources both financially and environmentally – is key element of our vision of sustainability. To drive this vision, we have set ourselves the challenging goals to divert 95% of waste from landfill by 2023, to recycle or use 100% waste by 2030, then move to zero waste by 2050.

To meet these targets, we are focusing on ways to avoid, reduce, reuse and recycle our waste. Key to this is ensuring that the many inputs of data required become more robust year on year. Our approach is therefore twofold: working with our own staff and supply chain to gain better insights into the quantities, types and treatments of waste resources; and collaborating to develop ways of reducing waste and improving the ways in which waste resource is then processed. **Graph 4** shows our improvements in waste management since 2014. In 2014, the relatively high percentage of waste diverted from landfill recorded was due in part to incomplete recording as we began to examine all waste streams in detail. Since 2014, we have worked closely with our contractors to increase and improve the data recorded as they undertake projects on behalf of SPD and SPM.

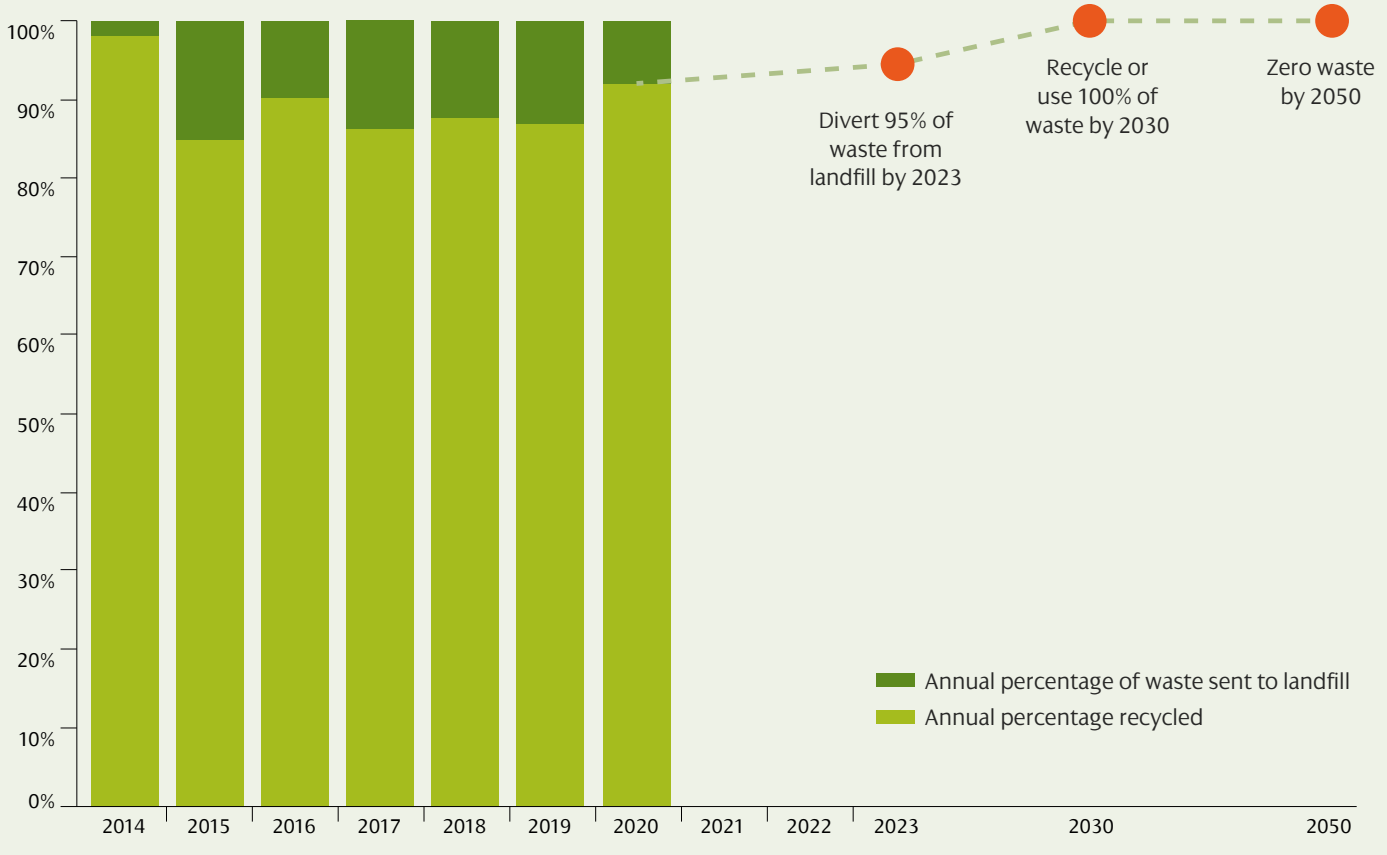
Since 2014, we have consistently achieved over 85% of our waste diverted from landfill.

We continue to work with our contractors and employees to make the final 10% push and reach our 95% landfill diversion goal by 2023.

Key to this is further improvement of the data received from our contractors, which has led us to implement the use of the SmartWaste tool.

Since January 2021, we have been using Smart Waste to collect waste and carbon data from our Distribution contractors in SPD & SPM. Smart Waste works by allowing contractors to upload their data directly to the system each month. We work alongside contractors, providing instructional videos and making ourselves available to assist in the data upload process when needed. Uploading the data to Smart Waste allows us to view and report on the data at different levels, whether that's by project, district or license area.

Graph 4 – Waste to Landfill Reduction



Management of Noise Impact

We seek to minimise the impacts of noise resulting from the construction, maintenance and operation of our electrical infrastructure.

When we build new infrastructure or when the local environment changes around our existing infrastructure this can sometimes result in a negative effect in the local area.

Substation Transformers typically generate a noise level ranging from 60 to 80 dBA. Transformer noise will transmit and attenuate at different rates depending on the transformer size, voltage rating and design and can cause a nuisance to nearby neighbours in some circumstances.

The SPEN strategy is both proactive and reactive in mitigating and avoiding these impacts. SPEN operates a 24-hour customer helpline where customers, contractors and staff can report problems on the network including issues related to noise and dust. Enquiries regarding noise are logged in our customer complaints system and passed to regional contacts with actions and deadline dates.

In reviewing operational complaints with respect to noise, most issues relate to the use of temporary power generators that power emergency maintenance works and customers who are off supply, rather than ongoing issues related to static assets.

Where issues are highlighted with our static assets, SPEN has a good track record in mitigating the effects. The solutions are often relatively straightforward once these are known to us.

This reporting year we have received one enquiry in SPD in relation to noise from our equipment.

The enquiry related to a rattling noise coming from one of our substations. On inspection, the noise was found to be coming from a loose bolt. The bolt was tightened and no further noise was reported.

This reporting year we have received four enquiries in SPM in relation to noise from our equipment.

Three enquiries were regarding noise from our transformers. All of the transformers were due to be replaced as part of our pre-1962 replacement programme. In each case we advised the customer of the approximate date of replacement and the customers were happy with the proposals. The last enquiry was related to a vibration noise emitting from our substation. Anti-vibration pads were installed and no further noise was reported.

In each of these cases an inspector promptly visited the location and conducted a full investigation. Our customer services and field teams worked together to keep customers fully informed at each stage of the process.

Climate Change Resilience

In December 2021, we will publish our Climate Resilience Strategy for RIIO-ED2 and beyond. Here we can share some of the top risks and associated mitigation measures from that strategy that will ensure we will continue to operate a safe, resilient and sustainable network and enable the Net Zero transition.

SP Energy Networks worked with the ENA to finalise the identification of climate change risks based on the latest UK Climate Projection 2018 (UKCP18). The UK Met Office, author of UKCP18, was tasked with undertaking an electricity and gas network specific analysis based on UKCP18 with the final report completed by November 2020. The highest priority hazards identified from Met Office analysis and stakeholder engagement with network companies are:

- Extreme high temperatures
- Heavy rainfall/drought cycles
- Prolonged rainfall leading to flooding

Bespoke analysis of the UKCP18 data has been undertaken for each of these hazards and the impact on networks evaluated for the key operational risks.

SP Energy Networks Operational Risks

The following are some of the most highly-ranked risks in our strategy due to high relative likelihood and impacts.

Fluvial, pluvial and coastal flooding: Substations affected by river or coastal flooding due to increased winter rainfall, or flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply. There is also an impact on other types of work being prevented due to safety issues (including flooding of office buildings).

Summer drought: Underground cable systems and surface infrastructure foundations affected by summer drought and consequent ground movement, leading to mechanical damage/failure. The drying out of the soil surrounding underground cables will also lead to an increased thermal resistivity, reducing heat transfer from cable to surrounding soil/backfill, resulting in a reduced current (load) carrying capacity.

Prolonged growing season: Overhead lines affected from interference from vegetation.

Hurricanes and high winds: Impacting overhead line structures, resulting in increased frequency of extreme events causing additional faults and a strain on resources.

Ice and snow in winter: Major incidents increased due to increased frequency of ice events. Heavy snowfall leading to excessive loading on buildings. Increased heating demand causing additional load on network, leading to additional faults.

Increased temperature in summer: Increased cooling demand, causing additional loadings placed on network, leading to additional faults. Heat waves resulting in increased staff absence due to sickness, safety concerns for field staff.

Flooding remains our principal risk with the highest impact. SP Energy Networks is working to ensure full network compliance is attained with existing flood resilience standards through adoption of flood protection barriers, "tank-lining" civil assets and raising substation doors. Flood resilient doors have been installed in areas defined as flood plains following detailed flood surveys. In 2018, the underlying flood resilience standard has been augmented (ETR 138 Resilience to Flooding of Grid and Primary Substations). We will work to that standard in RIIO-ED2 (2023-2028) to address the risk management of flooding at grid and primary substations in England, Scotland and Wales from coastal, river and surface water flooding. We will also continue to engage with the environmental agencies Environment Agency (EA), Scottish Environmental Protection Agency (SEPA) and Natural Resources Wales (NRW) to undertake collaborative efforts in flood protection/mitigation schemes.

For our overhead networks, as part of RIIO-ED2 planning, we will continue to rebuild, modernise and refurbish our assets with the long-term plan of achieving storm resilience for 40% of all interconnected 11kV and 33kV overhead networks by 2034. We are also continuing our proactive tree management work (in line with ENATS 43-8 and ETR 132). Our vegetation management work has highlighted the opportunities to reduce the cost of damage and disruption to assets and property, and the positive impacts that adaptive investment can deliver. Ahead of RIIO-ED2, we will incorporate the analysis of potential impact from ground movement on poles/towers within the statutory 6-yearly inspection cycles and overhead line condition assessments.

Biodiversity

We aim to have a net positive impact on the environment and communities in which we operate, protecting and enhancing the biodiversity around our assets in support of national and local strategies.

In recognition of the importance of biodiversity, we have identified land and biodiversity improvements as one of our six Sustainability Drivers. We have set ambitious objectives within our 2020 Sustainable Business Strategy including the implementation of a methodology to measure biodiversity and make relevant business decisions to deliver biodiversity protection and enhancement.

We consult regularly on biodiversity with informed stakeholders to share best practice and steer strategy, activity and reporting. NatureScot (previously Scottish Natural Heritage), Scottish Wildlife Trust, Scottish Environment Protection Agency and Keep Scotland Beautiful are members of our quarterly Sustainability Stakeholder Working Group (SSWG). Engaging directly with this level of expertise drives our biodiversity ambitions.

In 2020/21 we started the process of identifying and piloting tools to assess our impact on biodiversity and natural capital and to advise the decision making process to target no net loss and where possible enhancement.

In order to develop a standardised approach to Natural Capital assessment, the reporting year brought greater collaboration with other network operators. We worked together on piloting and reviewing an Innovate UK funded tool (NATURE), project managed by consultants WSP. Further assessment of the tool will be carried out by the end of 2021, this will be a whole systems approach including Distribution Network Operators to ensure the NATURE tool is fit for purpose in assessing natural capital across the network.

Stakeholder Engagement

In February 2021 we hosted a Biodiversity and Natural Capital stakeholder workshop. Stakeholders were supportive of the use of quantitative assessment through the use of standardised tools, however they also highlighted the importance of qualitative assessment and reporting. Stakeholders supported the development of an overarching SPEN strategy to ensure that there is consistency in our approach to biodiversity and natural capital, taking into account national, regional and local policy and priorities. Stakeholders also reinforced the importance of working closely with relevant organisations at a local level and collaboration to share data and expertise. In cognisance of this stakeholder feedback we have commenced the development of a Biodiversity and Natural Capital Strategy and are strengthening our collaboration activity with local groups.

Employee Engagement

Effective employee engagement is vital in order to achieve our vision as a sustainable and innovative network business of the future.

Our employee engagement strategy

It is essential that our staff understand the environmental processes, programmes and targets contained in our Sustainable Business Strategy, RIIO-ED1 Business Plan and Environmental Management System. Our internal engagement strategy and plan are designed to ensure that all members of staff have the requisite knowledge of environmental aspects and impacts, and the awareness to be able to identify and solve issues as they arise and are better able to determine and address the priorities for change. Training and awareness raising is delivered via a suite of training courses, monthly team briefs, workshops, toolbox talks and online materials.

The Executive Sustainability Steering Group (ESSG) continued to meet quarterly, group membership includes SPEN Chief Executive, Chief Operating Officer, Directors and SPEN Sustainability Team. The main areas of focus in the reporting year:

- Identification of barriers or areas for improvement.
- Best Practice and how this can be replicated across the SPEN Directorates.
- Discussion around key priorities and strategic planning.

Transformation Milestone Plan – There is a significant level of business change required as we prepare for ED2. SPEN Sustainability Team, SPEN Directors and the Chief Operating Officer have developed a change management plan, around the Prosci change model, to deliver the people side of this change. The plan addresses the key areas of awareness, desire, knowledge, ability and reinforcement. In the reporting year the plan focused on the following areas:

- Internal sustainability best practice calls, with attendance from across the organization. There are two calls, an SPM South call and a North call covering SPD and SPT. The call discusses sustainability and environmental initiatives, shares observations, highlights processes/procedures, and strengthens responsibilities in controlling and reducing our environmental risks and impacts.
- Environmental roles and responsibilities formalised and communicated to staff.
- Sustainability personal goals for all SPEN staff.

Training – Staff undertake a range of mandatory environmental training tailored to specific job roles, these include environmental awareness, spillage control, resource management, SF_6 awareness and wildlife and countryside.

These bespoke courses were developed with an environmental consultant to provide an awareness and understanding of: environmental risks encountered in activities: how to identify risks; mitigate against them and ensure environmental compliance. In the reporting year 889 e-learning courses were completed by SPD staff and 992 by SPM.

New training: SPD and SPM joined the Supply Chain Sustainability School (SCSS) in 2020, a collaborative online school with a catalogue of free resources that offers extensive training in different areas of Sustainability. SPEN is a Partner of the School, enabling CPD accredited training both for internal staff and supply chain. SPEN specific learning pathways were created in 2020, providing more targeted topic specific training pathways in key areas of focus where upskilling is required, such as Carbon Management, Biodiveristy and Natural Capital and Circular Economy. Staff engagement with the school has led to achievement of gold accreditation

The ScottishPower group also launched a new climate e-learning course to increase climate literacy across the organisation.

Future Networks Learning Lunches: Learning lunches to inspire innovation and sharing of best practice took place virtually in the reporting year. These included a presentation and Q&A session with Prof Sir Jim McDonald, Vice Chancellor and Principal of Strathclyde University on the topic of Industry, government and academic collaboration – the essential approach to delivering national priorities such as Net Zero. These sessions are well attended by people from across SPEN, including SPD and SPM.

COP26: ScottishPower is a principal partner of the COP26 United Nations Climate Change Conference taking place in Glasgow later this year. A SPEN COP26 steering group was established in the reporting year to identify opportunities for sharing of best practice internally and externally, this includes the development phase of an SPD Net Zero Secondary substation.

Regular face to face engagement – Discussing sustainability and environmental compliance and improvement through regular engagement with senior managers, their teams and other groups of staff, including staff away days, graduate and apprentice inductions and regular meetings with licence directors and their management teams.

Environmental Express and Toolbox Talks – A number of email publications highlighting legislative and behavioural changes to all front-line and management staff. Topics included proper waste disposal practices to avoid contamination; reuse and disposal of wood poles; Japanese Knotweed awareness; and environmental incident reporting.

ICAN – Employee Climate Action Network – Our Employee Networks are created and run by people with a drive and a real interest in bringing people and teams together. Supported by Scottish Power and led entirety by employees, the growing number of employee networks help build our business and help us to attract and retain diverse talent. The iCAN network is a fantastic vehicle for employees to share and build knowledge on sustainability, taking personal action and driving enthusiasm for climate action across the Scottish Power group.

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

Introduction

SP Energy Networks is committed to delivering the low carbon transition in the UK and are proud to be a part of Iberdrola's global leadership on climate change.

Our Sustainable Business Strategy identifies that we must support the low carbon transition in two key ways:

- By adapting how we operate our business and network; and
- By facilitating the low carbon transition ambitions of our customers and stakeholders.

Driving the transition to a low carbon energy system while minimising the impact of our activities on the environment is the underpinning concept behind our Business Plan, the focus of which is on:

- Delivering fast, efficient and innovative low carbon technology connections, and;
- Ensuring the efficient delivery of additional capacity where there is no available capacity.

As a regulated DNO, our priority is to provide a safe reliable supply of electricity to homes and businesses. Through innovation, we can continue to provide this safe, reliable supply whilst also facilitating decarbonisation and managing our environmental impact.

Our role in the Low Carbon Transition is to:

- Connect Low Carbon Technology;
- Develop our Innovation Strategy and culture of innovation;
- Develop Smart Grid solutions;
- Bring developments proven in innovation projects into business as usual; and
- Facilitate the roll-out of Smart Meters to homes and businesses.

This approach is underpinned by mature business processes and delivery platforms which enable all SP Energy Networks staff to be involved in the identification, development and delivery of industry-leading projects to support the low carbon transition.

Connecting Low Carbon Technology

One of the biggest opportunities and challenges for all distribution network operators is that networks were built for traditional one-way flow of energy.

Through the installation of Low Carbon Technologies our customers are increasingly becoming 'prosumers' (both consumers and producers of electricity), opening up opportunities to manage flows of energy on the network in a more hands-on way. Taking on these new opportunities to support the low carbon transition whilst maintaining system reliability and availability means a shift from the traditional role of Distribution Network Operator towards the more dynamic and proactive role of Distribution System Operator.

An effective system will reduce balancing costs and enable the flexibility required for customer use of Low Carbon Technologies.

In 2020/21, we installed a total of 5288 Low Carbon Technologies (equivalent to 210 MW). This includes the facilitation of Heat Pumps, PV and Electric vehicles.

In 2020/21 no new G98 PV connections were reported within both licence areas in the Ofgem quarterly reports. As we did not believe this was a plausible outcome internal reports were used to determine the volume of G98 PV connections.

The uptake of heat pumps remains slow in comparison to ED1 forecasts. Whilst the volume of recorded new EV charge points (slow and fast charge) in both SPD and SPM have seen significant increases during 2020/21, it remains lower than ED1 forecasts.

Stronger incentives and/or national registration systems need to be put in place to encourage customers to notify network companies of newly installed LCTs, ensuring that all LCTs connecting to the network are captured. Accurate reporting of these volumes will assist DNOs and Ofgem in planning and forecasting activities throughout RIIO ED1 and ED2.

The volume of other LCT DG connections during 2020/21 fell marginally below our ED1 forecasts with some changes between the volume of primary and secondary connections. We have not forecast any material changes to our longer term LCT uptake forecasts at this time due to (i) the continuing uncertainty regarding the impact of government subsidy mechanisms and broader economic forecasts; and (ii) expectation of increased connections as a result of opportunities afforded by our flexible connection policies.

Table 13 – Number of LCTs installed in SPD

Estimated Volumes of LCTs Installed SPD	Heat Pumps	Electric Vehicle Slow Charge	Electric Vehicle Fast Charge	Solar Panels	Other Distributed Generation including Biomass & Wind Generation	Total MW Connected
2015/16	20	405	0	5,497	145	146
2016/17	45	226	0	468	139	438
2017/18	132	73	553	671	178	88
2018/19	63	42	327	1,164	227	34
2019/20	79	30	968	287	111	17
2020/21	57	2	1,260	495	172	117

Table 14 – Number of LCTs installed in SPM

Estimated Volumes of LCTs Installed SPD	Heat Pumps	Electric Vehicle Slow Charge	Electric Vehicle Fast Charge	Solar Panels	Other Distributed Generation including Biomass & Wind Generation	Total MW Connected
2015/16	42	437	0	7,966	120	98
2016/17	70	229	0	579	74	150
2017/18	62	85	413	268	282	64
2018/19	132	43	362	347	354	51
2019/20	182	102	426	64	94	116
2020/21	239	3	2,048	757	255	93

Progress of the Innovation Strategy

2020 was a year of unprecedented challenges – at SP Energy Network's we have adapted and grown to meet these challenges and seen our drive for sustained progress continue unabated.

The past year has been extremely challenging, for our business certainly the most challenging in living memory. One of the key focus areas for us as we delivered our innovation portfolio in 2020-21 has been transitioning our innovation projects into Business as Usual (BaU), where possible, in order to unlock their true value and full range of benefits. We have continued to engage with key stakeholders, making every effort to ensure that the knowledge and learnings we take from these projects are shared more widely for the benefit of other distribution network operators (DNOs).

DRIVE

DRIVE (Delivering Real Innovation and Engagement) is an initiative that was launched in 2019, looking to create a strong culture of innovation within our business. The initiative continues to provide our colleagues with the tools and mechanisms to engage with the innovation process and foster ideas from our people that are implemented as BaU.

Our 'DRIVE' highlights from 2021 include:

- Utilising our digital innovation platform, iHub, to find solutions to specific challenges, with successful ideas being delivered and funded by the business. Projects delivered through iHub have included the use of thermal imaging cameras to locate cable faults and using endoscope technology for carrying out equipment inspections.
- To date, we have now generated over 300 ideas and involved over 1,200 colleagues, with over 90 ideas selected for further development.

NIA PMO Update

Within the past year, we have continued to develop and deliver projects through our dedicated Project Management Office (PMO), tracking project progress across the portfolio on a weekly basis, enabling timely decision making and maintaining a live record of current project progress which is then used as a source of management information by the Innovation Board.

We have formalised a process that focuses on the plausible benefits of the projects undertaken by the PMO. The benefits of the projects were anticipated by conducting a thorough review of all the current ongoing NIA projects which aided in the generation of benefit maps and schedules. The PMO comprises of experienced project managers and portfolio managers who ensure thorough internal reporting of every project by working hand-in-glove with the dedicated project managers. The internal reporting and logging of projects focused particularly on the projects which are in transition to the BaU stage, in order to unlock their true value and full range of benefits. We also ensure that all the projects meet NIA governance requirements and are on track to meet the milestones and financial forecasts. The detail focused approach ensures maximum return on investment possible from our yearly spend.

SPEN Electricity Distribution Strategy

Our portfolio of projects underpins our activities in a wide number of key areas such as the decarbonisation of transport and heat, and our efforts to accelerate the journey to Net Zero. We are acutely aware that the funding we access through the various innovation mechanisms is sourced from our customers. In developing our Electricity Distribution Network Innovation Strategy we have not only ensured that our innovation activity is focused on areas which customers most value, but also that customers are willing to invest more and by engaging with them, we have ensured that our existing and new projects can contribute directly to the five focus areas of significant customer value in the near-term:

- Facilitate the adoption of flexibility and smart systems.
- Facilitate and enable the electrification of heat and transport.
- Facilitate the efficient connection of low and zero carbon electricity generation.
- Understand the operational impact of long duration reserve services on the network.
- Contribute to a UK-wide methodology for calculating the cost of carbon.

A key element of our ED2 business plan is the Distribution Innovation Strategy and this will reflect both the greater focus on innovation in comparison to ED1, and the ambition needed if we are to tackle the challenges, we face from 2023-28. The UK energy and networks sectors are being placed under the spotlight like never before and this truly is the time for innovation.

Progress of the Innovation Strategy
continued

Delivering Value to Customers
This priority area focusses on maximizing the performance efficiency and benefits delivered through our core business activities.

This area identifies 20 specific opportunities and challenges split across four themes:

- Managing an ageing network
- Reducing the number and length of power cuts
- Network Control and Management
- Maximising benefits of data.

Projects like WaNDA, (Weather Normalised Demand Analytics) which, using historic SCADA, generation and discretized weather data allow us to conduct better network planning and avoid costly reinforcement – savings which are passed on to our customers.

A Smarter Flexible Network
The inclusion of this priority area clearly demonstrates that the thoughts of our stakeholders and the challenges faced by our business have shifted considerably in recent years. The connection of Low Carbon Technology (LCTs) was only covered in two themes of the original strategy and the provision of flexibility was completely absent as it was not a priority of our stakeholders. Throughout our engagement, this priority area proved to be the closest to our stakeholders' current thinking and needs. Given this level of interest and input we were able to identify 16 specific opportunities and challenges identified split across three themes against this new priority area, namely:

- Faster, Easier Connection.
- Preparing the Network for Low Carbon Technologies.
- Network Flexibility and Communications.

Sustainable Networks
Similarly, to the previous priority area, aspects of this were included as themes in our previous strategy but as a result of the feedback from our stakeholder and internal consultation it is now more prominent, featuring four themes:

- Socially Responsible member of the Communities we serve.
- Minimising the Environmental Impact of our Activities and Assets.
- Working Practices and Business Systems.
- Our People – Skills and Resources.

Accessibility
As well as refocussing the Priority Areas; Themes, Opportunities and Challenges contained within our Innovation Strategy have been rewritten in full and are in a new format. This new format and content has been written to make it accessible to all stakeholders. It aims to educate readers on who we are, the changing energy landscape and our changing electricity network.

Our Innovation Process
We have placed particular emphasis on our open-door policy for innovators, including a transparent breakdown of how we innovate and how they can get involved. Each element of our innovation process is described in detail:

- **Inception –** The generation of ideas and their alignment with our Innovation Strategy.
- **Creation –** The creation of unique projects aimed at
- **Delivery –** The application of professional project management practices.
- **Transition –** The Business as Usual adoption and dissemination of the project.
- **Tracking –** The multiyear tracking benefits realised by the project.

The current SPEN Distribution Innovation Strategy is available here: https://indd.adobe.com/view/7e04a310-b61e-4a56-8dd8-2b4c2d014b36

Portfolio Update
During During the 2020/21 reporting year SPEN has registered 5 new Network Innovation Allowance (NIA) projects, along with 21 ongoing projects. The new projects broad spectrum of development areas includes large scale trial of thermal storage and smart in-home control, trial of Flexibility using Tower Block Heating and Electrical Vehicles and a study into Innovative Replacement for Underground Substations. We are committed to identifying innovative performance improvements across all aspects of our business.

For details of SPEN led projects can be found in the NIA Annual Report [distribution] from 2020/21: https://www.spenergynetworks.co.uk/userfiles/file/NIA_Distribution_Annual_Report_2021.pdf

Roll Out of Smart Grids and Innovation into Business as Usual

In ED1 there is increased need to ensure that innovation is embedded into all business function, as such the role of our Innovation Board is to ensure increased participation from all business functions and to allow innovation projects to be completed and integrated into Business as Usual (BaU).

Our Think Big, Start Small, Scale Fast approach to innovation enables us to be at the forefront of innovative practice and is embodied in our guiding values. At SP Energy Networks we believe in the power of innovation to enhance all aspects of our business and improve our service for the benefit of both our internal stakeholders and customers.

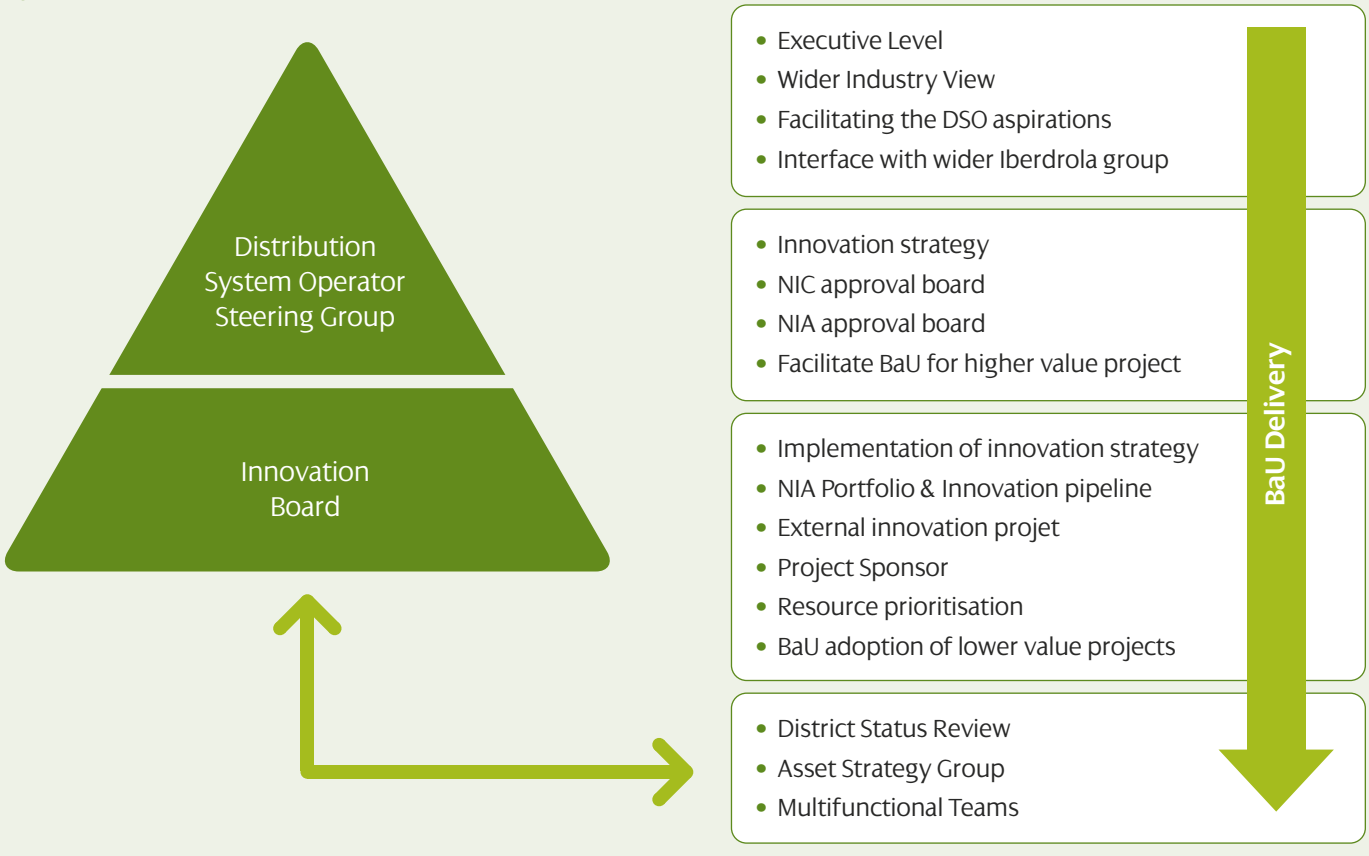
Transition into BaU is a process taking place thorough step 4 and 5 of our innovation process.

In step 4 – Development and Delivery: A project manager and project team identified for each project to deliver the day-to-day project activities. Business Sponsors help to facilitate the integration of proposed, existing and completed project into BaU. Projects are monitored through their life cycle and, in the event that anticipated benefits do not arise projects may be terminated. Technology readiness levels and project scale will be used to determine appropriate funding route, be it NIA, NIC or other funding steams such as research grants.

In step 5 – Application of Learning: Appropriate channels both internal and external will be used to disseminate learning from both successful and unsuccessful projects to a wider audience. We will also seek opportunities to learn from and collaborate, as appropriate, with other DNOs.

There is a need to ensure that innovation is embedded into all business function as such the role of the Innovation Board is to ensure increased participation from all business functions and to allow innovation projects to be completed and integrated into BaU.

Figure 12 – Innovation Governance Structure



Roll Out of Smart Grids and Innovation into Business as Usual *continued*

In scheme year 2020/21 we have enhanced the following innovative technology projects to achieve further business as usual benefits:

Network Constraint Early Warning Systems NCEWS (phase 2) and NAVI

These projects are part of a multi-phase investigation requirement into the benefit of Smart Meters (SM) data in LV network Design and Planning, and Fault Management. Full SM coverage is realistically expected to take between 5-7years (2017-23 or beyond if deployment is delayed). It has been stated by the industry that operational benefit will not be achieved from SMs until 60% penetration. Within the early years of SM Penetration (2017-18) we tried to utilise pockets of high-level SM penetration to carry out fundamental research and try to derive early benefit from SM data. Visibility and control in the network is being addressed.

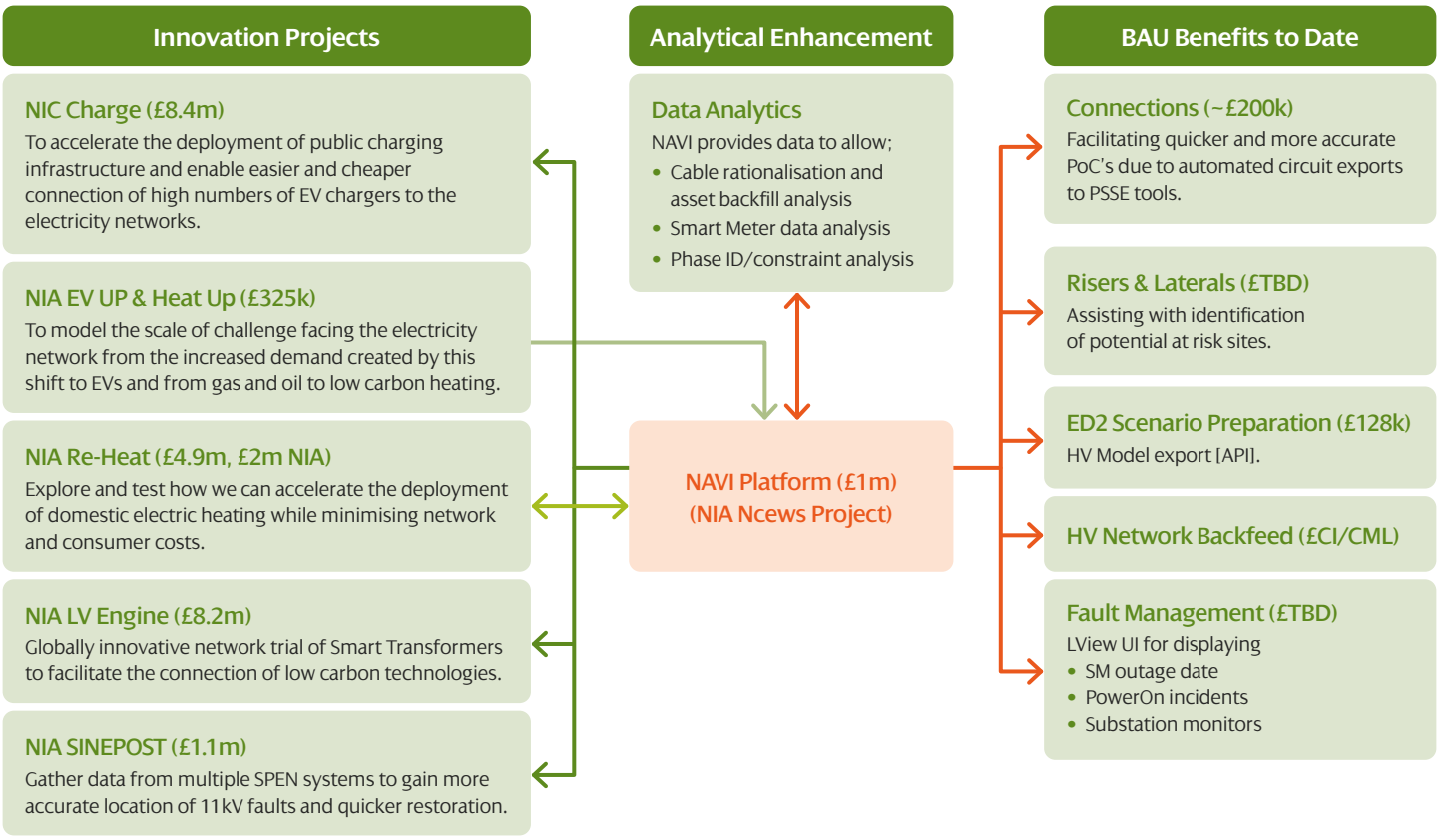
NCEWS (phase 2)

NCEWS2 has further developed the LV connectivity platform initially developed as part of NCEWS1 by adding a range of functionality as well as increasing the geographical scope of the analysis.

With more Smart Meters and substation monitors now installed within the SPEN licence areas we have begun to analyse voltage profiles to help with phase identification more accurately. By correlating the Smart Meter data, substation monitor data and the various data sets annotated to the NAVI network model (including Customer Numbers, MDI and ADMD data) we have developed a methodology to highlight and prioritise potentially at risk areas of the network and present the results in a manner easily consumed by the business. By bringing the smart meter voltage reads into the NAVI Platform it has also helped to provide visibility of the current demand on each section of the network and therefore assist with connections analysis and decisions. Work is ongoing on the improvement of LCT ADMDs with the hope it will provide the final risk analysis capability that will then be tested through stakeholder engagement with connection designers.

Since transitioning to BaU operation in 2020, the solution has formed a key part of many projects including LV connection and scenario analysis, HV tracing to assist earthing studies and has acted as the main feed of pre-analysed GIS data to several projects including the Integrated Network Model (INM) which forms a key part of the Smart Data Integration Fabric (SDIF) solution, and the NIC funded CHARGE and LV Engine projects as well as a tool to analyse and view the results from NIA funded projects EV-UP, Heat-Up and Re-Heat.

Figure 13 – Projects benefiting from the NAVI Platform



Roll Out of Smart Grids and Innovation into Business as Usual *continued*

NAVI

The NAVI solution was developed under the Ofgem Network Innovation Allowance (NIA) scheme as part of the Network Constraint Early Warning System (NCEWS) project. The project developed a fully connected LV network model that was suitable for supporting detailed analytics and data extracts to identify network issues. The initial aim of the solution was to provide a mechanism to annotate Smart Meter data to a network reference model to allow analysis and to provide the foundation for understanding the operation of an instantiated network model which sits outside core operational systems such as ADMS and GIS. The solution proved very useful within the business and was extended to cover SPEN's full network at HV and EHV.

One major selling point of NAVI is due to the way in which we have rationalised and backfilled asset data within the network model. Asset information from GIS is used and processed through a set of rules defined by SPEN to identify the "proxy_cable" and assign the correct impedance and rating values. The rules have been created for LV and HV assets up to 33kV. A fully rationalised network model has a multitude of benefits including identification of potential risks on the network and the need for reinforcement and faster identification of suitable points of connection.

By developing exports of the network to multiple PSSE tools, at both LV and now HV level, we have also been able to provide our design engineers with an automated snapshot of circuits, annotated with all asset information, to improve the speed and accuracy of designing new points of connection and managing the network. This has been very well received by the users who have seen a great improvement to the otherwise very manual process.

LView

Within the NCEWS2 project we noticed the potential to extend the NAVI Platform to create a User Interface (UI) closely related to the existing NAVI LV data model for displaying/managing LV fault indications from substation monitors, Smart Meters and PowerOn outage predictions. The intention here is to allow SPEN to internally manage this data and move away from several 3rd Party platforms to display 'our own' data in one place. The trial platform has been developed, named LView, and we have successfully integrated it with EATL Visnet monitors, PowerOn and our Smart Meter data system for near real-time visualising of their LV alarms. We now intend to extend this to include other 3rd party monitors.

Key benefits include enhanced visibility/decision making as all data will be in one place, quicker fault resolutions so customers are back on supply faster, reductions in CI/CML, plus a major step forward towards digitalization and Net Zero goals.

Figure 14 – Navi platform

NAVI platform visualisation showing circuit connectivity, ADMD (After Diversity Maximum Demand) estimation and building understanding, with Smart Meter voltage data.

Roll Out of Smart Grids and Innovation into Business as Usual *continued*

Flexible Tower Project

We are working with Glasgow Housing Association (GHA) and Connected Response to demonstrate how smart storage can support the network's flexibility needs whilst also bringing financial benefit to customers. Our NIA project Flexible Tower, due for completion in May 2022, aims to show through simulation that shifting of demand using thermal storage heaters is feasible. The project aims to show that this demand shift can support increasing local EV charging requirements and wider use of constrained wind.

The next steps for the project are:

- Work with Retailers, Aggregators and Supplier to develop an appropriate commercial mechanism to unlock the revenue streams available for customers with storage heating.
- Understand how storage heaters respond to market signals and novel commercial tariffs.
- Expand the work within Flexible tower block to other properties within GHA's portfolio.

Moving into the RIIO-ED2 price control period we hope to see the present barriers preventing flexible use of storage heaters to be removed enabling the technology to make an important contribution to our flexibility needs at LV. We hope that storage heating will be able to be used proactively to avoid local constraints and congestion for example where high EV uptake occurs.

The potential to use flexibility within storage heating has been recognised through other initiatives including the 4D heat project which estimated there could be benefits to the ESO through avoiding curtailment payments to wind generators of £26m by 2030. However, at times of high wind and high local demand conflicts may occur which is a challenge that will be exacerbated as more EVs and HPs are connected to the network. We hope that within the RIIO-ED2 period we can overcome these conflicts to deliver an optimised solution for the customer considering their comfort and warmth as a priority but also seeking to bring benefits from BM revenue streams and LV flexibility.

Roll Out of Smart Meters

Installations under the UK's Smart Metering Implementation Programme were significantly impacted by the Covid-19 pandemic during the 2020/21 regulatory year. Nevertheless, by 31st March 2021 there were approximately 135k SMETS2 devices in our SP Distribution licence area (6.8% of our customer base), with approximately 192k (13.7%) in SP Manweb area. During 2020/21, our systems could only communicate with SMETS2 meters, so we received limited benefit in respect of these low volumes. As the volumes increase, the benefits we anticipate from communication with connectable smart meters include:

- The ability to accurately determine when a customer has lost supply, potentially before the customer themselves has realised.
- Once a loss of supply is identified we believe that smart meters will allow us to identify the location and nature of faults on the network with a much greater degree of accuracy, restoring power to customers more quickly and reducing the number of unnecessary site visits made by us each year.
- Smart meters will allow us to identify when an individual customer's power has not been restored allowing us to ensure we act swiftly to rectify outstanding faults.
- Avoided voltage complaints – In this area, we believe we can become proactive in identifying and addressing voltage anomalies before they inconvenience customers.

During 2020/21, SP Energy Networks implemented further refinement to our Smart Metering IT application, introducing new functionality and system enhancements. Further improvement is planned for 2021/22, including the opportunity to communicate with older SMETS1 devices enrolled in the UK smart metering infrastructure.

We have continued to make preparations for increased volumes of smart data as and when this becomes available. We target refinement of our system application, network monitoring and data modelling. In addition, we continue to work with key stakeholders to identify the best opportunity to utilise smart meter data for the benefit of our customers. This practice will continue, ensuring we monitor and enhance our business processes as more customers join the smart metering revolution.

For the 2020/21 regulatory year, we did identify a limited financial benefit from the SMETS2 meters currently installed. This relates to reducing fault costs by avoiding unnecessary visits to premises where the smart meter confirms the electricity supply to be on.

References

If you would like further information on SP Energy Networks please visit our website:
spenergynetworks.co.uk

SP Energy Networks Stakeholder Reports:
https://www.spenergynetworks.co.uk/pages/stakeholder_reports.aspx

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https://www.spenergynetworks.co.uk/pages/innovation.aspx

List of Abbreviations

AC	Alternating Current
ADMD	After Diversity Maximum Demand
ANM	Active Network Management
AONB	Area of Outstanding Natural Beauty
ARC	Accelerating Renewable Connections
BCF	Business Carbon Footprint
CBA	Cost Benefit Analysis
CO_2	Carbon Dioxide
dBA	A-Weighted Decibels
DC	Direct Current
Defra	Department of Environment farming and rural affairs
DIgSILENT	Software and consulting company providing engineering service
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
EA	Environment Agency
ED1	Electricity Distribution Period 1
EHV	Extra-High Voltage (33kV)
ENA	Energy Network Association
FITS	Feed in Tariff
GIS	Geographic Information System
G83	Domestic LCT's
GB	Great Britain
GWh	Gigawatt Hours
HV	High Voltage (11kV)
IPSA	Interactive Power System Analysis
kV	Kilovolt
LCNI	Low Carbon Network & Innovation Conference
LCNF	Low Carbon Networks Fund
LCT	Low Carbon Technologies
LV	Low Voltage (230/415V)
MVDC	Medium Voltage Direct Current
MW	Megawatts
MWh	Megawatt Hours
NAVI	Network Analysis and View
NCEWS	Network Constraint Early Warning Systems
NGET	National Grid Electricity Transmission
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
NRW	Natural Resources Wales
NSA	National Scenic Area
OHL	Overhead Line(s)
PSSE	Power System State Estimation
PV	Photovoltaic
REGO	Renewable Energy Guarantees Origin
RIIO-ED1	Revenue Incentives, Innovation and Outputs – Electricity Distribution Period 1
RSPB	Royal Society for the Protection of Birds
USEF	Universal Smart Energy Framework
SCADA	Supervisory control and Data Acquisition
SEPA	Scottish Environment Protection Agency
SF_6	Sulphur Hexafluoride
SMETS	Smart Meter Equipment Technical Specification
SPD	SP Distribution Licence Area
SPEN	ScottishPower Energy Networks
SPM	SP Manweb Licence Area
SPT	SP Transmission Licence
SSSI	Site of Special Scientific Interest
tCO_2e	Tonnes of Carbon Dioxide Equivalent
UK	United Kingdom
WANDA	Weather Normalised Demand Analytics
WIN	Debut-load flow package used for LV network design

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