Environmental & Innovation Report

2017-18

SP ENERGY NETWORKS

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

Contents

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Executive Summary

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

The 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 seven Sustainability Drivers.

Following extensive engagement with stakeholders and expert organisations we agreed the SPEN Sustainable Business Strategy in 2017.

In 2018 we released our new Distribution Innovation Strategy, which formalised our increasing focus on delivering value for customers, providing network flexibility and improving sustainability.

During the 2017/18 reporting year SPEN registered 12 new Network Innovation Allowance (NIA) projects, along with 25 ongoing projects. Fundamental to the internal approval of each project was their alignment to the new Innovation Strategy.

1. **Faster, Easier Connection**
2. **Preparing the Network for Low Carbon Technologies**
3. **Network Flexibility and Communications**

We continue work to improve the quality and completeness of our data allowing us to better report our progress towards our goals.

Since our 2013/14 baseline year SPD & SPM have jointly achieved a 29% reduction in our business carbon footprint excluding losses. By reporting year 2015/16 we had reached our 2023 target of a 15% reduction in emissions.

The continuous improvements made to our Environmental Management System (certified to ISO 14001) ensure that we have robust processes in place to drive improvement. In October 2017 we achieved recertification to ISO 14001:2015.

At the start of ED1 we committed to reducing oil leaks by 50% through replacement of poorly performing 132kV cable in SPM. In 2017/18 we have reduced our oil leakage by 52% from 2016/17 figures which represents an 80% reduction against our 2015/16 figures.

In tackling network losses we have invested in 237 new lower loss transformers since the start of ED1, resulting in estimated savings of 37,114 MWh equivalent to 14,174 tCO_2e.

We strongly believe that involving our stakeholders in projects and initiatives will lead to improvements in our processes, a better understanding of the communities we work in and more ideas on the table. We will continue to be positive and open about developing new relationships.

We are keen to explore your thoughts on the information presented within this report, and we welcome your feedback which will be invaluable as we progress towards our goal to become a Sustainable Networks Business.

Our seven Sustainability Drivers


Sustainable Society


Carbon and Energy Reduction


Climate Change Resilience


Water Efficiency and Protection


Raw Materials Optimisation


Land and Biodiversity Improvement


Waste Management and Minimisation

Introduction

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). This report focusses on our two distribution licence's, SPD and SPM only. Further information on our Transmission licence, SPT is available on our website.

The electricity distribution network in central and southern Scotland SPD, covers an area of almost 23,000km, whilst the distribution network SPM, in North Wales, Merseyside, Cheshire, and North Shropshire in England covers approximately 12,000km. SPEN 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. 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 move towards a Sustainable Networks Business. We have been continuously certified to ISO 14001 since 1997. In October 2017 we achieved certification to ISO 14001 (2015) Standard for Environmental Management Systems (EMS).

Figure 1
SP Energy Networks Distribution Licence Areas

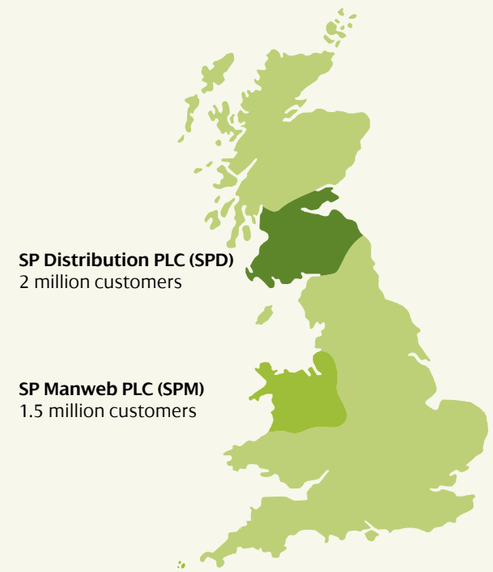
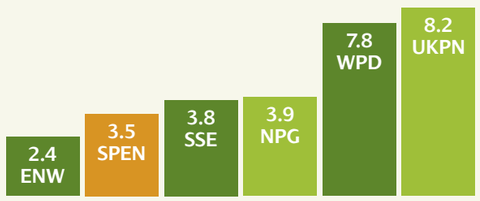


Figure 2
DNO Size by Customer Numbers (Millions)



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, 2,500 contractors and supports tens of thousands more jobs in our supply chain. By working together we are embarking on delivery of our goals to reduce our environmental impact in areas such as Carbon, Waste and Water (see Table 1). SPEN recognises the importance of acting responsibly towards the environment. We strive to maintain our reputation for doing so, enhancing it wherever we go.

In fulfilling our ambition to be a Sustainable Networks Business, we strive to integrate fair and responsible environmental practices with socio-economic considerations.

Table 1
Key Goals and their Rationale

	Carbon and Energy Reduction	Waste Management and Minimisation	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 a 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 baseline of 2013/14 (carbon footprint 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 ED1 Business Plan 2015-2023 set out our goals and targets to reduce the impacts of our network in key areas.

These aims will be realised primarily through capital investment and innovation activity. This report will re-state these commitments (see Table 2) and provide a progress update to stakeholders on our progress in achieving them. This report will also update stakeholders on the development of our Sustainable Business Strategy and the other progressive changes we are making in pursuit of becoming a Sustainable Networks Business (please see Appendix 1).

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 Meter 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 1,300 of our secondary substations.	
	Carry out "Smart" asset replacement – using future proofed assets where justified.	
	Exceed the IEC international standards for SF6 switchgear by specifying a maximum leakage rate five times more stringent for 33kV and below, and twice as stringent for higher voltages.	

Stakeholder Engagement

It's critical that we engage with our stakeholders to understand their challenges and help them to achieve their aspirations.

Since 2013, our robust Stakeholder Engagement Strategy has aligned to the global AA1000SE Standard, consistent with its principles of inclusivity, materiality and responsiveness. The AA1000 AccountAbility Stakeholder Engagement Standard (2015) is the most widely applied global stakeholder engagement standard, supporting organisations to assess, design, implement and communicate an integrated approach to stakeholder engagement.

This year we engaged AccountAbility, owners of the AA1000SE standard, to conduct a health check on our performance against the standard. AccountAbility found our strategy and its implementation in line with the 'Advanced Stage' of the AccountAbility Stakeholder Engagement maturity ladder.

For a full list of all 2017-18 engagement outcomes, see spenergynetworks.co.uk/stakeholderfeedback

Figure 3
Stakeholder Engagement maturity ladder

- **Mature stage** (76-100%) ↑
- **Advanced stage** (51-75%) ↑
- **Early stage development** (25-50%) ↑
- **Beginner stage** (0-25%) ↑

"SP Energy Networks demonstrated a strong performance across the various elements of AccountAbility AA1000SES, 2015. With a total score of 66%, the organisation lies within the Advanced Stage of the AccountAbility Stakeholder Engagement maturity ladder. The score is a very strong score, notably for a first time assessment."

Figure 4
Our perpetual feedback loop drives relentless service improvement

All stages of our feedback loop are supported by a strong core engagement programme, robust governance and an industry leading engagement management system.

This level of maturity is due to the significant management, staff and systems resource we commit to carrying out in-depth engagement and changing our business strategies and plans in response. In the year 2017-18, SPEN staff carried out over 650 distribution-related engagements, reaching 121,402 stakeholders through direct consultation and dialogue, and delivering wide-ranging stakeholder outcomes. For more information, please see our **2017-18 Distribution Stakeholder Engagement Reports**.

Our robust embedded engagement model (see Figure 4) means every team in our business has responsibility to identify and engage stakeholders to understand their needs and improve our service. This is underpinned by a strong annual programme of core engagement that looks at the big strategic issues facing our stakeholders and legitimises top-down changes in our strategic approach.

Stakeholder influence

This year, stakeholders have been able to influence our strategies for managing environmental impact, sustainability and innovation, through a wide range of engagement opportunities, including two-way discussion on:

- UK and Scottish Energy Strategies;
- Sustainable Business Strategy development;
- SPEN and National Innovation Strategies;
- Removing Barriers to Decarbonisation;
- Removing Barriers to Connection;
- Electric Vehicle Rollout;
- Local benefit from Local Resources;
- Open Innovation;
- Flexible Energy partnerships;
- Smart Meter Rollout; and
- Local Area Energy Planning.

Every team in our business has responsibility to identify and engage stakeholders to understand their needs and improve our service.

Stakeholder-led Strategy

2017-18 saw the culmination of several years of intensive engagement in the release of both the SPEN Sustainable Business Strategy and the SPEN Distribution Innovation Strategy.

Since 2016, the SPEN Sustainability Team have engaged and consulted with 104 impacted and expert organisations including WWF, Natural Resources Wales, Scottish Natural Heritage, Scottish Government, Centre for Sustainable Practice and Living, Scottish Wildlife Trust and SEPA to develop an industry-leading Sustainable Business Strategy. Both regular SPEN Strategic Stakeholder Panels and the quarterly Sustainability Stakeholder Working Group have been vital sources of challenge and insight during the development of the Strategy. The Strategy, agreed in September 2017, has been praised for the inclusion of a detailed vision statement and is already driving progress through its detailed and ambitious sustainability drivers and goals.

Twelve key engagements with over 100 government, academic, industry, business and community energy stakeholders led us to the introduction of our new Distribution Innovation Strategy, which formalised our increasing focus on delivering value for customers, providing network flexibility and improving sustainability. Stakeholders encouraged us to broaden horizons to increase focus on innovating to protect the vulnerable and improve energy equity and social inclusion; align with our strategies for sustainability and energy market transformation; improve the accessibility of our strategy to enable a wider audience to understand and get involved; and build on the Open Innovation approach and become technologically agnostic.

Where these strategy advancements represent the top-down development of our business approaches, the tangible stakeholder outputs delivered by the initiatives featured in the remainder of this document come as a direct result of ongoing, in-depth, relevant and detailed engagement on environmental and innovation priorities throughout our business.

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.

Since their introduction in 2014, our Sustainability Drivers have underpinned our strategy for managing our environmental impact and delivering wider sustainability benefits. These drivers are regularly reviewed with stakeholders and refined in response to their feedback.

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.

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 a 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:

- Snowdonia National Park;
- Anglesey, Llŷn Peninsula, Clwydian Range, Denbighshire and Northumberland Coast AONBs; and
- Loch Lomond & Trossachs National Park, Nith Estuary, Eildon & Leaderfoot, Upper Tweedale, Fleet Valley and East Stewartry NSA designated areas.

This prioritised list has to date resulted in the completion of five projects in 2017/18, 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 2017/18

Location of OHL	Designated site	SPD/SPM	Km of lines removed	Km of lines undergrounded
Netherdale	Upper Tweedale NSA	SPD	**1.06km**	-
Snowdonia National Park	Snowdonia National Park	SPM	**2.11km**	**2.81km**
Bryniau Clwyd A Dyffryn Dyfrdw	Clwydian Range	SPM	**1.36km**	**1.83km**
Llŷn Peninsular	Anglesey, Llŷn Peninsula	SPM	**3.95km**	**0.82km**
Ynys Mon/Anglesey	Anglesey, Llŷn Peninsula	SPM	**0.02km**	-
Total			**8.5km**	**5.46km**

This collaborative activity results in an agreed priority list of infrastructure identified for undergrounding, supported by the local community. SPEN 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 2 'Visual Amenity'.

The pictures below show before and after our overhead lines were removed from Rhyd-Ddu in Snowdonia National Park. This area boasts one of the easiest paths to the summit of Snowdon. The OH line ran in parallel with the route of the Welsh Highland Railway just as the first views of Snowdon come into view (the mountain on the left of the photo), our OH line was in the line of sight. The removal provides a beautiful uninterrupted first view of Snowdon.

Figure 6
Before – Rhyd-Ddu in Snowdonia National Park

Figure 7
After – Rhyd-Ddu in Snowdonia National Park

The removal provides a beautiful uninterrupted first view of Snowdon.

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 within the bund. The sump sends an alarm to allow a staff member to arrive on site and assess what action to take on the oil leak.

The actual and estimated costs for these projects are presented in Table 4. Works are underway for the 15 SPD sites and at 12 SPM sites. Transformer replacement projects may take place over a number of years. The table below identifies costs of works that have taken place during this year only.

Table 4
Summary of Transformer Replacements and Associated Costs

Site name	Network area	Work undertaken	Environmental mitigation expenditure
Langside	SPD	Transformer Modernisation	£55,947.63
Bonnington Road	SPD	Circuit Breaker Modernisation	£8,833.78
Denholm	SPD	Circuit Breaker Modernisation	£8,644.38
Carrutherstown	SPD	Primary Circuit Breakers	£3,850.73
Barterholm	SPD	Primary Switchgear Replacement	£5,743.79
East Mains Broxburn	SPD	Primary Circuit Breakers	£4,270.10
Pinwherry	SPD	Transformer Modernisation	-£345.93
Fauldhead	SPD	Transformer Modernisation	£1,232.41
Hunterston Farm	SPD	Transformer Modernisation	£17,185.93
Balmore Village	SPD	Transformer Modernisation	£598.84
Pencaitland	SPD	Primary Circuit Breakers	£7,990.72
Gorgie	SPD	Transformer Modernisation	-£2,143.95
Dunscore	SPD	Transformer Modernisation	£625.72
Strathaven	SPD	Transformer Modernisation	£2,354.38
Milliken	SPD	Transformer Modernisation	£9,617.53
North Wales	SPM	Transformer Modernisation	£12,476.98
Acer Avenue	SPM	Transformer Modernisation	£1,148.16
Lugsdale	SPM	Transformer Modernisation	£10,400.00
Hadkayne	SPM	Transformer Modernisation	£51,336.08
Croxteth	SPM	Transformer Modernisation	£3,153.58
Mobil Oil Wallasey	SPM	Transformer Modernisation	£165,913.13
Four Crosses	SPM	Transformer Modernisation	£7,691.29
Llanilar	SPM	Transformer Modernisation	£56,574.63
Lymm	SPM	Transformer Modernisation	£56,268.16
MDHB Egerton	SPM	Transformer Modernisation	£43,909.42
Lostock	SPM	Transformer Modernisation	£1,180.00
Speke	SPM	Transformer Modernisation	£108,979.28
Total			**£643,436.77**

In addition to carrying out the works detailed in Table 4, we also make use of MIDEL 7131 Synthetic Ester transformer oil on sensitive sites. Midel oil is fire safe, non-toxic and non-harmful to aquatic life 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 in close proximity to watercourses or those substations providing electricity at locations with an increased impact of fire.

SPEN owns and operates a number of underground oil-fluid-filled cables, which were historically installed as an alternative to overhead lines. There are 28.9km of underground oil filled cables within SPD and 159km within SPM.

Oil filled cables are monitored by pressure alarm systems. An alarm from one of these systems indicates fluid loss from the cable and a potential leak.

Once the alarm sounds, detecting the exact point of leakage can prove difficult, especially when the leaks are small.

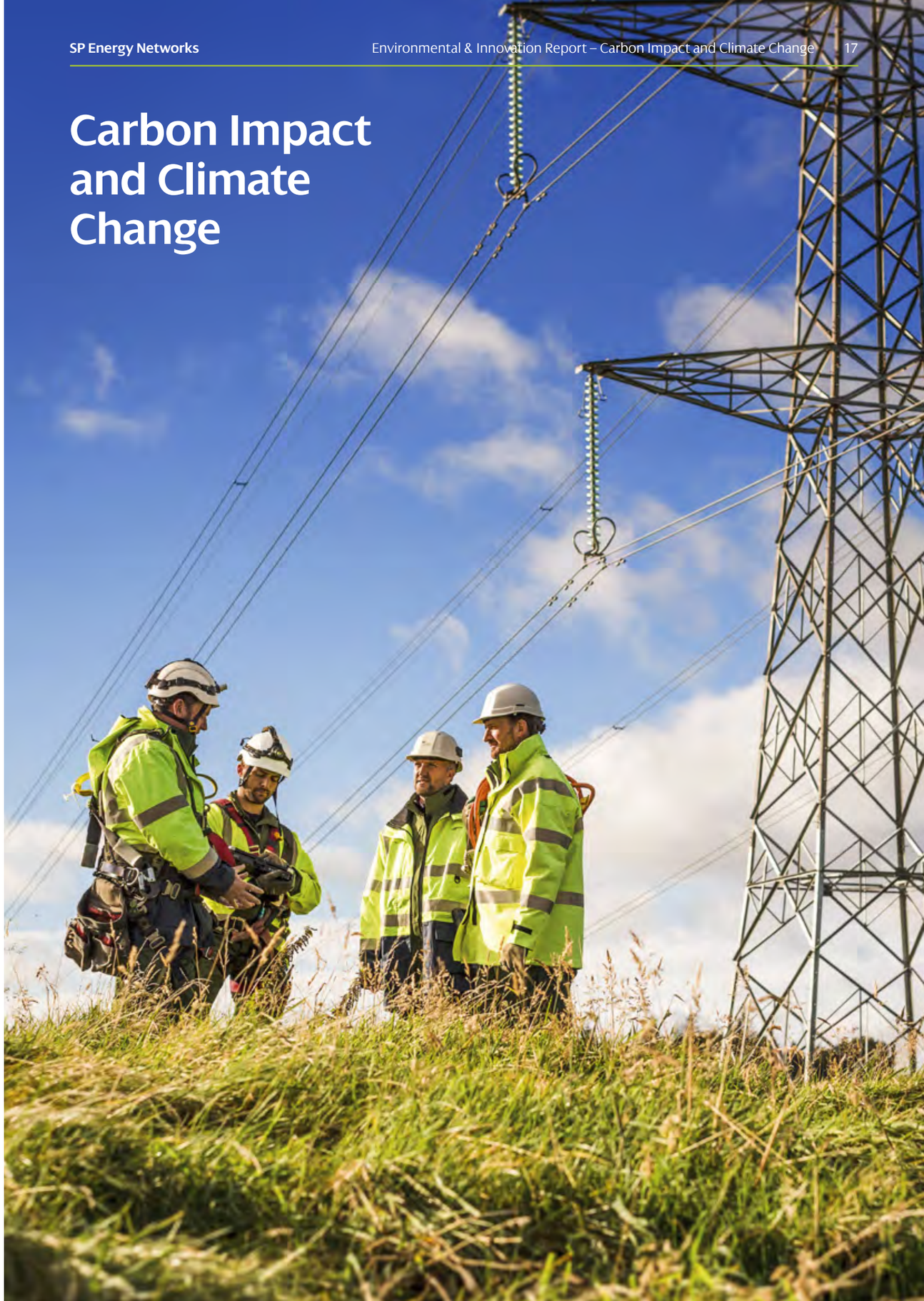
In SPM we had a number of small leaks resulting in a 2% leakage rate for the reporting year 2015/16. To combat this, we adopted an ongoing policy of strategic leak repair management and targeted asset replacement. Several methods were deployed including sniffer dogs, tagging with PFT (perflurocarbon) and the freeze method. This strategy has resulted in a leakage rate of 0.4% in 2017/18, an 80% reduction in leakage rate since 2015/16, far beyond our ED1 commitment of 50% reduction by 2023.

Another key environmental activity is the ongoing compliance with ISO 14001. We have had continuous compliance since 1997 and in October 2017 we achieved recertification to ISO 14001:2015. To help achieve this we undertook a revision of our process to identify our Environmental Aspects and improved the methodology used to assess the risks. These measures allow us to continuously improve and meet our targets. Our Depots are audited annually according to the Aspects and Impacts (A&I) Assessment Matrix and risk scores applied.

We continue to use the reporting tool, Cintellate to assist in measuring and driving compliance for Health, Safety and Environmental issues. Cintellate is used to record environmental incidents, to track the actions taken to resolve the issue together with details of any intervention by an environmental regulator, where relevant. The data is then collated by the 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 incidents and wider trends at SPEN monthly director meetings to ensure lessons learned can be shared across the business.

Our strategy has achieved an 80% reduction in oil leakage from oil filled cables since 2015/16, far beyond our ED1 commitment of 50% reduction by 2023.

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 will actively support our customers and local communities towards achieving this goal. Our ambitious carbon impact and climate change targets aligned with international agreement to curb global temperature rises within 2°C. Our goal is to reach 15% reduction on 2013/14 levels by 2023, 80% reduction by 2030 and carbon neutrality by 2050.

This section reports on our Business Carbon Footprint (BCF) excluding losses, Sulphur Hexafluoride (SF6) Emissions and Distribution Losses, each of which contribute to our Sustainability Driver for Carbon and Energy Reduction (please see Table 5). Full details of our BCF reporting can be found in Appendix 2 Business Carbon Footprint.

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, SF6 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 obtained The Planet Mark™ certification on 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 academics and industry experts.

SPD & SPM have jointly achieved a 29% reduction in Business Carbon Footprint* against a 2013/14 baseline.

*excluding losses

Table 5
Estimated tCO_2e for SPEN Distribution 2016/17 & 2017/18 including losses

Licence & year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total
SPD 2016/17	3,974	511,022	3,360	**518,356**
SPD 2017/18	3,755	446,600	3,155	**453,510**
SPM 2016/17	3,774	430,195	3,545	**437,514**
SPM 2017/18	4,333	364,164	6,901	**375,398**

Business Carbon Footprint

Since our 2013/14 baseline year SPD & SPM have jointly achieved a 29% reduction in business carbon footprint excluding losses. By reporting year 2015/16 we had reached our 2023 target of a 15% reduction in emissions. Whilst being the largest portion of our carbon footprint, electricity losses (energy lost or stolen from the network as it travels from source to user), is also the category most influenced by external factors. We describe this category in detail in the Distribution Losses section.

After network losses, our largest carbon footprint comes from the energy used in our buildings and substations, followed by contractor emissions, business transport, Sulphur Hexafluoride (SF6) and lastly the red diesel used in our generators to provide electricity to customers while we complete work on the network.

This year, emissions from depot and substation energy use, business travel, fleet transport and red diesel use all decreased.

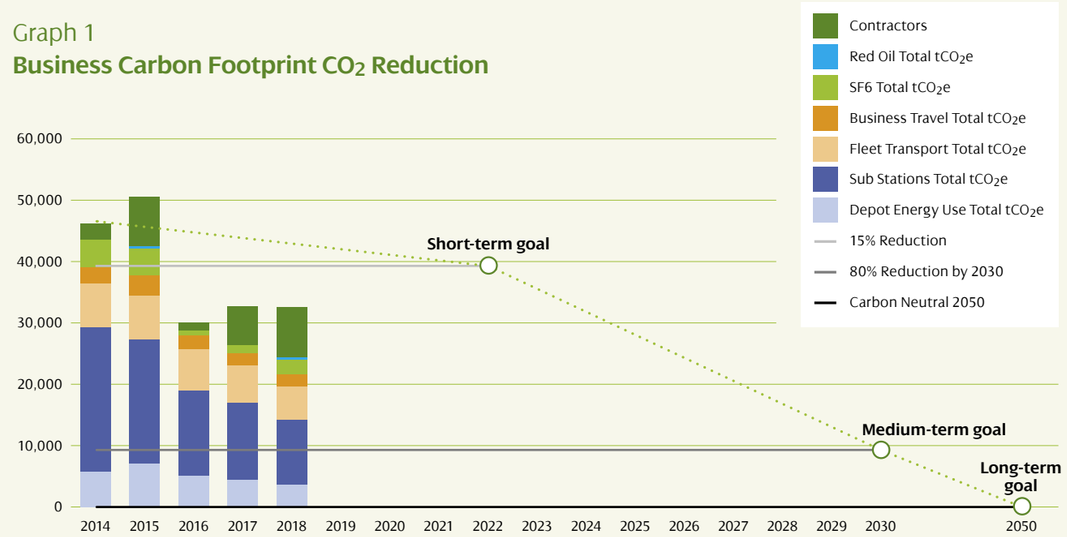
Depot energy use emissions reductions were largely due to increases in the energy efficiency of our buildings, including the introduction of LED lighting. While it is operationally necessary to use a certain amount of electricity at our substations, ongoing reductions in the carbon intensity of the energy generation mix mean that the energy used at substations results in lower emissions year on year.

Emissions from staff domestic air travel reduced by 26% and emissions from business miles reduced by 10% as a combined result of a staff awareness campaign, competitive rail pricing and increased access to video-conferencing facilities.

In the same period, emissions reported from SF6 and contractor operations increased. These increases in reported emissions are explained in full in the following pages and in the Sulphur Hexafluoride Emissions section.

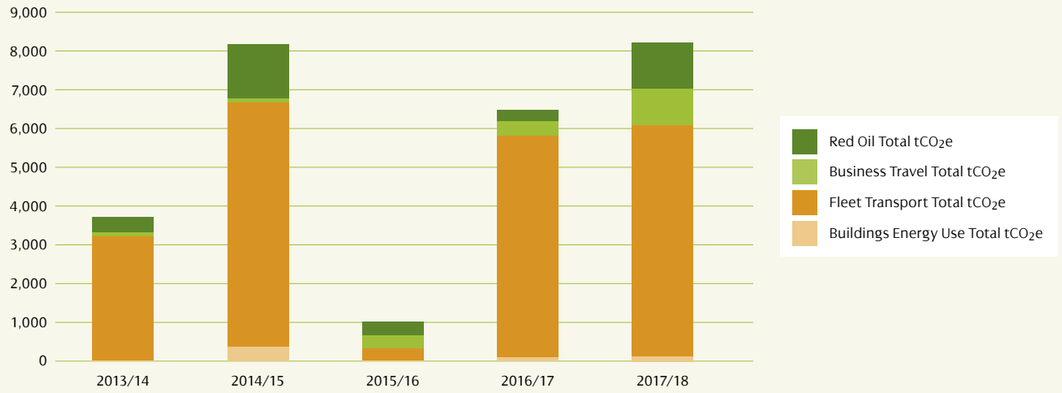
Since forming a Sustainability Team at the start of ED1, the team has worked to improve data collection by moving away from estimations and providing accurate data. This is evident in the increase of data recorded for our Scope 3 emissions associated with our contractors. Concentrating on our largest contracts in monetary terms, we have increased the number of contractors reporting their emissions and continue to target our top 20 contractors for accurate records of data. In this way, we are able to record the impacts of our supply chain and begin to work with them to reduce their emissions, which will have wider benefits beyond their contract with SPEN.

Graph 1
Business Carbon Footprint CO_2 Reduction



Graph 2 below shows estimated contractor data for 2013/14 and 2014/15. In 2015/16 we moved away from estimated data, and provided actual data as reported by a small number of contractors. In 2016/17 and our current year 2017/18, we include a greater number of our contractors reporting accurate data, resulting in an increasing figure.

Graph 2
Contractor Business Carbon Footprint data



In 2016/17 and our current year 2017/18, we include a greater number of our contractors reporting accurate data, resulting in an increasing figure.

Summary of 2017-18 carbon and climate change impact reduction initiatives:

Developing our Sustainable Business Strategy to lead business change and achieve our 2023 15% CO_2 reduction target from a baseline year 2013/14. Our 2017/18 BCF represents a 29% decrease on the 2013/14 figures. Our primary focus is now on reaching a stretching target of 80% reduction by 2030, in line with our target of carbon neutrality by 2050.

Continuing to incorporate energy efficiency measures in our buildings – We installed LED and motion sensor lights at our sites and commissioned the building of a new energy efficient depot office at Middlewich.

Continuing to review our data and make improvements where required – This reporting year we enhanced our SF6 data and increased contractors providing carbon data.

Encourage a reduction in travel – In 2017/18 domestic air travel across SPEN reduced by 26% and staff business miles claims have reduced by 10%. The change is a combined result of travelling less, competitive rail pricing and increased staff awareness of carbon emissions from travel.

Continuing to collaborate with suppliers to identify SF6 alternatives and drive lower leakage rates, whilst working to provide robust reporting systems for SF6 equipment.

Undertaking planned transformer replacements and installed lower loss transformers. Since the start of ED1 we have replaced 237 higher loss transformers with lower loss alternatives.

We have now fully embedded our electronic vehicle management system TrackM8. Since 2015/16 CO_2 emissions from our fleet vehicles have reduced by 7%.

Sulphur Hexafluoride Emissions

To increase the operating efficiency of our assets, and to reduce the potential for significant local environmental impacts through the leakage of oil, SPEN and other DNOs have been installing SF6 switchgear when replacing oil containing network assets, such as transformers.

SF6 is a colourless and odourless gas used to insulate electrical switchgear. Although it causes no detectable impact on the local environment if released, it is considered the most potent greenhouse gas with an intensity 22,800 times that of CO_2 and is capable of persisting in the atmosphere for thousands of years. It is expected that the quantity of SF6 on our network, described as the 'SF6 bank', will increase as the oil replacement programme proceeds. Therefore, efforts to minimise escape of SF6 from equipment to the environment is of paramount importance.

SPEN sought to drive the supply chain towards developing equipment with reduced SF6 leakage rates. The International Electro technical Commission (IEC), the body responsible for setting international guidance recommends a leakage rate of 0.5% (indoor equipment) and 1% (outdoor equipment) each year. We have specified a more stringent maximum leakage rate of 0.1% for all 33kV and 11kV switchgear.

SPEN is adopting a collaborative approach with suppliers to identify alternative insulating gases to SF6. At present, one project related to our transmission licence is due to see deployment of an alternative gas, with others possible throughout our distribution and transmission licences if the outcome is successful. We are continuing discussions with other suppliers developing other alternatives to SF6.

In order to reduce the risk of leaks during planned maintenance and improve data quality, we have provided specialist training to operational staff, covering methods for accurately measuring and recording leaks and processes for safe equipment refill.

As we move away from estimating SF6 emissions, it is important to make sure we capture all possible SF6 leakage scenarios. Data for the SPM licence, which includes 132kV assets, is recorded by checking the volume of gas required to top up the tank to original capacity. However, in the SPD licence area, which covers voltages only up to 33kV, much of the equipment that contains SF6 is sealed, thus top ups are not viable. When a piece of equipment is found to leak, we replace it and return it back to the manufacturer or to a SF6 licenced scrap merchant. In 2017/18 we have expanded and improved on our recording of this data leading to an increase in the SPD SF6 emission data value.

Summarised SF6 information is presented in Table 6 and more detailed information is available in Appendix 2, Environmental Reporting.

In SPM we fixed leaking equipment at ICI Wade in early 2017 and recorded no further leaks at this site through 2017/18. 67% of the SF6 emitted in 2017/18 can be attributed to our site at Sankey Bridges. This equipment is due to be repaired by the manufacturer in 2018.

Table 6
Summary of SF6 Information

	SF6 Bank	SF6 Emitted	Actual leakage rate
SPD	15,182kg	37.0kg	0.2%
SPM	17,833kg	67.5kg	0.4%

Distribution Losses

Our published Losses Strategy is based upon a high-level vision that we will **"Consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers".**

Electricity losses are an inevitable consequence of transferring energy across electricity networks and contribute a significant financial and environmental impact. Effective losses management can therefore reduce our environmental impact and protect consumers from unnecessary increases to the distribution costs they pay.

About 6% of the energy entering the distribution system is not billed to customers. Much of this is lost in heat and noise as part of the electricity supply process. This energy is referred to as technical losses. In addition a small amount of energy is stolen, or not fully recorded. This is referred to as non-technical losses. Electricity industry settlement systems charge suppliers for network losses and are therefore paid for by the customer.

We submitted our application for Tranche 1 of the Losses Discretionary Reward in January 2016, and were awarded £770,000 in July 2016.

In February 2018 we submitted our application for Tranche 2 of the losses Discretionary Reward. Ofgem received 6 submissions for Tranche 2, one from each of the DNOs. Whilst it was noted that SPENs submission was strong, no DNOs were successful in securing a reward.

To attain our goal of loss-inclusive network management, a good understanding is required of the causes of losses, their magnitude and location, and their impact and interaction with network users across the whole system.

Delivering cost effective loss reduction activities will reduce customer energy bills, carbon emissions and help to reduce the pace of climate change.

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Technical losses

Our distribution networks convey energy from the interface with the transmission system to the low-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 or noise or both as electricity is transferred. The behaviour of Technical Losses can be described as Fixed Losses or Variable Losses.

Even if no power was being delivered to customers, the system has losses just because it is electrically energised (Fixed Losses). Largely these arise because the steel in each transformer's magnetic core is reversing magnetic polarity in every AC cycle. This causes it to pulse (which emits 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 insulation used in transformers, lines and cables. Taken altogether, these inefficiencies are the "No Load" or "Fixed Losses" on 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. The amount of heat losses rises as the square of the current and therefore if the peak current was 10 times the minimum, losses at peak would be 100 times as large as the losses at minimum load. Because these losses vary with the current flowing through the system such losses are called "variable losses".

Calculating the value of technical losses is complex because variable losses change with load on the circuit but the value of energy also varies with the time of day. In addition, a further type of loss categorised as a Technical Loss is Energy consumed by our equipment to ensure safe and reliable network operation. In our substations, energy is typically consumed for heating and lighting, dehumidification and cooling equipment, oil pumps, air compressors and battery chargers to maintain secure network operation and resilience.

We recognise the importance and benefit of collaboration amongst DNOs and currently chair the ENA Technical Losses Working Group which is aimed at facilitating the sharing of best practice within the industry.

Industry settlement data is used to estimate losses. At EHV, 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 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 data is estimated to final reconciliation which includes actual data.

Non-technical losses

Non-technical losses primarily relate to unidentified, misallocated and inaccurate energy flows and not to a loss of energy to the environment. The three main types of non-technical losses are:

1. Energy Theft
2. Unmetered Supplies; and,
3. Conveyance.

Energy Theft

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

Unmetered Supplies

Not all customer supplies are metered. Typical unmetered loads include street lighting, traffic lights and road signs, advertising hoardings and lighting in shared occupancy buildings. 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.

Conveyance

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

We recognise the importance and benefit of collaboration amongst DNOs and currently chair the ENA Technical Losses Working Group which is aimed at facilitating the sharing of best practice within the industry.

Distribution Losses Strategy

In September 2015 we published our Losses Strategy. This strategy applies throughout the ED1 2015-2023 regulatory period and is subject to regular reviews and updates. We are committed to modifying processes and technical documents to ensure there is a culture of considering losses in every major investment appraisal we take, and to implement investment decisions which are justified after considering losses.

Specific actions include:

- Accelerate replacement of more than 1,000 higher loss transformers that would have otherwise been replaced between 2031 and 2039.
- HV main line new builds and offline rebuilds throughout the RIIO-ED1 period will be constructed using larger than usual (100mm^2) conductor.
- Project specific evaluation of installing larger cross-section cables on new circuits, and review ongoing studies to inform any policy revisions.
- To address transactional theft, increase our Revenue Protection team by 22% and consider the use of HV and LV network metering and smart metering to identify zonal problems.
- Proactively improve the accuracy of records for unmetered supplies by working closely with customers and settlement stakeholders.

Accelerate replacement of higher loss transformers – To reduce losses we have brought forward the replacement of some of our highest loss transformer units, which were manufactured before 1962. Over the last 60 years, advances in materials and manufacturing techniques have resulted in the reduction of fixed losses in transformers. The continuing program has led to the replacement of 60 high loss transformers in 2017/18 that would otherwise have remained in service for an additional 16 years.

We anticipate that the actions included within our Strategy will lead to carbon savings of 23,835 tCO_2e and 44,977 tCO_2e in SPD and SPM respectively.

We have committed to providing an annual update to inform stakeholders of the work we are carrying out within this area.

Losses Discretionary Reward

The Losses Discretionary Reward encourages 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 Losses Discretionary Reward is managed in three tranches during ED1:

- Tranche 1 – submissions made in 2016
- Tranche 2 – submissions made in 2018
- Tranche 3 – submissions made in 2020

For our Tranche 1 Submission we established a 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.

- Smart Meter Data to reduce non-technical Losses
- Smart Meter Data to reduce Technical Losses
- Voltage Optimisation to improve Network Losses
- Improved Modelling of Complex Networks to Consider Losses
- Improved Modelling of Rural Networks to Consider Losses
- Assessment of Power Factor to Improve GB Losses
- Improved Detection of Theft through Revenue Protection
- Improved Network Loading through Stakeholder Engagement
- Substation Efficiency – Waste Heat Recovery
- Substation Efficiency – Monitoring and Self-Sufficient Substations

Our Tranche 2 Submission has provided a review of the activities undertaken and their outputs and implementation into the business. The section below provides a summary of our actions. Our full Tranche 2 submission can be found on the SP Energy Networks website: **spenergynetworks.co.uk/userfiles/file/SPEN_LDR_T2_Submission_Issued_27_02_18.pdf**

Innovative use of smart meter and Network Data – Throughout Tranche 1 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. Recent work on the identification of non-technical losses through the innovative analysis of smart meter data has included engagement with suppliers via the TRAS Expert Group (TEG). These new developments will continue throughout the RIIO-ED1 period.

Improve Substation Efficiency – We plan to continue our work on understanding the scale and profile of energy required to operate our substations. We are exploring recovering waste heat from transformers to reduce substation heating demand. To better understand typical distribution substation thermal conditions, we installed temperature and humidity monitors during 2017.

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 a permanently embedded member of staff with the Merseyside Police force resulting in a significant increase in the detection of energy theft. Consequently, we are actively pursuing a similar initiative with Police Scotland.

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 for monitoring and informed our understanding of this source of losses.

Customer and Stakeholder Engagement

This work recognised the impact on network loadings of customer/prosumer behavioural change and additional embedded generation. Where these changes result in higher loads on existing assets there is a consequential increase in technical losses. We have engaged with specific customers to assist them in understanding their usage patterns and the impact on losses. Examples include our on-going work with Flintshire County, their supplier and the Welsh Assembly.

Preparing for RIIO-ED2

In our role as chair of the ENA Technical Losses Working Group we are working collaboratively with the other DNOs and NGET to provide recommendations for a regulatory approach in RIIO-ED2. We submitted a set of proposed Guiding Principles which have been accepted by the ENA working group to form the basis of ongoing optioneering, stress-testing and modelling exercises to identify effective and practical potential options for a RIIO-ED2 losses regulatory mechanism.

The total losses are presented in Table 7, this data relates to total losses including both Technical and Non-technical losses.

Tables 8 and 9 present the summary of losses costs and benefits in each licence, and Tables 10 and 11 present the summary of losses activities also for each licence.

Table 7
Assessment of Losses (Technical and Non-Technical) 2017/18

	SPD	SPM	SPEN Total
Units Entering (GWh)	19,081	16,135	35,216
Units Exiting (GWh)	17,833	15,117	32,950
Losses (GWh)	1,248	1,018	2,266
Losses (%)	6.54%	6.30%	6.43%

Table 8
Summary of Losses Costs and Benefits (SPD) from Activities in RIIO-ED1

Programme/ Project title	Distributed Losses – Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative reduced losses to date
Replace high loss transformers	£9.2m	4,794MWh	1,795 tCO_2	17,492MWh
Internal and External Revenue protection inspections	£0.04m	4,835MWh	1,692 tCO_2	21,667MWh
Theft in conveyance	£0.0m	54.78MWh	1.91 tCO_2	877.08MWh
Totals	**£9.24m**	**9,683MWh**	**3,489 tCO_2**	**40,036MWh**

Table 9
Summary of Losses Costs and Benefits (SPM) from Activities in RIIO-ED1

Programme/ Project title	Distributed Losses – Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative reduced losses to date (year 1)
Replace high loss transformers	£12.5m	3,938MWh	1,438 tCO_2e	19,622MWh
Internal and External Revenue protection inspections	£0.06m	7,857MWh	2,749 tCO_2e	20,883MWh
Theft in conveyance	£0.0m	0MWh	0 tCO_2e	0MWh
Totals	**£12.56m**	**11,795MWh**	**4,187 tCO_2e**	**40,505MWh**

We have engaged with specific customers to assist them in understanding their usage patterns and the impact on losses. Examples include our on-going work with Flintshire County, their supplier and the Welsh Assembly.

Table 10

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	35	62
Revenue protection inspections	Visits made by revenue protection (metered supplies)	16,199 visits 1,292 irregularities	n/a
Theft in conveyance	Visits made by revenue protection (metered supplies)	120 cases investigated 1 case confirmed interference	n/a

Table 11

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	25	144
Revenue protection inspections	Visits made by revenue protection (metered supplies)	8,861 visits 1,023 irregularities	n/a
Theft in conveyance	Investigations	228 cases investigated 0 cases confirmed interference	n/a

In our role as chair of the ENA Technical Losses Working Group we are working collaboratively with the other DNOs and NGET to provide recommendations for a regulatory approach in RIIO-ED2.

Other Environment Related Activities

Introduction

We recognise the need to record and monitor our environmental, social and financial impacts, and to 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 earlier figure 5). This includes waste management, noise and air emissions, climate change adaptation, ecological enhancement and stakeholder engagement with communities, staff and other key groups to deliver this ambition.

We recognise the need to record and monitor our environmental, social and financial impacts.

Waste Management

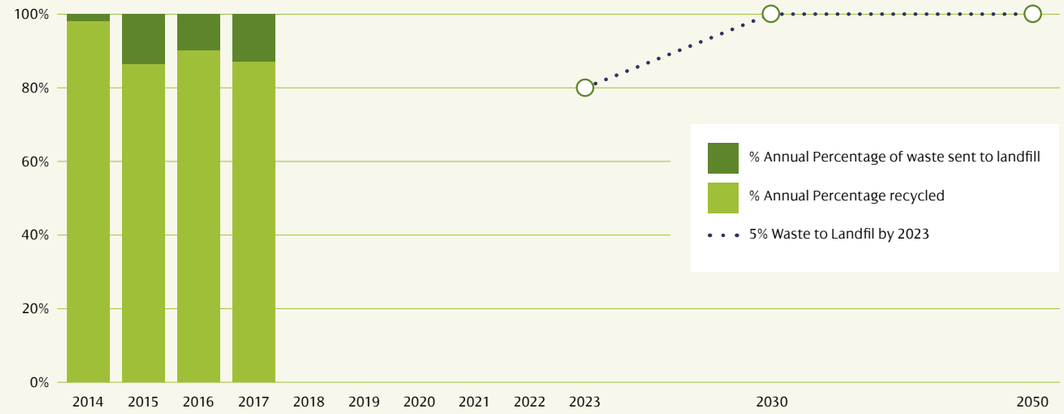
In our Sustainable Business Strategy we describe a vision where 'The principles of a circular economy and efficient use of resources will be embedded in our business'. The materials required for network construction and operation will come from sustainable sources. We will produce 'zero waste', with 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 a key element of our vision of sustainability. In order to drive this vision, we have set ourselves the challenging goals to divert 95% of waste from landfill by 2023, to recycle or reuse 100% waste by 2030, then move to zero waste in 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 improve the ways in which waste resource is then processed. Graph 3 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.

Graph 3

Waste to Landfill Reduction



Management of Noise Impact

The construction and maintenance of electrical infrastructure by its nature will result in some degree of noise. Where our infrastructure is being constructed in the urban or rural environment, or where new settlements are built adjacent to infrastructure that is already present, this can result in negative effects on the amenity value of an area to society.

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 noise and dust complaints. Complaints are logged in our Cintellate system and passed to regional contacts with actions and deadline dates.

In reviewing operational complaints with respect to noise, the majority of issues relate to the use of temporary power generators that power emergency maintenance works and customers who are off supply, rather than ongoing noise 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 straight forward once these are known to us. In the 2017/18 reporting year, SPEN received nine complaints in relation to noise. In each case an inspector visited the property and conducted a full investigation. Five complaints were found to not require any further action from SPEN.

The remaining four were resolved through noise abatement projects including installing sound proofing, replacing transformers or the redesign of the substation. We keep in regular contact with affected customers, involving them at each stage of the process.

Climate Change Resilience

Seventeen of the eighteen warmest years on record have occurred since 2001, with 2016 the warmest year on record and 2018 likely to be one of the hottest years. Climate scientists have agreed for some time that there is a clear link between human activity forcing current global climate change patterns and countries, businesses and society are now moving to adapt to the costly impacts of climate change, as well as battling to reduce environmental impacts that could contribute to further climate change and even greater impacts.

In the UK, severe weather events will manifest in several ways with potential to impact on our network:

- More frequent and intense rain showers are predicted to result in localised flooding which could flood our assets or limit safe access for maintenance or emergency repairs.
- More frequent wind storms with higher wind speeds are predicted, which could cause overhead line faults and therefore power cuts.
- Sustained increased temperatures, which could cause a reduced operating efficiency of the network and an increase in vegetation growth which requires clearance from beneath and around our assets.

The challenges resulting from interdependencies of our network are also of key concern for SPEN and our stakeholders.

In June 2015 SPEN published a Climate Change Adaptation Report to record the vulnerability of our network to the effects of climate change and has identified measures to mitigate these adverse effects.

Key Risks:

The following risks were included in this report and the previous 2011 report:

- Risk AR10: Substations affected by river flooding due to increased winter rainfall, with loss or inability to function leading to reduced security of supply;
- Risk AR11: Substations affected by flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply;
- Risk AR12: There is a risk that due to extreme sea flooding a substation may be lost or unable to function leading to reduced system security of supply. A number of sites may be at risk from sea level rise/coastal erosion.

SPEN Operational Risks:

- Risk SP1: impact of increased temperatures on the network with warmer winters and hotter summers potentially shifting peak annual loads from the winter season into the summer months, therefore limiting the flexibility of the network and windows for undertaking maintenance work.
- Risk SP2: extreme weather events may have led to a failure on the network, with repair and maintenance teams unable to reach the site, for example where it and/or access roads are flooded. This could result in extended periods of interruptions for customers.
- Risk SP3: flooding impacts upon communication and control infrastructure, affecting the ability to control and operate the network remotely.

The programme of mitigation at our substations includes the installation of flood proof doors, waterproof membrane applications and increasing the height of bunds around transformers. To increase the resilience of our overhead lines, we are continuing proactive tree management work and targeting the modernisation of assets in high weather areas.

This year we are continuing to work through our programme of work for ED1 for flood defences, whilst engaging with our Regulators on the next steps for making our whole network resilient to severe weather events based upon the most recent prediction models.

Our proactive vegetation management work has been recognised within Adaptation Scotland's 'Is Your Business Climate Ready?' guidance for businesses, published in November 2017. Our case study was used to highlight the opportunities to reduce the cost of damage and disruption to assets and property, and the positive impacts that adaptive investment can deliver, with 25% fewer faults caused by winter weather than a decade ago.

Effective resilience investment has reduced faults caused by winter weather by 25% in the last decade.

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 addition to complying with the Biodiversity Policy of our parent group, Iberdrola, the principles by which we support biodiversity have been included within our Environment Policy, and our objectives within our wider Sustainable Business Strategy. The principles within the SPEN Environment Policy require us to:

"Recognise and understand the value to society of biological diversity and natural and cultural heritage, striving within the scope of our operations to conserve, preserve, and enhance these resources and mitigate adverse impacts".

Protection of the environment in which we operate is a priority as we undertake work on our network. In recognition of the importance of biodiversity, we have identified Land and Biodiversity Improvement as one of our seven Sustainability Drivers. The following examples show our approaches to supporting protected species and understanding the value of the environments in which we operate.

Dormouse Project

As part of the North Wales Wind Farm Connection Project SP Energy Networks enhanced approximately 1.6ha of land. This involved clear-felling the majority of the conifer and restocking with small-seeded broadleaved species (e.g. blackthorn, dog rose, bramble, hawthorn, willow) to benefit dormice, together with allowing natural regeneration (area of 0.8ha). A maximum of 550m of hedgerow has been created to replace the 106m removed. The hedgerows comprise hawthorn, blackthorn, hazel, holly and at least 2 species from dog rose, guelder rose, field maple and spindle. The 68 trees that were removed were replaced with saplings on a 2 for 1 basis, providing a total of 140 trees. In most cases replacements will be the same species as the tree that is lost. However, non-native species will be replaced with native species. 20 dormouse boxes have been installed in suitable habitats in the vicinity.

Checks of dormice boxes will be undertaken each year for the first 5 years after construction and then on a 2 yearly cycle for a further 6 years.

Approximately 6,500m^2 of enhancement planting will be undertaken as part of the landscape planting on the scheme. This planting will be within the Coed y Fadir LWS and will comprise a seasonally wet areas mix (based on National Vegetation Classification (NVC) Mix 23). This will be monitored for a period of 5 years.

Tree and hedgerow removal has been avoided where possible along the route of the connection. Where a section of hedgerow has been removed (maximum of 383m), this will be replaced and the length of the hedgerow enhanced with native species. This planting will be monitored for a period of 5 years.

Woodland edge improvements are proposed along with woodland scrub habitat and natural regeneration. 13,231m^2 of woodland and scrub planting and 8,970m^2 of scrub planting is proposed in areas where woodland removal has occurred. A total area of approximately 7,993m^2 will be left for natural regeneration. This planting will be monitored for a period of 5 years.

Natural Capital Pilot Project

In this scheme year, SP Energy Networks (SPEN), the Scottish Wildlife Trust (SWT) and Aecom completed Phase I of our joint Natural Capital pilot project within the Cumbernauld Living Landscape (CLL) area. We marked this occasion by publishing our Phase I report in October 2017, participating as a panel speaker at the prestigious Natural Capital World Forum in November 2017, and appearing in the short Scottish Wildlife Trust film titled 'Scotland: Our Natural Wealth' where we briefed on our work and the importance of Natural Capital.

The World Forum is an international event held every 2 years in Edinburgh for international experts, policy makers and practitioners from government, nature conservation agencies, environmental regulators, business and consultancy to communicate progress in implementing Natural Capital. Our panel appearance involved presenting on the CCL pilot project, particularly our intent to:

- Better understand the existing natural capital value of their landholdings;
- Understand ways in which this value can be protected and increased;
- Understand the ways in which SPEN depends on natural capital; and
- Enhance the evidence base used when making investment decisions about restoring or improving natural capital and ecosystem service provision.

Alignment with wider Policy/Opportunities

Through completion of Phase I of the pilot project SPEN identified six key ecosystem services, a number of which are recognised as nationally important by the Scottish Government, the farming sector, environmental groups and society in general. By acknowledging these impacts and putting effort into defining measures which can reduce these impacts, SPEN is aligning itself with the expectations of its most crucial stakeholders.

As SPEN is not materially dependent on ecosystem services, the application of the approach would be achieved by controlling its impacts, most notably in the operational decisions taken through the management of its existing assets in the short term. For example, seeding mown lawns with wildflower seed may reduce SPEN impacts on wild species diversity by providing new habitat for pollinating species of insects. This may also support the crops ecosystem service through increased abundance of pollinators if specific sites were close to agricultural land.

SPEN identified six key ecosystem services, a number of which are recognised as nationally important by the Scottish Government, the farming sector, environmental groups and society in general.

Next Steps

On a medium term basis, and with careful adaptation, it may be possible for SPEN to incorporate the Natural Capital approach on the selection and review of mitigation options following the selection of an overhead line route. This would have the benefit of directing SPEN towards the best value mitigation options, creating more from its financial investment, and in doing so, create a transparent reporting framework.

We anticipate Phase II of the pilot will:

- Adopt the six ecosystem services identified in the Cumbernauld Living Landscapes Phase I study (Global Climate Regulation, Wild Species Diversity, Recreation, Hazard Regulation, Crops, Timber);
- Extend the study area beyond its current urban setting to capture the high materiality ecosystem services common in the rural areas of the SPEN network;
- Develop a decision support tool for the six ecosystem services suitable for use by project managers and environmental specialists in order that decisions on the management of existing SPEN assets can be compared to deliver best value for customers, society and the environment;
- Identify SPEN sites where Natural Capital principles can be adopted on the management of the site to test the tool, for example:
  - sites where where maintenance and working practices can be tested (e.g. depot grounds or substations),
  - sites where project mitigation options can be tested.

We are mindful of the business as usual deployment of the Natural Capital approach, how it can maximise the positive benefits of the approach, and how it can be deployed quickly and effectively. Ahead of initiating Phase II, we have engaged with National Grid to discuss their experience of using Natural Capital and are keen to understand how we can learn their lessons quickly, and deploy the principles consistently for the benefit of our stakeholders.

Employee Engagement

Effective employee engagement is a vital enabler in achieving our vision as a sustainable networks business of the future, including:

- Consideration of environmental, social and economic costs and benefits in decision making;
- Collaboration with stakeholders; and,
- Transparency in decision-making processes and reporting of performance.

Our Executive Sustainability Steering Group (ESSG) meets quarterly to provide strategic direction and guide the implementation and ongoing development of our Sustainable Business Strategy. In 2017-18, the ESSG agreed three important initiatives to enhance employee knowledge and autonomy:

- The establishment of a network of Sustainability Ambassadors across the business to identify practical actions and drive improvements. The Ambassador role is to identify sustainability gaps and opportunities for improvement, to implement initiatives at their work location and support pilot projects across the SPEN network.
- The introduction of an Internal Sustainability Fund to enable employees to identify and solve practical environmental or sustainability issues in their community. All projects are required to support the overall SPEN Sustainable Business Strategy and must show a benefit against one or more of our Sustainable Business Drivers.
- The introduction of an External Collaboration Fund to enable joint working with external organisations that have skills, networks or resources that enhance our existing capability to deliver against our Sustainable Business Drivers.

Our employees and supply chain partners are experts on our network, with detailed knowledge of our assets and the operations undertaken to install, maintain and repair them. By raising awareness of sustainability and environment impacts, our employees are better able to determine and address the priorities for change. In 2017-18, we have engaged with employees of all levels through a wide range of channels, including:

- **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 within SPEN, including staff away days, graduate and apprentice inductions and regular meetings with licence directors and their management teams.
- **Environmental Express and Tool Box Talks** – a number of email publications highlighting legislative and behavioural changes to all front-line and management staff, topics including water discharges from construction sites, oil spillage risk mitigation, biosecurity and birds in construction.
- **Open Networks** – enhancing our culture of democratic innovation by engaging, training and supporting staff to identify innovation opportunities and reach a much broader community of ‘solvers’ to realise them.
- **SPEN Sustainability Mailbox and employee suggestion box** – ensuring all stakeholders, both internal and external can reach the central sustainability team with any issues or topics for discussion.
- **Online and direct methods** – providing messaging to employees via our internal social media and intranet platforms, local notice boards and direct email.

In 2017-18, we developed an Environmental Training Plan for approximately 3,000 SPEN staff, aimed at providing employees with the enhanced environmental awareness required to be able to deliver the ambitious targets set out in our Sustainable Business Strategy. This significant three-year programme will include e-learning, in-house classroom training and externally audited training for high impact employees.

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. There are two areas of our Sustainable Business Strategy that have aspects relating to the low carbon transition:

- How we operate our business and our network; and
- How we facilitate the low carbon transition.

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 this is not possible.

As a regulated DNO, SPEN's 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.

Many of our assets are approaching the end of their natural life, by embracing innovative processes and technologies we expect to manage the replacement of these assets in the most efficient manner possible. This approach requires the business to provide a high visibility platform to raise awareness of the need for innovation including the formation of specific innovation teams. The result of which is a staff body who view innovation as a normal part of day-to-day business.

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 2017/18 we connected a total of 1,607 Low Carbon Technologies in SPD (equivalent to 87.8MW) and 1,110 in SPM (equivalent to 63.8MW). This includes the facilitation of customers connecting Heat Pumps, Photovoltaics (PV) and Electric Vehicles to our network.

New PV connections continue, however, volumes remain impacted by the change in Feed-In Tariff rates in December 2015.

By choosing the optimisation of existing assets over construction of new network infrastructure, we can deliver the required capacity to support this transition at a lower cost, in a reduced timeframe, using reduced quantities of raw materials and reducing environmental impact. In the context of ensuring quicker connections at lower cost, consideration of this approach is essential.

Table 12
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		5,497	145	145.9
2016/17	45	226		468	139	438.5
2017/18	132	73	553	671	178	87.7

Table 13
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		7,966	120	98.4
2016/17	70	229		579	74	150.0
2017/18	62	85	413	268	282	63.7

In addition to supplying connections to low carbon energy generators, our engineers are engaged in developing and delivering industry leading projects to support the low carbon transition.

Dumfries & Galloway Integrated Network Management – The network in Dumfries & Galloway has amongst the highest proportions of renewable generation connected in the UK relative to local demand, and more generators are seeking to connect to this resource rich geographical area. The project is establishing wide-scale integrated network management solution, monitoring and matching network capacity with local generation output. By actively managing generation in real time, we can make the most of the existing assets that are already there, ultimately keeping costs down for our customers. This ground breaking scheme is the first of its kind in terms of complexity and scale.

Benefits include:

- **Faster, more flexible service for our customers** – Active Network Management will allow between 70MW and 200MW of non-firm generation to connect ahead of the wider South West Scotland works. This will encourage local investment and growth.
- **More low carbon generators** – (windfarms/battery storage etc) can invest in the local area because they will be able to connect to the network quicker and at a cheaper rate.
- **Energy locally generated and locally consumed** – lays the foundations for real-time operation and control for customers and puts Southern Scotland at the forefront in our transition to becoming a Distribution System Operator.

LV Engine – This project, due to complete in 2022, will demonstrate the use of a new type of Smart Transformer on the distribution network, delivering significant savings and demonstrating a new type of network connection for LCTs.

This world-leading project will trial Smart Transformers at a number of secondary substations in SPM to understand how this new technology can enhance network flexibility and release additional capacity within existing low voltage networks. This will facilitate the increasing uptake of Low Carbon Technologies such as electric vehicles and rooftop solar PV. If successful, this project has the potential for UK-wide rollout.

Advantages of Smart Transformer use are:

- The Smart Transformer uses power electronics to create a more flexible and resilient supply for our customers by providing phase voltage regulation, balancing power flows and limiting fault current in the interconnected LV network.
- The project will make a low voltage DC supply available to our customers to accelerate the uptake of electric vehicles.
- The Smart Transformer will allow us to operate our network more intelligently by improving the quality of power to our customers and reducing network losses.
- This new technology releases capacity within the existing LV infrastructure which means more renewable technologies can connect to our network.

By actively managing generation in real time, we will make the most of the existing assets that are already there, ultimately keeping costs down for our customers.

FUSION – The increase in Distributed Energy Resources coupled with increasing load demand from low carbon technologies such as electric vehicles is fuelling a need to create an active distribution network capable of managing modern customers' needs. Our innovative FUSION project is testing a European market model for the trading of flexible network services, aiming to release additional network capacity for low carbon connections and create the information infrastructure required to facilitate the market. FUSION will enable all market actors to unlock the value of local network flexibility in a competitive and transparent manner.

Benefits include:

- Empowering customers to commoditise their flexibility thanks to new routes to market for existing and emerging flexibility providers in the distribution network.
- Smarter use of the distribution network assets, meaning significant carbon and environmental benefits. The system favours renewable energy sources and facilitates the uptake of low carbon technologies.
- Unlocking flexibility in the distribution network, meaning it can be procured by a range of market actors. Aggregators will be able to operate to aid the development of the flexibility market. By facilitating this neutral market, network flexibility will be accessible to all parties.
- Tested approaches to constraint management, alleviating localised network congestion without requiring costly and time consuming network reinforcement. This will provide excellent value for money for customers. The creation of a flexibility market will go beyond existing bilateral trading of flexibility, providing a whole systems approach to realising the value of flexibility.

FUSION will enable Distribution Network Operators and all market actors to unlock the value of local network flexibility in a competitive and transparent manner.

Progress of the Innovation Strategy

In the 2017/18 reporting year SPEN has invested significant time and effort engaging with local and national stakeholders to deliver both a fully refreshed SPEN Electricity Distribution Innovation Strategy and the very first national Electricity Network Innovation Strategy. Both are now driving the types of innovation projects we take forward, fostering greater collaboration between licenced network operators (gas and electricity) and enabling more innovators to become involved in our industry.

SPEN Electricity Distribution Strategy

Since we laid out our strategy, we have cemented our position as leaders in innovation, delivering a broad and diverse portfolio of projects to deliver significant customer value.

With the energy landscape evolving at pace, we worked with stakeholders to refresh our strategy in order to continue to lead the transformation of the energy system.

This activity aimed to shape the strategy to:

- become more accessible and understandable;
- enable greater collaboration from a wider range of partners;
- take a holistic view of challenges and opportunities;
- take an agnostic view of technologies and solutions; and to
- provide a clear plan for implementation with timelines.

We sought to understand stakeholders' network needs and expectations in ED1, ED2 and beyond. In parallel, significant engagement was undertaken with each function of SPEN to identify new challenges and opportunities faced by the business. Through this engagement we identified three priority areas for innovation:

Delivering Value to Customers

This priority area focusses on maximising the performance, efficiency and benefits delivered through our core business activities. This area identifies 20 specific opportunities and challenges, split across four themes:

1. Managing an ageing network.
2. Reducing the number and length of power cuts.
3. Network Control and Management.
4. Maximising the benefit of data.

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:

1. Faster, Easier Connection.
2. Preparing the Network for Low Carbon Technologies.
3. 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:

1. Socially Responsible member of the Communities we serve.
2. Minimising the Environmental Impact of our Activities and Assets.
3. Working Practices and Business Systems.
4. 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 delivering quantifiable benefits to customers.
- **Delivery** – The application of professional project management practices.
- **Transition** – The Business as Usual adoption and dissemination of the project.
- **Tracking** – The multi-year tracking of benefits realised by the project.

The new SPEN Distribution Innovation Strategy is available here:
https://www.spenergynetworks.co.uk/pages/innovation.aspx

2017/18 Innovation Projects

During the 2017/18 reporting year SPEN has registered 12 new Network Innovation Allowance (NIA) projects, along with 25 ongoing projects. Fundamental to their internal approval of each project was their alignment to the new Innovation Strategy:

1. Faster, Easier Connection
2. Preparing the Network for Low Carbon Technologies
3. Network Flexibility and Communications.

Full details of SPEN led projects can be found in the NIA Annual Report from 2017/18 page 10 onwards and details of collaborative projects are detailed from page 41 onwards.

https://www.spenergynetworks.co.uk/userfiles/file/SP_Distribution_Report_2017_2018.pdf

National Electricity Network Innovation Strategy

Brand new for 2017/18 was the creation of the first ever Electrical Network Innovation Strategy and the corresponding Gas Network Innovation Strategy. These documents have been authored collectively through the Energy Networks Association (ENA).

The Electricity Network Innovation Strategy echoes the content of our own document, albeit with subtle differences in the terminology to describe five Innovation Themes, underpinned by a further 30 Challenge categories.

Theme 1: Network improvements and system operability

Theme 2: Transition to a low carbon future

Theme 3: New technologies and commercial evolution

Theme 4: Customer and stakeholder focus

Theme 5: Safety, health and environment.

As with our own strategy, stakeholder engagement was at the core of creating this document. SPEN played a leading role in the production of the Electricity Innovation Strategy, chairing the related working group and featuring prominently in several events arranged by the ENA.

With the energy landscape evolving at pace, we have worked with stakeholders to refresh our strategy in order to continue to lead the transformation of the energy system.

Roll Out of Smart Grids and Innovation into Business as Usual

Strategy

The process of transition to business as usual is built into the fabric of every project we undertake. Our strategy for rolling out Innovative Solutions into business as usual lays out six essential elements for successful adoption:

- Ownership – At the start of each project, we identify the business and system owners for the solution, should it make the transition to business as usual. This assessment is reviewed throughout the life of the project.
- Successful delivery – Appreciating that the success of the project is a key driver in transitioning to business as usual, we continually review projects against their success criteria, carrying out a final review prior to business as usual adoption.
- Realisation of benefits – We measure actual benefits and findings of each project and undertake this analysis using an industry approved cost benefit analysis tool to facilitate efficient transfer to business as usual by our organisation and other network operators.
- Financial approval – Carrying out stringent financial assessment to understand the benefits of the new solution over tried and tested solutions and processes, where long term costs are predictable.
- Policy standards and specifications – Providing a strong mandate for the business to absorb the new solution into business as usual.
- Training and dissemination – The transition of the business and wider industry to using the new solution is underpinned by the delivery of effective training and dissemination.

Each of these essential elements is described in Project Transition – section 9.5 of our innovation strategy.

We engage with a wide range of innovation sources to identify opportunities for innovation and assess solutions with a view to adoption into business as usual. In addition to the Project Transition phase, opportunities to adopt innovative solutions into business as usual can arise at several other points in our innovation process.

During Project Inception, we engage not only with our people, partners and peers, but with other industries, manufacturers, academia and stakeholders in the UK and in other countries to identify viable options for progression. If at this stage, we discover an existing solution, we assess its readiness for direct adoption in line with the six essential elements above.

The Project Creation phase provides another opportunity to monitor the output of innovation trials, including those of other DNOs, as we seek to avoid duplication with our proposed innovation projects. We draw on information from the industry-wide **Smarter Networks Portal,** liaise with other DNOs and draw on experience from across the wider Iberdrola Group.

For smaller, day-to-day innovations which can nonetheless deliver significant benefits, our Open Innovation process identifies opportunities through our 'Hatch a Challenge' process, then draws on the expertise of a broad community of small-to-medium-enterprise (SME) and individual solvers to create dynamic solutions with strong routes into business as usual.

Deployment of innovative solutions into business as usual

Building on the deployment of enhanced secondary substation monitoring, voltage optimisation and dynamic thermal rating earlier in ED1, we have deployed two innovative technologies into business as usual in scheme year 2017-18 – enhanced transformer ratings at primary substations and installation of a bus section reactor at a key grid supply point. This amounts to the release of 43.48 MVA, and together with annual benefits from the 2016 SPM deployment of smart locks, an estimated gross avoided costs of £6.15m for the year. We have started the process of rolling out the active network management solutions first tested in our industry-leading ARC (Accelerating Renewable Connections) project into two new areas – Dumfries and Galloway and North Wales – in order to accelerate connections and reduce costs, whilst testing the approaches that will be necessary for operating the smart grid of the future. Looking more broadly at ways to support connections, we have tested a new streamlined Statement of Works process which provides increased certainty and control to small generators wishing to connect to the network, whilst also reducing timescales and costs. We are currently working with industry peers to introduce this approach across all networks as business as usual.

Bus section reactor

The deployment of an innovative 33kV Bus Sector Reactor at Giffnock Grid Supply Point (GSP) delivers additional firm capacity to the network by alleviating fault level constraints. This project releases 42.28MVA, opening up opportunities for a greater number of local connections to be made sooner and avoiding estimated gross costs of £5.4m in the year. Prior to being deployed a full assessment of all alternatives solutions was undertaken by SPENs Design Engineers and the impact of the Bus Section Reactor was modelled in detail. The installation of the Bus Section Reactor reduces the flow of fault current from one side of the GSP busbar to the other in the event of a fault. By doing so it reduces the prospective fault current seen by each circuit breaker, bringing the fault current down below their design rating and creating headroom.

Enhanced transformer rating

The deployment of an Enhanced Transformer Rating (ETR) solution at two primary substations delivers additional firm and un-firm capacity to the network and has provided customers with a significantly reduced connection cost when compared to traditional options. These two deployments release 1.2MVA, and avoid £0.75m estimated gross costs. This solution looks to increase the capacity of primary transformers by enabling them to operate at a higher temperature without jeopardising their health. Allowing the transformer to operate at a higher temperature allows it to provide more network load, increasing its firm and un-firm capacity. Prior to being deployed a full condition assessment of the transformers current condition is undertaken, which includes checking for hotspots, ensuring the transformer tails are rated for the additional demand, and oil sample tests. This is then followed by the installation of additional monitoring equipment and the adjustment of the temperature alarm settings of the transformer from 95°c to 115°c.

Active Network Management

With a modest total budget of £8.46m, the ARC (Accelerating Renewable Connections) project has been successful in accelerating network access for 133MW of Distributed Generation capacity across 13 individual projects through deployment of a range of flexible active network management solutions. The project has facilitated around £285m of private capital investment in distributed generation assets and facilitated one of Europe's largest community owned wind farms, profits from which will support the development of affordable homes available to rent over the next 20 years. Further community benefits derived from the project are the connection during 2018 of a new Energy from Waste facility that over the next 20 years will divert around 4.25 million tonnes of waste from landfill and provide an economic boost to the area through the creation of 55 full time jobs.

Key to this success and vital to its business as usual adoption, the ARC project has proven the value and reliability of Active Network Management (ANM) solutions to manage connected Distributed Energy Resources (DER) in real-time within the existing distribution network. This has led to SPEN committing to the roll out of ANM across our wider SPD and SPM networks.

During 2017, SPEN were awarded funding by Ofgem as part of the Innovation Rollout Incentive Mechanism, to deliver an ANM solution that will firstly focus upon the Dumfries and Galloway (D&G) region of the SPD network. The rollout of ANM across D&G is unique in that the system will manage DER connected to the distribution network against known network constraints at a transmission voltage level in real time, and will be deployed in place of the originally planned new network infrastructure that would have been both costly and timely to complete.

In addition to the deployment of ANM across our SPD network, plans are already in place to implement a similar solution across the North Wales area of the SPM network that will facilitate the significant volume of DER seeking to connect to the existing network and which will control power flows across eight Grid Supply Points. Both of these projects will move from initiation into delivery in 2019.

Streamlining Statement of Works

Rising demand for distribution connections – each with their own geographical and technical considerations – can lead to bottlenecks in the connections system. Observing the challenges for these new, small, low carbon electricity generators has driven the need to transform how we help generators.

Throughout 2017 we continued our joint transmission and distribution trial of a revised Statement of Works process to give developers seeking to connect to the distribution network upfront visibility of the potential transmission impact straight away, rather than waiting up to 12 months.

This new process provides increased certainty and control to the connecting party and improves visibility for both the distribution and transmission licence operator. It reduces timescales and costs, removing invoicing issues. Our approach ensures effective queue management and minimises contracted queues being established if projects are not advanced enough. Crucially, it also provides the UK Electricity System Operator better visibility of new generation connecting to the system – which is vital as we transition to the distribution system operation world of the future.

This enhanced information is helping to better plan the distribution network and develop whole system solutions, whilst at the same time providing potential access to DER flexible services for GB system balancing requirements, opening up new markets to smaller players and accelerating the low carbon transition.

Implemented at four diverse Grid Supply Points (GSP), each exhibiting different challenges, the trial has enabled 25 connections offers to be made up to 12 months sooner in this reporting year, in addition to the 20 reported previously. Based on the success of this initiative, SPD and SPT are now working with industry peers to enshrine this new approach in UK-wide connections processes through the Energy Networks Association Open Networks project.

Throughout 2017 we continued our joint transmission and distribution trial of a revised Statement of Works process.

Roll Out of Smart Meters

As energy suppliers roll out smart meters to homes and businesses across the UK, we continue to refine our strategy and systems for maximising the benefits for consumers. Over and above the estimated 2% energy bill savings that smart meters are expected to deliver, effective use of the data from smart meters has the potential to reduce both the length and number of power cuts and provide other service enhancements, enabling us to:

- accurately determine when a customer has lost supply, potentially before the customer themselves has realised;
- 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;
- identify when an individual customer's power has not been restored allowing us to ensure we act swiftly to rectify outstanding faults; and
- become proactive in identifying and addressing voltage anomalies before they inconvenience customers.

Access to quality smart meter data in sufficient volumes is essential in delivering these service improvements. This is especially the case when viewed against the emerging backdrop of increased overall reliance on electricity (for transport and heat) and more dynamic use of networks as the prosumer revolution intensifies.

The original SMETS1 specification smart meters do not currently have the ability to send network operators this vital data, though it is expected that these meters will be upgraded in coming years, with the first meters due for enrolment by the end of 2018. In total across SPM and SPD 972,129 SMETS1 and 16 (sixteen) SMETS2 devises have been installed. The SMETS2 installations represent virtually 0% of our customer base. As only SMETS2 meters are currently able to provide data to DNOs, the lack of data means that we are unable to realise direct benefit to customers in the reporting year. Lack of certainty on the speed of the SMETS2 rollout also makes it impossible to accurately forecast expected benefits for the coming year.

During 2017/18 we continued with the testing and implementation of our smart metering management application – Energy IP. This system connects with the Data Communications Company (DCC Gateway), the central company set up to process the data from smart meters, and alow us to:

- Receive notification of a new smart meter
- Send initial messages at the time of (or shortly after) installation to request information
- Receive response messages providing information shortly after installation
- Send updates to the smart meter with specific DNO details/settings
- Send periodic messages to request data
- Receive response messages containing data
- Receive notifications issued by the smart meter (such as outage notifications)

Our approach to maximising these potential benefits therefore involves the further development of our smart meter data management systems to be ready for the time when stable data at volume becomes available. In addition to the continued development of our systems and data modelling, we are refining our business processes with key stakeholders and making the appropriate changes to ensure we are ready for the time when SMETS2 meter installation gathers pace.

We continue to refine our strategy and systems for maximising the benefits for consumers.

References

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SP Energy Networks Distribution Innovation Strategy:
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List of Abbreviations

AC	Alternating Current
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
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
ED1	Electricity Distribution Period 1
EHV	Extra-High Voltage (33kV)
FITS	Feed in Tariff
G83	Domestic LCT's
GB	Great Britain
GWh	Gigawatt Hours
HV	High Voltage (11kV)
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
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
NSA	National Scenic Area
OHL	Overhead Line(s)
PV	Photovoltaic
RIIO-ED1	Revenue = Incentives + Innovation + Outputs Electricity Distribution Period 1
RSPB	Royal Society for the Protection of Birds
USEF	Universal Smart Energy Framework
SEPA	Scottish Environment Protection Agency
SF6	Sulphur Hexafluoride
SMETS	Smart Meter Equipment Technical Specification
SPD	SP Distribution Licence Area
SPEN	SP Energy Networks
SPM	SP Manweb Licence Area
SSSI	Site of Special Scientific Interest
tCO_2e	Tonnes of Carbon Dioxide Equivalent
UK	United Kingdom

List of Figures, Tables and Graphs

Environment

We have a key role in enabling greater adoption of low carbon technologies (LCTs), such as Electric Vehicles and micro-generation. We also have an important role in managing down the environmental impacts of our own operations.

In this 2017/18 distribution report we provide an overview of our environmental performance against our ED1 Commitments and give examples of the specific initiatives driving progress as part of our longer term strategic plan.

By 2015 we had reached our 2023 target of a 15% reduction in emissions. Since our 2013/14 baseline year we have achieved a 29% overall reduction in our business carbon footprint excluding losses. This year we have seen a further reduction in Buildings Energy use, operational vehicle use and business travel. We continue to target the number of our contractors providing emissions data. This focus has lead to an increase in contractor emissions recorded.

Progression towards our target to remove 85km of overhead line in AONB continues. Since the start of ED1 we have removed a total of 12.05km of overhead lines with 8.5km removed in the 2017/18 reporting year. The pictures show before and after photographs from work carried out at the village of Rhyd Ddu in the heart of Snowdonia, a location where many walkers start their journey up Mount Snowdon. The OH line ran in parallel with the route of the Welsh Highland Railway, just as the first views of Snowdon come into view.

In December 2017 we launched a 6 month trial of 5 electric fleet vehicles, initial feedback has been extremely positive, and we eagerly await full results of the trial.

We have enabled Electric Vehicle projects with 8 council partners, including enabling rural EV for fuel poverty reduction and enabling electric bin lorries.

In addition to this, Electric Vehicle charging points were installed at a further 3 of our depots in 2017/18 reporting year with plans in place to install at a further 5 sites in the coming year.

We are facilitating new carbon technologies – This includes the facilitation of Heat Pumps, PV and Electric vehicles. 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) continues to increase, year on year. In 2017/18 we installed a total of 2,717 of Low Carbon Technologies (equivalent to 151MW).

Energy consumed within our depots and substations is our second biggest emissions contributor. To reduce energy consumed we continue with our programme to upgrade existing depots and rationalise our site portfolio. In 2017/18 we commissioned a new depot office at Middlewich. The new site benefits from thermal insulation, heat pumps, LED motion censored lights and has been given a EPC rating of B.

In summer 2017 our new Headquarters were opened in Glasgow. The new building has a BREEAM Excellent rating and benefits from high performance wall insulation, air source heat pumps and low energy lighting with automatic daylight and presence detection.

Further background

- Environmental Report
- Losses Strategy – Reducing network energy losses & greenhouse gas emissions

Key

Substantially below 2017/18 target | Partially or marginally below 2017/18 target | On 2017/18 target | Substantially ahead of 2017/18 target

Our Business Plan Commitments

We recognise the significance of our impact on the environment, both as a direct result of our operations and, indirectly, by helping stakeholders achieve their own environmental goals.

Commitment	Jointly across SPD and SPM this year
Utilise Smart Meter technology to ensure all generation sources are supported quickly.	SPEN has implemented an IT solution which allows us to connect to the Data Communications Company (Smart DCC). Only a few "pilot" SMETS2 installations were completed during 2017/18, but we expect this to accelerate in 2018/19, at which point we will have more opportunity to access Smart meter data.
Carry out "Smart" asset replacement – using future proofed assets where justified.	We have redeveloped our Innovation Strategy, reinforcing our aims of delivering faster, easier connection; preparing the network for low carbon technologies; and providing network flexibility and communications. These aims are directly reflected in a portfolio of 20 projects ongoing or completed in 2017-18.
Identify Low Carbon Technology hotspots using network monitoring, data from Smart Meters and stakeholder engagement.	We are developing the next generation of heat maps to address the uptake of Low Carbon Technologies (e.g. Heatpumps and Electric Vehicles) and will engage with our stakeholders to understand exactly what their future requirements are. This engagement will help us identify the enhanced functionality required and allow us to implement the changes efficiently and in a timely manner.
Connect 4.5GW of Distributed Generation by 2018, with up to 5.5GW of generation connected to our network by 2023.	Across both licences to date we have connected 3.85GW of generation to the exiting network across a variety of sources.
Underground 85km of overhead lines in Areas of Outstanding Natural Beauty.	We continue to target measures to reduce the visual impact of our network by 2023. This year we removed a further 8.5km of overhead line and installed 5.46km of underground cable.
Install lower loss transformers to reduce losses by 50% at more than 1,300 of our secondary substations.	Our programme to install lower loss transformers continued through 2017/18 when we replaced 60 of our higher loss transformers. Activity in this area will increase as we go through the ED1 period.
Reduce our carbon footprint (excluding network losses) by 15% by 2023.	By 2015/16 we had reached our 2023 target of a 15% reduction in emissions. Since our 2013/14 baseline year SPD and SPM have achieved a 29% reduction in business carbon footprint excluding losses.
Use electronic vehicle management system to optimise our vehicle utilisation keeping vehicle numbers, broadly similar in ED1.	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 with the purchasing of new fleet vehicles.
Monitor and reduce the energy used within our substations, invest in lower carbon buildings and reduce energy use in existing buildings.	We installed LED and motion censored lights at our sites, commissioned the building of new energy efficient depot office at Middlewich and opened our new Head Quarters with high Sustainability performance.
Reduce costs to customers by developing modern "Smart Grid" network solutions.	We are carrying out a wide range of projects utilising Smart Grid network solutions to reduce customer costs and encourage greater market flexibility. These include Dumfries & Galloway Integrated Network Management, Project Fusion, North Wales Active Network Management Zone and a range of network demonstration and community energy partnerships.
Increase the use of electric vehicles and charging points.	Charging points were installed at 3 of our depots with a further 5 planned for next year. SPEN launched a 6 month trial of 5 electric fleet vehicles, initial feedback has been positive, and we hope the trial will pave the way for the introduction of a range of electric powered vehicles within the fleet.
Install oil containment around all new and high risk plant containing high volumes of oil.	In 2017/18 we carried out oil mitigation schemes in 23 of our sites.
Exceed IEC international standards for SF6 switchgear by specifying a maximum leakage rate five times more stringent for 33kV and below and twice as stringent for higher voltages.	We have embedded this in our processes and systems for procuring and specifying equipment.
Reduce oil leaks by 50% through the replacement of poorly performing 132kV cable in SPM.	The amount of fluid leaked from our fluid filled cables has reduced by 52% in 2017/18 in comparison to 2016/17 figures. This is a direct result of our ongoing policy of strategic leak repair management and targeted asset replacement of oil-filled cables.
Engage on the environmental impacts of our developments from a very early stage.	We have a dedicated Environmental planning team who engage with our engineers and legal teams in our developments early stages as a standard business process.
Utilise low carbon alternatives to travel, through the use of technology and smarter ways of working.	In 2017/18 our domestic air travel has reduced by 26% and staff business miles claims have reduced by 10%. The change is a combined result of travelling less, competitive rail pricing and increased staff awareness of carbon emissions from travel.

Regulatory Reporting Tables Environmental & Innovation

E1 – Visual Amenity SPD 2018										
			2011	2012	2013	2014	2015	2016	2017	2018
Volume – Visual Amenity Inside Designated Areas			427.47	427.47	426.67	433.28	436.17	407.00	404.20	403.14
Total OHL Inside Designated Areas at End of Reporting Year (km)	LV	km	-	-	-	-	-	-	-	-
Total OHL (km) Removed During Year		km	-	-	-	-	-	-	-	-
Total UG Cables Installed During Year (km)		km	-	-	-	-	-	-	-	-
Total Visual Amenity Expenditure		£							0.14	

OHL Inside Designated Areas at End of Reporting Year (km)					
	LV	HV	33kV & 66kV	132kV	**Total**
Loch Lomond & Trossachs	0.30	0.80	-	-	**1.09**
Nith Estuary	25.00	85.30	-	-	**110.32**
Eildon & Leaderfoot	8.80	45.30	-	-	**54.03**
Upper Tweedale	18.28	69.39	1.02	-	**88.69**
Fleet Valley	11.30	39.50	5.80	-	**56.61**
East Stewartry Coast	28.80	52.50	-	-	**81.34**
Northumberland Coast	2.10	8.90	-	-	**11.06**
Visual Amenity Inside Designated Areas:					
	LV	HV	33kV & 66kV	132kV	**Total**
Loch Lomond & Trossachs	-	-	-	-	**-**
Nith Estuary	-	-	-	-	**-**
Eildon & Leaderfoot	-	-	-	-	**-**
Upper Tweedale	-	1.06	-	-	**1.06**
Fleet Valley	-	-	-	-	**-**
East Stewartry Coast	-	-	-	-	**-**
Northumberland Coast	-	-	-	-	**-**
Visual Amenity Inside Designated Areas:					
	LV	HV	33kV & 66kV	132kV	**Total**
Loch Lomond & Trossachs	-	-	-	-	**-**
Nith Estuary	-	-	-	-	**-**
Eildon & Leaderfoot	-	-	-	-	**-**
Upper Tweedale	-	0.00	-	-	**0.00**
Fleet Valley	-	-	-	-	**-**
East Stewartry Coast	-	-	-	-	**-**
Northumberland Coast	-	-	-	-	**-**
Visual Amenity Inside Designated Areas:					
	LV	HV	33kV & 66kV	132kV	**Total**
Loch Lomond & Trossachs	-	-	-	-	**-**
Nith Estuary	-	-	-	-	**-**
Eildon & Leaderfoot	-	-	-	-	**-**
Upper Tweedale	-	-	-	-	**-**
Fleet Valley	-	-	-	-	**-**
East Stewartry Coast	-	-	-	-	**-**
Northumberland Coast	-	-	-	-	**-**

E1 – Visual Amenity SPM 2018									
		2011	2012	2013	2014	2015	2016	2017	2018
Volume – Visual Amenity Inside Designated Areas									
Total OHL Inside Designated Areas (km)	km	3,455.80	3,449.30	3,438.41	3,236.72	3,267.43	3,170.06	3,167.54	3,160.23
Total OHL (km) Removed During Year	km	11.30	6.50	4.30	-	3.91	1.60	1.97	7.44
Total UG Cables Installed During Year (km)	km	11.30	6.50	4.30	-	3.85	-	1.62	5.46
Total Visual Amenity Expenditure	£	0.60	0.62	0.64	0.26	0.34	0.09	0.21	0.49

OHL Inside Designated Areas at End of Reporting Year (km)					
	LV	HV	33kV & 66kV	132kV	**Total**
Snowdonia National Park	427.98	1,153.52	210.33	51.35	**1,843.17**
Shropshire Hills	0.01	-	-	-	**0.01**
Bryniau Clwyd A Dyffryn Dyfrdw	204.51	378.03	28.81	2.08	**613.43**
Llŷn Peninsular	115.04	178.17	6.40	-	**299.61**
Ynys Mon/Anglesey	162.22	235.05	6.33	1.17	**404.76**
Visual Amenity Inside Designated Areas: OHL (km) Removed During Year					
	LV	HV	33kV & 66kV	132kV	**Total**
Snowdonia National Park	0.04	2.07	-	-	**2.11**
Shropshire Hills	-	-	-	-	**-**
Bryniau Clwyd A Dyffryn Dyfrdw	-	1.36	-	-	**1.36**
Llŷn Peninsular	1.27	2.68	-	-	**3.95**
Ynys Mon/Anglesey	0.02	-	-	-	**0.02**
Visual Amenity Inside Designated Areas: UG Cables Installed During Year (km)					
	LV	HV	33kV & 66kV	132kV	**Total**
Snowdonia National Park	0.21	2.60	-	-	**2.81**
Shropshire Hills	-	-	-	-	**-**
Bryniau Clwyd A Dyffryn Dyfrdw	0.04	1.79	-	-	**1.83**
Llŷn Peninsular	-	0.82	-	-	**0.82**
Ynys Mon/Anglesey	-	-	-	-	**-**
Visual Amenity Inside Designated Areas: Visual Amenity Expenditure (£m) on Visual Amenity					
	LV	HV	33kV & 66kV	132kV	**Total**
Snowdonia National Park	0.00	0.00	-	-	**0.35**
Shropshire Hills	-	-	-	-	**-**
Bryniau Clwyd A Dyffryn Dyfrdw	0.00	0.00	-	-	**0.02**
Llŷn Peninsular	0.00	0.00	-	-	**0.08**
Ynys Mon/Anglesey	0.00	0.00	-	-	**0.05**
Visual Amenity Outside Designated Areas: OHL (km) Removed During Year					
	LV	HV	33kV & 66kV	132kV	**Total**
Snowdonia National Park	0.01	0.06	-	-	**0.06**
Shropshire Hills	-	-	-	-	**-**
Bryniau Clwyd A Dyffryn Dyfrdw	0.00	0.00	-	-	**0.00**
Llŷn Peninsular	0.00	0.01	-	-	**0.01**
Ynys Mon/Anglesey	0.00	0.01	-	-	**0.01**

E2 – Environmental Reporting SPD 2018									
	Unit	2011	2012	2013	2014	2015	2016	2017	2018
Environmental costs									
Oil Pollution Mitigation Scheme – Cables	£m	-	-	-	-	-	-	-	-
Oil Pollution Mitigation Scheme – Operational	£m	0.11	-	1.14	0.03	0.03	0.45	0.32	0.12
Oil Pollution Mitigation Scheme – Non Operational	£m	-	-	-	-	-	-	-	0.05
SF6 Emitted Mitigation Schemes	£m	-	-	-	-	-	-	-	-
Noise Pollution	£m Interventions	0.11	0.45	-	-	0.01	-	-	0.03
Contaminated Land Clean Up	£m	-	-	-	-	-	-	-	0.0898
Environmental Civil Sanction	£m	-	-	-	-	-	-	-	-
Total		**0.2**	**0.5**	**1.1**	**0.0**	**0.0**	**0.4**	**0.3**	**0.3**
Environmental volumes									
Oil Pollution Mitigation Scheme – Cables	Volume	-	-	-	-	-	-	-	-
Oil Pollution Mitigation Scheme – Operational	Volume	1.0	-	16.0	1.0	1.0	16.0	15.0	15.0
Oil Pollution Mitigation Scheme – Non Operational	Volume	-	-	-	-	-	-	-	1.0
SF6 Emitted Mitigation Schemes	Volume	11.0	10.0	10.0	14.0	39.0	-	-	3.0
Noise Pollution	Volume	8.0	10.0	-	-	-	-	-	-
Contaminated Land Clean Up	Volume	1.0	1.0	1.0	-	1.0	-	-	-
Environmental Civil Sanction	Volume	-	-	-	-	-	-	-	-
Fluid-Filled Cables									
Fluid-Filled Cables in service	Circuit km	30	30	29	29	29	29	29	29
Oil in Service in Cables	Fluid ltrs	-	-	-	-	-	86,700	86,700	86,700
Fluid Used to Top Up Cables	Fluid ltrs	190	-	500	46	37	-	-	20
Fluid Used to Top Up Cables % of volume in service	%	-	-	-	-	-	0%	0%	0.02%
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs	-	-	-	-	-	-	-	-
SF6									
SF6 Bank	kg	11,017	11,397	11,856	12,564	13,259	12,710	25,115	15,182
SF6 Emitted	kg	55	69	61	62	61	1	1	37
SF6 Emitted as a percentage of SF6 Bank	%	1%	1%	1%	0%	0%	0%	0%	0.2%
Noise Pollution									
Total complaints received	Volume	-	-	-	-	-	-	-	4

E2 – Environmental Reporting SPM 2018									
	Unit	2011	2012	2013	2014	2015	2016	2017	2018
Environmental costs									
Oil Pollution Mitigation Scheme – Cables	£m	-	-	-	-	0.02	-	-	-
Oil Pollution Mitigation Scheme – Operational Sites	£m	-	-	0.18	0.27	0.12	0.37	0.42	0.69
Oil Pollution Mitigation Scheme – Non Operational Sites	£m	-	-	-	-	-	-	-	-
SF6 Emitted Mitigation Schemes	£m	-	-	-	-	-	-	-	-
Noise Pollution	£m Interventions	-	-	-	0.06	0.22	-	0.23	0.15
Contaminated Land Clean Up	£m	-	0.21	-	0.10	-	-	-	0.0083
Environmental Civil Sanction	£m	-	-	-	-	-	-	-	-
Total		**-**	**0.2**	**0.2**	**0.4**	**0.4**	**0.4**	**0.6**	**0.8**
Environmental volumes									
Oil Pollution Mitigation Scheme – Cables	Volume	-	-	-	-	1	-	-	-
Oil Pollution Mitigation Scheme – Operational Sites	Volume	-	-	9	-	2	8	12	8
Oil Pollution Mitigation Scheme – Non Operational Sites	Volume	-	-	-	-	-	-	-	-
SF6 Emitted Mitigation Schemes	Volume	-	-	-	-	-	-	-	-
Noise Pollution	Interventions	8	7	10	11	33	-	7	2
Contaminated Land Clean Up	Volume	29	22	-	-	-	-	-	-
Environmental Civil Sanction	Volume	12	7	7	1	1	-	-	-
Fluid-Filled Cables									
Fluid-Filled Cables in service	Circuit km	-	-	-	-	-	159	159	159
Oil in Service in Cables	Fluid ltrs	-	-	-	-	-	699,600	699,600	699,319
Fluid Used to Top Up Cables	Fluid ltrs	4,722	10,443	4,326	5,535	3,555	13,600	9,315	4,420
Fluid Used to Top Up Cables percentage of volume in service	%	-	-	-	-	-	2%	1.3%	0.6%
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs	-	-	-	-	-	-	-	-
SF6									
SF6 Bank	kg	21,691	21,949	21,691	22,193	23,117	16,893	16,922	17,833
SF6 Emitted	kg	108	119	121	122	124	30	47	67.5
SF6 Emitted as a percentage of SF6 Bank	%	1%	1%	1%	1%	1%	0%	0.3%	0.4%
Noise Pollution									
Total complaints received	Volume	-	-	-	-	-	8	2	5

E3 – BCF SPD 2018									
	Unit	2011	2012	2013	2014	2015	2016	2017	2018
Total BCF (excl. losses)	tCO_2e	**34,235.07**	**35,595.94**	**35,029.61**	**30,279.88**	**20,729.36**	**16,063.18**	**13,841.78**	**12,501**
TOTAL BCF (incl. losses)	tCO_2e	**91,847.57**	**96,891.56**	**88,529.61**	**77,892.38**	**74,754.36**	**62,694.70**	**515,306.63**	**453,510**
DNO Emissions: Buildings Energy Usage									
Buildings – Electricity	tCO_2e	4,388.47	2,940.76	3,411.40	2,459.93	3,377.00	2,270.62	2,161.66	1,554
Buildings – Other Fuels	tCO_2e	132.82	57.17	104.20	17.00	28.00	25.21	46.89	21
Substation Electricity	tCO_2e	25,508.00	25,450.74	24,390.00	20,878.08	10,072.00	8,227.59	7,305.10	6,245
Radio Base Stations	tCO_2e	21.95	82.54	56.50	69.54	190.00	21.99	17.83	33
Contractors	tCO_2e	-	-	-	-	187.00	-	-	-
Total	tCO_2e	**30,051.24**	**28,531.21**	**27,962.10**	**23,424.55**	**13,854.00**	**10,545.41**	**9,531.48**	**7,853**
Operational Transport									
Road (Diesel)	tCO_2e	968.01	3,476.51	3,948.30	3,825.04	3,599.00	3,770.14	2,944.24	2,677
Road (Petrol)	tCO_2e	-	-	-	-	-	14.69	30.68	34
Total	tCO_2e	**968.01**	**3,476.51**	**3,948.30**	**3,825.04**	**3,599.00**	**3,784.92**	**2,974.93**	**2,711**
Business Transport									
Road	tCO_2e	1,818.19	1,562.39	1,397.10	1,423.72	1,456.00	674.13	464.31	365
Rail	tCO_2e	-	6.33	7.90	7.46	11.00	12.78	5.00	12
Sea	tCO_2e	-	-	-	-	-	-	-	-
Air	tCO_2e	43.17	187.32	98.90	68.25	220.00	91.54	66.76	45
Contractors	tCO_2e	-	-	-	-	53.00	-	-	-
Air Miles European	tCO_2e	-	-	-	-	-	28.94	40.77	38
Air Miles International	tCO_2e	-	-	-	-	-	5.79	8.04	8
Hire Car Diesel	tCO_2e	-	-	-	-	-	-	2.92	2
Hire Car Petrol	tCO_2e	-	-	-	-	-	-	1.66	4
Road (Petrol)	tCO_2e	-	-	-	-	-	100.65	85.22	50
Road (Unknown)	tCO_2e	-	-	-	-	-	575.33	444.53	367
Total	tCO_2e	**1,861.36**	**1,756.04**	**1,503.90**	**1,499.42**	**1,740.00**	**1,489.16**	**1,119.21**	**892**
Fugitive Emissions									
SF6	tCO_2e	1,316.53	1,638.82	1,457.91	1,474.63	1,491.36	18.24	23.71	832
Total	tCO_2e	**1,316.53**	**1,638.82**	**1,457.91**	**1,474.63**	**1,491.36**	**18.24**	**23.71**	**832**
Fuel Combustion									
Diesel	tCO_2e	32.54	-	157.40	56.24	45.00	225.45	192.46	212
Fuels Other	tCO_2e	5.39	193.36	-	-	-	-	-	-
Total	tCO_2e	**37.93**	**193.36**	**157.40**	**56.24**	**45.00**	**225.45**	**192.46**	**212**
Losses									
Losses	tCO_2e	57,612.50	61,295.62	53,500.00	47,612.50	54,025.00	46,631.52	501,464.85	438,747
Contractor emissions: Buildings energy usage									
Buildings – Electricity	tCO_2e						18.63	88.43	88
Buildings – Other fuels	tCO_2e						4.71	1.20	1
Total	tCO_2e						**23.34**	**89.63**	**89**
Operational Transport									
Road Diesel	tCO_2e						65.26	2,134.22	1,552
Road Petrol	tCO_2e						-	223.91	6
Total	tCO_2e						**65.26**	**2,358.13**	**1,558**
Business Transport									
Road Diesel	tCO_2e						293.05	432.19	352
Road Petrol	tCO_2e						-	-	1
Total	tCO_2e						**293.05**	**432.19**	**353**
Fuel Combustion									
Diesel	tCO_2e						275.02	158.69	263
Total	tCO_2e						**275.02**	**158.69**	**263**
Contractor Total	tCO_2e						**656.67**	**3,038.64**	**2,263**

E3 – BCF SPM 2018									
	Unit	2011	2012	2013	2014	2015	2016	2017	2018
Total BCF (excl. losses)	tCO_2e	**15,806.07**	**15,278.15**	**15,485.50**	**15,143.10**	**26,026.38**	**13,114.38**	**16,095.21**	**17,510**
TOTAL BCF (incl. losses)	tCO_2e	**63,739.67**	**63,462.82**	**59,997.50**	**54,756.70**	**80,051.38**	**51,999.42**	**437,622.36**	**375,398**
DNO Emissions: Buildings Energy Usage									
Buildings – Electricity	tCO_2e	4,270.90	3,851.92	3,545.90	3,068.81	3,377.00	2,842.31	2,445.80	2,034
Buildings – Other Fuels	tCO_2e	59.78	4.28	7.10	9.89	28.00	0.50	7.05	7
Substation Electricity	tCO_2e	3,546.60	3,656.27	3,471.00	2,952.98	10,072.00	5,561.38	4,937.75	4,222
Radio Base Stations	tCO_2e	64.88	21.11	18.20	21.53	190.00	1.91	1.71	14
Contractors Other Fuels	tCO_2e	-	-	19.50	2.12	187.00	-	-	-
Total	tCO_2e	**7,942.16**	**7,533.58**	**7,061.70**	**6,055.33**	**13,854.00**	**8,406.11**	**7,392.30**	**6,276**
Operational Transport									
Road	tCO_2e	3,602.16	3,198.98	3,388.70	3,282.94	3,599.00	2,681.16	2,880.24	2,752
Road (Petrol)	tCO_2e	-	-	452.10	1,484.77	3,121.00	10.45	30.02	35
Total	tCO_2e	**3,602.16**	**3,198.98**	**3,840.80**	**4,767.71**	**6,720.00**	**2,691.66**	**2,910.25**	**2,787**
Business Transport									
Road	tCO_2e	1,576.82	1,340.96	1,199.10	951.16	1,456.00	520.18	528.14	476
Rail	tCO_2e	-	5.44	6.80	6.40	11.00	9.09	4.89	13
Air	tCO_2e	37.44	160.77	84.90	58.58	220.00	65.10	65.31	46
Air Miles European	tCO_2e	-	-	-	-	-	20.58	39.89	39
Air Miles International	tCO_2e	-	-	-	-	-	4.12	7.87	8
Car Hire Diesel	tCO_2e	-	-	-	-	-	-	2.85	2
Car Hire Petrol	tCO_2e	-	-	-	-	-	-	1.62	4
Road (Petrol)	tCO_2e	-	-	51.80	110.54	53.00	85.50	62.43	63
Road (Unknown)	tCO_2e	-	-	-	-	-	223.74	268.89	299
Total	tCO_2e	**1,614.26**	**1,507.17**	**1,342.60**	**1,126.67**	**1,740.00**	**928.31**	**981.89**	**950**
Fugitive Emissions									
SF6	tCO_2e	2,592.07	2,845.06	2,891.90	2,911.02	2,968.38	681.04	1,275.89	1,539
Total	tCO_2e	**2,592.07**	**2,845.06**	**2,891.90**	**2,911.02**	**2,968.38**	**681.04**	**1,275.89**	**1,539**
Fuel Combustion									
Diesel	tCO_2e	50.03	-	157.40	56.24	45.00	7.06	15.99	7
Gas Natural	tCO_2e	-	-	-	-	-	-	-	-
Fuels Other	tCO_2e	5.39	193.36	-	-	-			-
Contractors – Diesel & LPG	tCO_2e	-	-	191.10	226.13	699.00	-	-	-
Total	tCO_2e	**55.42**	**193.36**	**348.50**	**282.37**	**744.00**	**7.06**	**15.99**	**7**
Losses									
Losses	tCO_2e	47,933.60	48,184.67	44,512.00	39,613.60	54,025.00	38,885.04	421,527.15	357,888
Contractor Emissions									
Buildings – Electricity	tCO_2e						15.62	22.53	110
Buildings – Other fuels	tCO_2e						0.05	2.10	3
Contractor Energy Use (Oil)	tCO_2e						7.67	-	-
Total	tCO_2e						**23.34**	**24.62**	**113**
Operational Transport									
Road (Diesel)	tCO_2e						0.28	340.97	116
Road (Petrol)	tCO_2e						295.34	2,906.71	4,286
Total	tCO_2e						**295.62**	**3,247.68**	**4,402**
Business Transport									
Road Diesel	tCO_2e						1.58	121.16	338
Road Petrol	tCO_2e						-	-	202
Total	tCO_2e						**1.58**	**121.16**	**540**
Fuel Combustion									
Diesel	tCO_2e						1.57	125.41	896
Fuels Other	tCO_2e						78.09	-	-
Total	tCO_2e						**79.66**	**125.41**	**896**
Contractor Total	tCO_2e						**400.21**	**3,518.88**	**5,951**

E4 – Losses Snapshot SPD 2018			
Programme/project title	2015/16 £m	2016/17 £m	2017/18 £m
Early replacement of Pre-1962 High Loss Transformer	30.0	48.0	35.0
Theft in Conveyance Investigations	1.0	-	1.0
Internal and External Revenue Protection Inspections	14,155.0	18,196.0	16,199.0
	Estimated total costs		
	2015/16 £m	2016/17 £m	2017/18 £m
Early replacement of Pre-1962 High Loss Transformer	0.4	0.3	0.3
Theft in Conveyance Investigations	-	-	-
Internal and External Revenue Protection Inspections	0.6	0.7	0.6
	Estimated Distribution Losses – Justified Costs		
	2015/16 £m	2016/17 £m	2017/18 £m
Early replacement of Pre-1962 High Loss Transformer	0.4	0.3	0.3
Theft in Conveyance Investigations	-	-	-
Internal and External Revenue Protection Inspections	0.6	0.7	0.6

	Estimated Distribution Losses benefits over 'Baseline Scenario'							
	2015/16 MWh	2016/17 MWh	2017/18 MWh	2018/19 MWh	2019/20 MWh	2020/21 MWh	2021/22 MWh	2022/23 MWh
Early replacement of Pre-1962 High Loss Transformer	313.6	793.7	1,143.2	1,143.2	1,143.2	1,143.2	1,143.2	1,143.2
Theft in Conveyance Investigations	0.6	0.6	55.4	55.4	55.4	55.4	55.4	55.4
Internal and External Revenue Protection Inspections	4,365.4	10,116.0	14,260.3	9,894.9	4,144.3	-	-	-

	Estimated unit cost of activity
	£k/unit
Early replacement of Pre-1962 High Loss Transformer	9.20
Theft in Conveyance Investigations	-
Internal and External Revenue Protection Inspections	0.04

E4 – Losses Snapshot SPM 2018			
Programme/project title	2015/16 £m	2016/17 £m	2017/18 £m
Early replacement of Pre-1962 High Loss Transformer	60.0	39.0	25.0
Theft in Conveyance Investigations	-	-	-
Internal and External Revenue Protection Inspections	9,470.0	11,694.0	8,861.0
	Estimated total costs		
	2015/16 £m	2016/17 £m	2017/18 £m
Early replacement of Pre-1962 High Loss Transformer	0.8	0.4	0.3
Theft in Conveyance Investigations	0.0	-	-
Internal and External Revenue Protection Inspections	0.5	0.5	0.5
	Estimated Distribution Losses – Justified Costs		
	2015/16 £m	2016/17 £m	2017/18 £m
Early replacement of Pre-1962 High Loss Transformer	0.8	0.4	0.4
Theft in Conveyance Investigations	-	-	-
Internal and External Revenue Protection Inspections	0.5	0.5	0.5

	Estimated Distribution Losses benefits over 'Baseline Scenario'							
	2015/16 MWh	2016/17 MWh	2017/18 MWh	2018/19 MWh	2019/20 MWh	2020/21 MWh	2021/22 MWh	2022/23 MWh
Early replacement of Pre-1962 High Loss Transformer	596	980	1,226	1,226	1,226	1,226	1,226	1,226
Theft in Conveyance Investigations	1,782	1,782	1,782	1,782	1,782	1,782	1,782	1,782
Internal and External Revenue Protection Inspections	5,022	11,822	18,572	13,550	6,750	-	-	-

	Estimated unit cost of activity
	£k/unit
Early replacement of Pre-1962 High Loss Transformer	12.5
Theft in Conveyance Investigations	-
Internal and External Revenue Protection Inspections	0.06

E5 – Smart Metering SPD 2018			
Costs	2016 £m	2017 £m	2018 £m
Smart Meter Communication Licensee Costs (pass through)	0.6	1.2	1.2
Smart Meter Information Technology Costs (pass through)	0.9	1.3	1.1
Elective Communication Services (outside price control)	-	-	-
Smart Meter Communication Licensee Costs (outside price control)			
Total	**1.5**	**2.5**	**2.3**
Estimated Benefits			
Avoided losses to network operators	-	-	-
Reduction in CML	-	-	-
Reduction in operational costs to fix faults	-	-	-
Reduction in calls to faults and emergencies lines	-	-	-
Better informed investment decisions for electricity network enforcement	-	-	-
Avoided cost of investigation of customer complaints about voltage quality of supply	-	-	-
Network capacity investment savings from electricity demand shift	-	-	-
Total	**-**	**-**	**-**

E5 – Smart Metering SPM 2018			
Costs	2016 £m	2017 £m	2018 £m
Smart Meter Communication Licensee Costs (pass through)	0.4	0.8	0.9
Smart Meter Information Technology Costs (pass through)	0.8	1.1	0.9
Elective Communication Services (outside price control)	-	-	-
Smart Meter Communication Licensee Costs (outside price control)			
Total	**1.2**	**1.9**	**1.7**
Estimated Benefits			
Avoided losses to network operators	-	-	-
Reduction in CML	-	-	-
Reduction in operational costs to fix faults	-	-	-
Reduction in calls to faults and emergencies lines	-	-	-
Better informed investment decisions for electricity network enforcement	-	-	-
Avoided cost of investigation of customer complaints about voltage quality of supply	-	-	-
Network capacity investment savings from electricity demand shift	-	-	-
Total	**-**	**-**	**-**

E6 – Innovative Solutions SPM 2018

	Voltage	Worksheet (costs)	Worksheet (savings)	RIIO-ED1 2016 £m	RIIO-ED1 2017 £m	RIIO-ED1 2018 £m	RIIO-ED1 2016 MVA	RIIO-ED1 2017 MVA	RIIO-ED1 2018 MVA	RIIO-ED1 2016 £m	RIIO-ED1 2017 £m	RIIO-ED1 2018 £m
				Costs			**Additions**			**MVA released**			**Estimated Gross Avoided Costs**		
Increase Network Capacity/ Optimise Utilisation															
Flexible Networks – Enhanced Secondary Substation Monitoring	LV	-0.0615	0.8775	-	-	-	2.93	-	-	0.88	-	-			
Flexible Networks – Dynamic (Enhanced) Thermal Rating of Primary transformers	33kV/ 11kV	-0.215	0.28	-	-	-	2.10	-	-	0.28	-	-			
Bes Section Reactor @ Giffnock GSP	33kV	-2.366	211.4166667	-	-2.37	1.00	-	-	42.28	-	-	5.40			
Improve Asset Life Cycle Management															
NIA NPG 0001 Vonaq Utility Pole Strength Measurement	All	0	0	-	-	-	-	-	-	-	-	-			
Transformer Refurbishment	33kV & 132kV	-0.048	0.232	-0.05	-	-	-	-	-	0.23	-	-			
Improve Safety															
IFI 1007 Outram Fault Level Monitor	All	0	0	-	-	-	-	-	-	-	-	-			
IFI 1414 PD – VMX	11kV	0	0	-	-	-	-	-	-	-	-	-			
Smart Locks	All	0	0	-	-	-	-	-	-	-	-	-			
Improve Environmental Impact															
NIA SPEN 0006 Mini-mole	LV & 11kV	0	0	-	-	-	-	-	-	-	-	-			
NIA SPEN 0011 LV Elbow Joints	LV	0	0	-	-	-	-	-	-	-	-	-			
Improve Connection Performance															
SPT2 004 ARC	Various	CV38	17.96	-	-	-	112.68	-	-	17.96	-	-			

E6 – Innovation SPD 2018

	Voltage	Worksheet (costs)	Worksheet (savings)	RIIO-ED1 2016 £m	RIIO-ED1 2017 £m	RIIO-ED1 2018 £m	RIIO-ED1 2016	RIIO-ED1 2017	RIIO-ED1 2018	RIIO-ED1 2016 MVA	RIIO-ED1 2018 MVA	RIIO-ED1 2016 £m	RIIO-ED1 2017 £m	RIIO-ED1 2018 £m	RIIO-ED1 2017	RIIO-ED1 2018	RIIO-ED1 2017	RIIO-ED1 2018
				Costs			**Additions**			**MVA released**		**Estimated Gross Avoided Costs**			**Estimate avoided fatalities**		**Estimate avoided major injuries**	
Increase Network Capacity/ Optimise Utilisation																		
Flexible Networks – Enhanced Secondary Substation Monitoring	LV	-0.0615	0.8775	-	-	-	-	-	-	2.93	-	0.88	-	-	-	-	-	-
Flexible Networks – Dynamic Thermal Rating of Primary transformers	33kV/ 11kV	-0.2155	0.3838	-	-	-	-	-	-	2.00	-	0.38	-	-	-	-	-	-
Flexible Networks – Voltage Optimisation	11kV/ LV	-0.0565	0.0537	-	-	-	-	-	-	0.36	-	0.05	-	-	-	-	-	-
Enhanced Trasformer Rating @Llanidloes Primary Substation	33kV/ 11kV	-0.05	0.45	-	-	-0.05	-	-	2.00	-	0.53	-	-	0.50	-	-	-	-
Enhanced Trasformer Rating @Frodsham Primary Substation	33kV/ 11kV	-0.05	0.2	-	-	-0.05	-	-	1.00	-	0.67	-	-	0.25	-	-	-	-
Total				**-**	**-**	**-0.1**	**-**	**-**	**3.0**	**5.3**	**1.2**	**1.3**	**-**	**0.8**	**-**	**-**	**-**	**-**
Improve Asset Life Cycle Management																		
Transformer Refurbishment	132kV/ 33kV	-0.27237	1.07093	-0.27	-	-	-	-	-	-	-	1.07	-	-	-	-	-	-
Total				**-0.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**
Improve Safety																		
Smart Lock Deployment in Merseyside 2016/17	All	-0.18	0.070477304	-	-0.18	-	-	-	-	-	-	-	0.07	0.07	0.06	0.06	0.28	0.28
Total				**-**	**-0.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.1**	**0.1**	**0.1**	**0.1**	**0.3**	**0.3**

E7 – LCTs SPD 2018					
		RIIO-ED1			
	Units	2016	2017	2018	Total
Estimated volumes of LCTs Installed					
Secondary Network					
Heat Pumps	Number	20.0	45.0	132.0	**197.0**
EV slow charge	Number	405.0	226.0	73.0	**704.0**
EV fast charge	Number	-	-	553.0	**553.0**
PVs (G83)	Number	5,497.0	468.0	671.0	**6,636.0**
Other DG (G83)	Number	4.0	-	-	**4.0**
DG (non G83)	Number	-	40.0	176.0	**216.0**
Total		**5,926.0**	**779.0**	**1,605.0**	**8,310.0**
Primary network					
Heat Pumps	Number	-	-	-	**-**
EV slow charge	Number	-	-	-	**-**
EV fast charge	Number	-	-	-	**-**
PVs (G83)	Number	-	-	-	**-**
Other DG (G83)	Number	-	-	-	**-**
DG (non G83)	Number	145.0	99.0	2.0	**246.0**
Total		**145.0**	**99.0**	**2.0**	**246.0**
Estimated size of LCTs Installed					
Secondary Network					
Heat Pumps	MW	0.1	0.3	1.0	**1.4**
EV slow charge	MW	2.7	1.4	0.3	**4.4**
EV fast charge	MW	-	-	6.6	**6.6**
PVs (G83)	MW	18.3	1.5	1.8	**21.6**
Other DG (G83)	MW	0.0	-	-	**0.0**
DG (non G83)	MW	-	3.8	26.9	**30.7**
Total		**21.1**	**7.0**	**36.6**	**64.7**
Primary network					
Heat Pumps	MW	-	-	-	**-**
EV slow charge	MW	-	-	-	**-**
EV fast charge	MW	-	-	-	**-**
PVs (G83)	MW	-	-	-	**-**
Other DG (G83)	MW	-	-	-	**-**
DG (non G83)	MW	124.7	431.5	51.2	**607.4**
Total		**124.7**	**431.5**	**51.2**	**607.4**

E7 – LCT's SPM 2018					
		RIIO-ED1			
	Units	2016	2017	2018	Total
Estimated volumes of LCTs Installed					
Secondary Network					
Heat Pumps	Number	42.0	70.0	62.0	**174.0**
EV slow charge	Number	437.0	229.0	85.0	**751.0**
EV fast charge	Number	-	-	413.0	**413.0**
PVs (G83)	Number	7,966.0	579.0	268.0	**8,813.0**
Other DG (G83)	Number	1.0	-	-	**1.0**
DG (non G83)	Number	-	4.0	280.0	**284.0**
Total		**8,446.0**	**882.0**	**1,108.0**	**10,436.0**
Primary network					
Heat Pumps	Number	-	-	-	
EV slow charge	Number	-	-	-	
EV fast charge	Number	-	-	-	
PVs (G83)	Number	-	-	-	
Other DG (G83)	Number	-	-	-	
DG (non G83)	Number	120.0	70.0	2.0	**192.0**
Total		**120.0**	**70.0**	**2.0**	**192.0**
Estimated size of LCTs Installed					
Secondary Network					
Heat Pumps	MW	0.3	0.5	0.4	**1.2**
EV slow charge	MW	2.7	1.5	0.3	**4.5**
EV fast charge	MW	-	-	3.5	**3.5**
PVs (G83)	MW	25.0	1.9	0.8	**27.7**
Other DG (G83)	MW	0.0	-	-	**0.0**
DG (non G83)	MW	-	0.4	32.3	**32.7**
Total		**28.0**	**4.3**	**37.3**	**69.6**
Primary network					
Heat Pumps	MW	-	-	-	
EV slow charge	MW	-	-	-	
EV fast charge	MW	-	-	-	
PVs (G83)	MW	-	-	-	
Other DG (G83)	MW	-	-	-	
DG (non G83)	MW	70.4	145.6	26.5	**242.5**
Total		**70.4**	**145.6**	**26.5**	**242.5**

E4 – Losses Snapshot – Cost Benefit Analysis (CBA)

Allocation and estimation methodologies.

Activity 1 – Undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)

The following assumptions are made in the RIIO-ED1 CBA Tool:

- We have estimated transformers are replaced 16 years earlier than normal, therefore, losses benefit is modelled for 16 years only
- CBA does not currently account for variable losses as they have not been modelled.
- Consequential reduction of losses on the higher voltage distribution and transmission network due to the reduction in perceived load on the HV network is not modelled.
- The CBA Unit Cost values are the resultant of the actual expenditure divided by volume of units replaced in both SPM and SPD.

Table of values used in the RIIO-ED1 CBA Tool

Figures for 2017/18 RRP Year							
Licence	Unit Cost 2012/13 (ED1 CBA)	Unit Cost 2017/18 (Revised Nominal)	Number of years replaced early	Annual No Load Losses New Transformer	Annual No Load Losses Post 1961	Annual No Load Losses 1956-1961	Annual No Load Losses Pre 1955
SPD	9.5k	10.39k	16 years	6MWh	9MWh	16MWh	17MWh
SPM	10.6k	12.53k	16 years	6MWh	9MWh	16MWh	17MWh

Activity 2 – Funding of Internal and External Revenue Protection Inspections

The following assumptions are made in the RIIO-ED1 CBA Tool:

- The returns provided within this activity cover inspections of equipment owned by all energy suppliers.
- The volume return is the number of visits over the regulatory year.
- The MWh saved for the 2017/18 RRP is given over a 14 month period; the maximum period costs can be recovered, this has been rationalised to a 12 month period.
- It is assumed that the MWh Losses would have gone undetected for 3 years. The losses benefits are modelled accordingly. (Sensitivities modelled 1, 3, 16, 32, 45 years).
- 3 years is chosen as it represents a realistic period that theft would have gone undetected, taking account of meter reading frequency and the roll out of smart meters.
- The baseline is "Do Nothing".

Table of values used in the RIIO-ED1 CBA Tool

Figures for 2017/18 RRP Year							
Licence	Number of Visits (Internal & External)	Number of Interference/ Irregularity Cases where there was an ability to Assess Units	Associated Assessed Units (14 months) MWh	Associated Assessed Units (12 months) MWh	Assumed Action Lifetime for CBA (Years)	Revenue Protection Inspection Costs (Internal & External) £m	Revenue (Income) £m
SPD	16,199	1,292	4,835	4,144	3	0.637	0.67
SPM	8,861	1,023	7,875	6,750	3	0.510	0.49

Activity 3 – Theft in Conveyance Investigations

The following assumptions are made in the RIIO-ED1 CBA Tool:

- The Volume return is the "Number of Interferences Detected", this is not only where an investigation has been conducted but where an issue has been actively uncovered.
- The MWh provided for the 2017/18 RY is the recovered total for the period the interference can be positively confirmed.
- It is assumed that the MWh losses would have gone undetected for 16 years in total and the benefits are modelled accordingly. (Sensitivities modelled 1, 16, 24, 32, 45 years).
- 16 years was chosen as a realistic value the issue would have gone undetected, taking into account that as the supply is not registered it is very unlikely that it would be uncovered by routine inspections, though it may be detected during other activities.
- This data is put into the RIIO-ED1 CBA tool as the accepted option, the baseline is "Do Nothing" which models zero expenditure and zero losses reduced.

Table of values used in the RIIO-ED1 CBA Tool

Figures for 2017/18 RRP Year							
Licence	Number of Cases Investigated	Number of Interference Detected	Associated Estimated Units (MWh)	Action Lifetime	Total assumed savings over action lifetime (MWh)	Costs £m	Income £m
SPD	120	1	54.78	16	876.48	-	0.01
SPM	228	0	-	16	-	-	-

Rationale for Activities

Activity 1 – Undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)

Over the last 60 years, advances in materials science and manufacturing techniques have resulted in the considerable reduction of transformers losses. Fixed losses occur whenever the transformer is energised and is not dependent upon load or other factors.

To reduce system technical losses we have brought forward the replacement of the highest loss transformer units, which were manufactured pre-1962. We estimate the remaining lifespan of these units to be 16 years.

SPD
By continuing our program of early replacement of high loss transformers in 2017/18 we have saved 17,492 MWh of losses and 6,644 tonnes of CO_2 equivalent.

SPM
By continuing our program of early replacement of high loss transformers in 2017/18 we have saved 19,622 MWh of losses and 7,530 tonnes of CO_2 equivalent.

Example: We have undertaken the early replacement of an 11kV secondary transformer due to the losses benefits of replacing this with a transformer of modern design and lower losses, compliant with the EU Ecodesign Directive.

Activity 2 – Funding of Internal and External Revenue Protection Inspections

Funding Revenue Protection activities ensures that non-technical losses associated with interference or irregularities are detected and corrected.

SPD
A total of 16,199 visits were conducted resulting in 1,292 irregularity cases detected, where it was possible to assess units. This resulted in an associated 4,835 MWh recovery over the 14 month recovery period, rationalised to 4,144 MWh over 12 months. Assuming the irregularity or interference would have occurred on average for a further 3 years in total this has reduced non-technical losses by an estimated 12,433 MWh.

SPM
A total of 8,861 visits were conducted resulting in 1,023 irregularity cases detected, where it was possible to assess units. This resulted in an associated 7,875 MWh recovery over the 14 month recovery period, rationalised to 6,750 MWh over 12 months. Assuming the irregularity or interference would have occurred on average for a further 3 years in total this has reduced non-technical losses by 20,250 MWh.

Example: We have funded the visiting and accessing of site to confirm illegal supply alterations and abstraction of electricity, subsequently providing the safe disconnection of the illegal supply.

Activity 3 – Theft in Conveyance Investigations

Over recent years we have investigated and resolved a number of cases of theft in conveyance; this is typically where no registered MPAN can be assigned to a property.

SPD
120 investigations were conducted during 2017/18, with one case of interference identified and successfully pursued. This resulted in 54.78 MWh Losses recovery for the 2017/18 regulatory year, over a 16 year duration this is equivalent to 876.48 MWh.

SPM
228 investigations were conducted, with zero successful cases. Our theft in conveyance activity is ongoing though losses rewards are not guaranteed and can be highly variable.

Example: In this instance energy had been delivered to a property without a registered MPAN.

Baseline Scenario

Activity 1 – Do not undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)

Our baseline for this activity would be to replace Pre-1962 high loss transformers based on condition or failure only.

Activity 2 – Funding of Internal and External Revenue Protection Inspections

Our baseline for this activity would be to not undertake/fund this activity.

Activity 3 – Theft in Conveyance Investigations

Our baseline for this activity would be to not undertake/fund this activity.

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