SP Energy Networks

ED1 Environment & Innovation Report 2016/17

SP ENERGY NETWORKS

Contents

Executive Summary

SP Energy Networks has had an eventful second year of RIIO ED1. Following our business restructure and creation of a Sustainability Team, we have developed a new Sustainable Business Strategy in conjunction with our stakeholders. We are leading the way on the journey to becoming a Distribution System Operator (DSO) and have set the ground work for the re-launch of our Innovation Strategy.

During 2016, following stakeholder consultation, we developed our Sustainable Business Strategy which was agreed by the Executive Team in December 2016. After further engagement we have finalised our Strategy, due to be published at the end of this year with our re-launched Sustainability Drivers and new Icons to facilitate communications. Goals have been set for 2023, 2030 and 2050 and we have identified objectives to reduce our direct and indirect environmental impacts. Over the course of the year we worked to improve the quality and completeness of our data to allow us to track and report our progress towards these Goals. The continuous improvements made to our Environmental Management System (certified to ISO14001) ensure that we have robust processes in place to drive improvement. During 2016/17 we have been preparing the organisation for recertification to ISO14001:2015.

As part of our circuit breaker renewal programme we plan to remove up to 1.5million litres of insulating mineral oil, and anticipate that through the replacement of specific oil filled cables incidents of oil leakage would be cut by up to 50%.

In tackling network losses we have invested in 87 new lower loss transformers, resulting in estimated savings of 13,833MWh equivalent to supplying the annual electricity use of approximately 3,158 homes and saving 5,256 tonnes of carbon dioxide.

In 2016/17 we are planning to re-launch our Innovation Strategy, providing SPEN with further opportunity to streamline our business and take steps to improve environmental and wider sustainability practices in the future.

During 206/17 our innovative project Accelerating Renewable Connections has moved to business as usual with a full policy guide in place and we have fully launched our Que Management system to enable better prioritising of new connections. In addition, we have registered a further 8 projects for the Network Innovation Competition and continue to work on a further 11 previously registered NIC projects.

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 in becoming a Sustainable Networks Business.

Introduction – Who we are

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 licences, 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. A summary of the selected network statistics is shown in Table 1.

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 are certified to ISO 14001 (2004) Standard for our Environmental Management System (EMS). One of our challenges in the coming year will be to prepare the organisation for certification to the new ISO14001:2015 standard.

Figure 1. SP Energy Networks Distribution Licence Areas

SP Distribution
2 million customers

SP Manweb
1.5 million customers

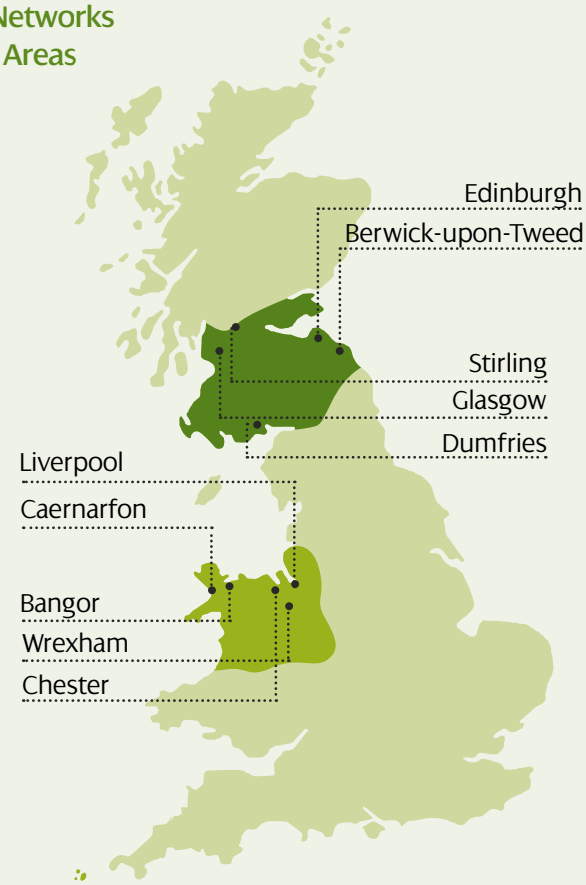


Table 1. Selected SP Energy Networks Statistics

	SPD	SPM
Customer numbers	circa 2 million	circa 1.5 million
Underground Cables	39,628km 15.5km Subsea	26,912km 13.9km Subsea
Overhead Lines	18,659km	20,020km

Introduction
Who we are continued

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 more 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 2 below). SPEN recognises the importance of acting responsibly towards the environment, and strives to maintain our reputation for doing so, and to enhance it wherever we go.

Table 2. 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 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 2013/2014 (carbon footprint excluding losses)

Introduction
Purpose of the Report

Our ED1 Business Plan 2015-2023 set out our goals and targets to reduce the impacts of our network in key areas. We have a critical role in the Low Carbon Transition by providing connections to our network to support our stakeholders as they take action to meet UK and Devolved Government carbon reduction targets. Our overarching aim to be a Sustainable Networks Business will be realised through capital investment and innovation activity to build on our ED1 commitments. This annual report provides additional information on our performance in these areas. In this, the second year of RIIO-ED1, we will use this report to re-state the commitments set in the ED1 Business Plan for the period 2015 – 2023 (see Table 3) and provide a progress update to stakeholders on the progress of achieving them. We also want to take the opportunity to update stakeholders on the development of our Sustainable Business Strategy as well as other progressive changes we are making in pursuit of becoming a Sustainable Networks Business and progressing to meet our Goals and ED1 commitments (please see Appendix 1).

Business Plan Commitments

Managing Our Environmental Impact (please see Section 2)
Underground 85km of Overhead Lines in Areas of Outstanding Natural Beauty
Reduce oil leaks by 50% through replacement of poorly performing 132kV cable in SPM
Install oil containment around all new and high risk plant containing high volumes of oil
Engage on the environmental impacts of our developments from a very early stage

Reducing Carbon Impact and Climate Change and associated environmental improvements (please see Sections 3 & 4)
Reduce our carbon footprint (excluding network losses) by 15% by 2023
Use electronic vehicle management system to optimise our vehicle utilisation keeping vehicle numbers, broadly similar in ED1
Utilise low carbon alternatives to travel, through the use of technology and smarter ways of working
Increase the use of electric vehicles and charging points
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 1300 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

Our role in the Low Carbon Transition (please see Section 5)
Connect 4.5GW of Distributed Generation by 2018 with 5.5GW of generation connected to our network by 2023
Identify Low Carbon Technology hotspots using network monitoring data from Smart Meters and Stakeholder Engagement
Utilise Smart Meter technology to ensure all generation sources are supported quickly
Reduce costs to customers by developing modern "Smart Grid" network solutions

As SPEN own and operate two distribution licences, this Report will publish results data presented separately for each SPEN Distribution licence area; in Scotland (SPD) and in England and Wales (SPM).

Introduction
Stakeholder Engagement

Stakeholder Engagement is critical to the delivery of our planned commitments. SPEN has continued to develop and implement its Stakeholder Engagement Strategy to be consistent with the principles of inclusivity, materiality and responsiveness inherent in the accreditation standard (AA1000) since creation of the Strategy in 2013. This standard is designed to enable organisations to become more accountable, responsible and sustainable. It provides operational guidance on sustainability assurance and stakeholder engagement. During 2016/17 SPEN has invested in a new IT system to manage contacts with stakeholders. The system, called Tractivity, is designed to provide consistent information to staff relating to external contacts, resulting in more aligned engagement across the SPEN business where stakeholders are in contact with multiple business areas and across the transmission and distribution licences. The system also seeks to identify the changes we made in response to stakeholder feedback, resulting in stakeholder engagement that is more effective for both the company and its stakeholders. Our Stakeholder Engagement has been externally verified to AA1000 standard.

In late 2015, SPEN established a new Sustainability Team, responsible for development of the Sustainable Business Strategy for the period to 2030 and beyond. In early 2016, the Sustainability Team developed the Strategy through consultation with external stakeholders. This formed the basis of the principles of the Strategy and these were agreed with the Executive Team in December 2016. In early 2017, further events were held to consult on the changes we made to our Strategy to ensure the document responded to stakeholder comments. This practice of revisiting our Stakeholder consultation is implemented as part of the 'continuous feedback loop', in line with the principles of our Stakeholder Engagement Strategy. During the remainder of 2017, we will be finalising our Sustainable Business Strategy consultation, due to be launched on our external website by the end of the year.

The team also analyse the data that has been collected over many years and track the improvements that result from initiatives to reduce environmental impact and sustainably improve our business practices, some of which are described in this document. We are tracking the initiatives in our business that will contribute to the delivery of our 2023 Goals for Waste, Water and Carbon (please see earlier Table 2).

In future years we plan to report relevant data and trends in upcoming Environmental Reports, where appropriate. This will follow the SPEN approach to engage proactively with stakeholders, to be, clear in our aims and expectations, operate with openness in working with individuals and organisations.

Managing Our Environmental Impact

Managing Our Environmental Impact
Introduction

In 2014 SPEN introduced our Sustainability Drivers. As part of the recent development of our Sustainable Business Strategy and response to stakeholder consultation, we have redefined these Drivers and introduced icons to facilitate their communication in the last year. These Drivers are presented in Figure 2.

The Drivers guide the activities and projects we take forward, enabling slinks to be made in the activities already taking place across our business that contribute to delivery of our Goals. These Drivers also facilitate communication of our activities and successes. Many of our Drivers are connected to reducing our environmental impact and will help us track our progress in future years. The Sustainability Drivers are central to enabling us to do our part in delivering the low carbon energy network required to limit temperature rise to 2°C compared to pre-industrial levels, as agreed at the 2015 United Nations Climate Change Conference. In this first section of the report we will focus on how we manage our environmental Impact through Visual Amenity and Oil Leakage.

Figure 2. Sustainability Drivers

Managing Our Environmental Impact
Visual Amenity

Distribution networks in the UK have been historically constructed using overhead lines and take the most expedient route to 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.

As part of our overall network renewal, SPEN plans to underground up to 85km of overhead lines located in AONBs, National Parks and NSAs during the ED1 period. This plan was developed in conjunction with our stakeholders in the SPM area such as Snowdonia National Park, Anglesey, Ll n Peninsula, and Denbighshire AONBs, and includes NSA designated areas with the SPD licence including The Loch Lomond & The Trossachs National Park, Nith Estuary, Eildon & Leaderfoot, Upper Tweedale, Fleet Valley, and East Stewartry Coast. We are also considering the visual effects of the network we own that is located within the Northumberland Coast AONB.

The process of identifying overhead lines for mitigation through undergrounding is dependent upon maintaining a close working relationship with stakeholders. For high-profile projects SPEN seeks to form a stakeholder partnership group where undergrounding may be required. This draws stakeholders together to determine the best route forward based upon local expertise and knowledge with regard to these important protected landscapes. For regular projects SPEN liaises directly with the officers employed by the relevant Local Planning Authority, proactively meeting every 6 months. SPEN anticipates that the officer is aware of local opinion from interest groups, or would engage with other stakeholders as required to present a common viewpoint, or facilitate SPEN gathering viewpoints if called to do so. The purpose of the one to one meetings with the officer (or officers if more than one administrative boundary is affected by the works) is for SPEN to provide an update on progress of existing work on circuits and to collaboratively look at new areas within AONBs that would benefit from visual mitigation through undergrounding.

The locations proposed by the officers would be assessed by SPEN to determine the constraints to undertaking the suggestions, primarily to ensure the proposal is not detrimental to the operation of our network system including safety and security to customers and other users.

Within our transmission license we have introduced a structure where stakeholders involved in the planning of visual amenity for transmission lines. We plan to build on these existing transmission stakeholders inviting them to sit on the panel for both distribution and transmission proposals.

In this reporting year 2016/17, SPEN completed undergrounding mitigation at three locations in SPM and one location in SPD. Table 4 (below) lists the visual amenity mitigation projects undertaken and their respective locations/designations. Further information can be found in Appendix 2 Visual Amenity.

Table 4. Progress of Visual Amenity Mitigation Projects SPM & SPD in 2016/2017

Location of OHL	Designated site	SPD/SPM	Km of lines removed	Km of lines undergrounded
Netherdale	Upper Tweedale NSA	SPD		1.04km
Yr Ysgwrn – Visitors Centre	Snowdonia National Park	SPM	0.1km	
Cilan Mountain nr Abersoch	Llyn Peninsula AONB	SPM	0.9km	0.8km
Aberfaw	Ynys Mon/Anglesey AONB	SPM	1.0km	0.8km
Total			**2.0km**	**2.64km**

Managing Our Environmental Impact
Visual Amenity continued

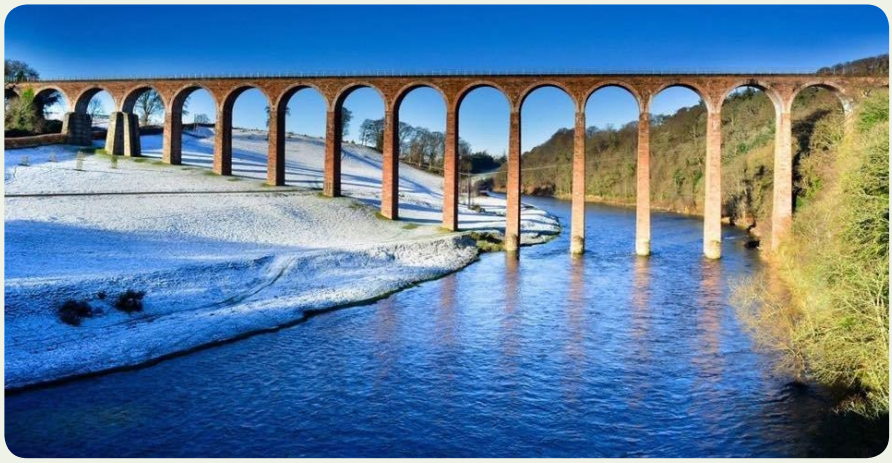
2016/17 saw the restoration of the celebrated poet Hedd Wyn's home at Yrf Yswgwrn along with the construction of a museum, exhibition and visitors centre. SP Manweb removed 0.1km of overhead lines around the house and installed a split Phase transformer providing Yr Ysgwrn with an electricity supply for the first time.

The photograph below (Figure 5) features the area around Newstead Roman Trmontium where 1.7km of Overhead Lines (OH) was recently undergrounded. This area, close to Melrose is not only a National Scenic Area (NSA) and site of specific scientific interest (SSSI) it is considered one of the most important archaeological sites in Scotland. It is surrounded by stunning countryside enjoyed by locals and tourists. SP Distribution completed this works through consultation with Historic Scotland, the Local Authority and Community Council.

Figure 3. Yrf Yswgwrn before removal of line

Figure 4. Yrf Yswgwrn after removal of line

Figure 5. Scots View



Managing Our Environmental Impact
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. In many cases where oil is used on our network, it is contained in aging assets with containment in various states of repair since the initial construction of the site. 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 will be prioritised for replacement or mitigation works.

The modernisation or replacement of our transformers includes aspects of environmental mitigation such as building on a low permeability concrete plinth and constructing reinforced concrete bunds to surround the oil containing equipment. The 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 and will send 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 5. Works are underway for the fifteen SPD sites and at twelve 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 5. Summary of Transformer Replacements and Associated Costs.

Site Name	Network Area	Work Undertaken	Environmental Cost
East Mains	SPD	Transformer Modernisation	£42,239.54
Balmore Village	SPD	Transformer Modernisation	£6,828.71
Barrhead Primary	SPD	Transformer Modernisation	£507.36
Bonnington Road Primary	SPD	Primary Circuit Breakers	£739.68
Barterholm 11KV	SPD	Primary Circuit Breakers	£78,851.98
Carruthers town	SPD	Primary Circuit Breakers	£11,567.62
Dunscore Primary	SPD	Transformer Modernisation	£24,423.71
Fairlie Transformer	SPD	Transformer Modernisation	£209.02
Gorgie T2 Primary	SPD	Transformer Modernisation	£30,620.58
Hunterston	SPD	Transformer Modernisation	£2,803.99
Langside Primary	SPD	Primary Circuit Breakers	£24,505.93
Muirhouse T1	SPD	Transformer Modernisation	£28,383.33
Pentcaitland T1	SPD	Transformer Modernisation	£22,262.18
Pinwherry Primary	SPD	Transformer Modernisation	£48,211.70
Towers Road T2	SPD	Transformer Modernisation	£423.55
Acer Avenue	SPM	Transformer Modernisation	£1,530.88
Allerton Primary	SPM	Transformer Modernisation	£5,200.00
Bersham Colliery	SPM	Transformer Modernisation	£20,577.66
Llanbedrog Primary	SPM	Transformer Modernisation	£56,493.84
St James Primary	SPM	Transformer Modernisation	£55,911.44
Walton Primary	SPM	Transformer Modernisation	£57,366.40
Croxteth Trans	SPM	Transformer Modernisation	£56,126.42
Lugsdale Primary	SPM	Transformer Modernisation	£43,791.38
Mobil Oil Wallasey	SPM	Transformer Modernisation	£52,235.04
Dyserth Rd Bunding	SPM	Transformer Modernisation	£56,264.00
HPO Copperas Hill	SPM	Transformer Modernisation	£4,160.00
MDHB EGERTON	SPM	Transformer Modernisation	£7,586.60
Total			**£739,404.50**

Managing Our Environmental Impact

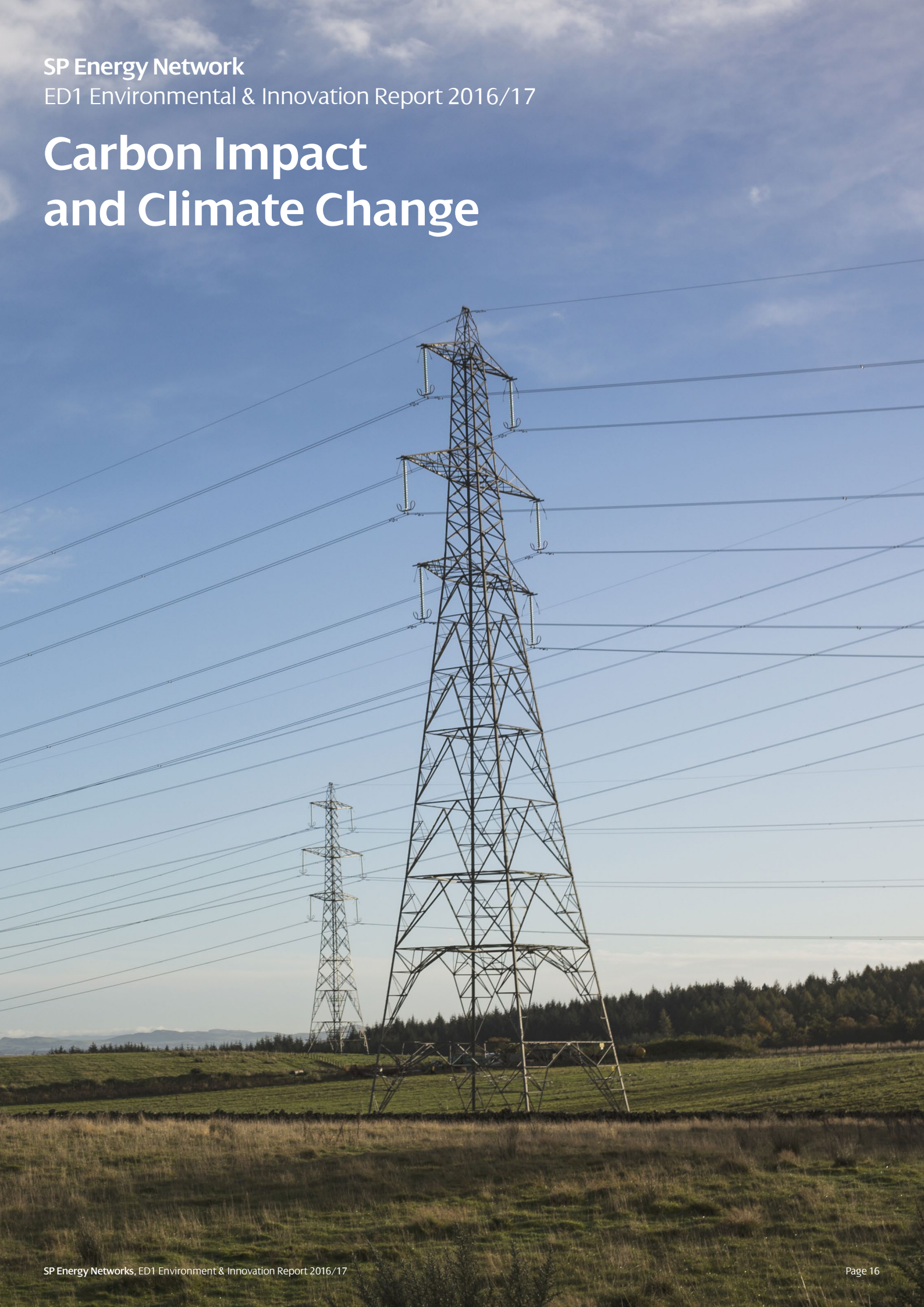
Oil Leakage continued

In addition to carrying out the works detailed above, 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, 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.

An example of our use of Midel transformer oil is at an environmentally sensitive area at the Falls of Clyde reserve. This area is part of the Clyde Valley Woodlands National Nature Reserve and a popular tourist attraction. We recently carried out asset replacement works including installation of bunds and sumps, as well as using Midel transformer oil to further protect the local environment from the risk of the close proximity our assets. Midel is also manufactured to provide a lower carbon footprint solution than traditional mineral oil.

SPEN owns and operates a number of underground oil-filled cables, which were historically installed as an alternative to overhead lines. On an ongoing basis we identify cable leaks, take corrective action to fix and recover leaked oil and leaks. Within the SPD licence there are 28.9km of underground oil filled cables. These cables are spread over nine smaller areas and have not experienced leaks in recent years. Within the SPM licence area there are approximately 159km of underground oil filled cables. In SPM, we have identified leaks, totalling 9,315 litres of which we have managed to contain and recover approximately 4,000 litres. We aim to repair the leaks or replace the oil filled cable as appropriate during 2017/18. SPEN report oil leakage data to Ofgem on an annual basis as part of the E2 – Environmental Reporting and this is attached to this report under Appendix 3 Environmental Reporting.

Carbon Impact and Climate Change



Carbon Impact and Climate Change
Introduction

Our Sustainable Business Strategy takes into account our many ways we can lessen our impact on the Environment, to mitigate against the effects of Climate Change and deliver our improvement targets aimed at curbing global temperature rises to a maximum of 2°C.

This section will report on our Business Carbon Footprint (excluding losses), Sulphur Hexafluoride Emissions and Distribution Losses. These areas of reporting contribute to our Sustainability Driver for Carbon and Energy Reduction (please see earlier Figure 2). We also have a future Business Goal to be Carbon Neutral by 2050. We report our Business Carbon Footprint annually via the Environment and Innovation Reporting Pack, table E3.

Carbon Impact and Climate Change
Business Carbon Footprint

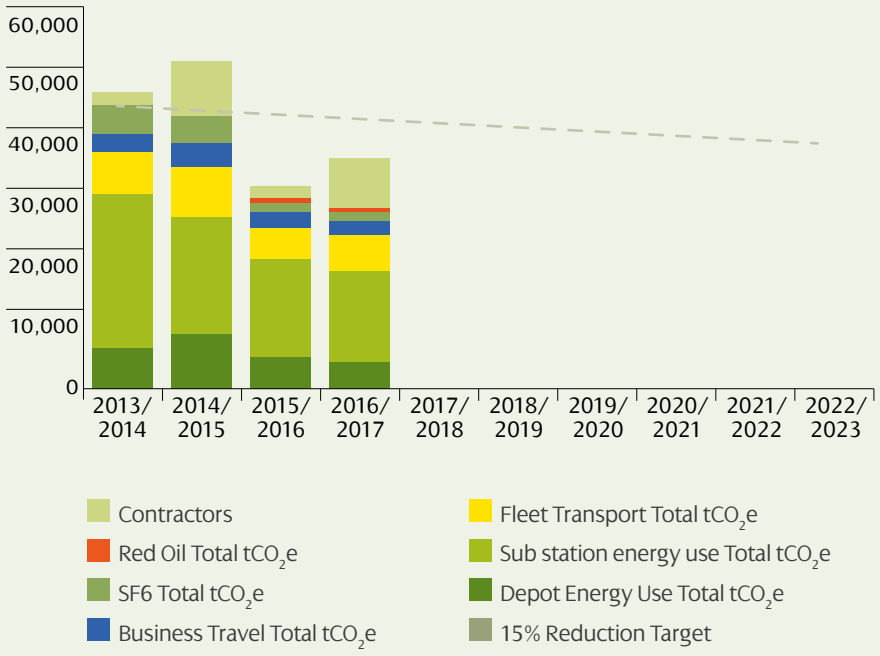
SPEN is committed to reducing our carbon footprint by 15% by 2023 (excluding network losses) from a baseline year of 2013/14. This year we have confirmed our targets for future emissions reductions as detailed in Graph 1 (below). The graph shows our actual BCF tCO_2e since our baseline year and excluding network losses. Although we are seeing a reduction in some areas, some of this is attributed to a change in calculation methodology. Reporting on Scope 3 Contractors is expanded in more detail in preceding figures (below) and network losses reporting is presented in Section 3.3.

The two key reductions relate to Sulphur Hexafluoride (SF6) and substation energy use. The reductions in SF6 emissions are largely due to a move away from estimation based on manufacturers guidelines to recording more accurately the actual SF6 lost in our equipment. The significant decrease in reported substation energy use is down to introducing a more accurate estimation methodology adopted in line with other DNO's.

The BCF reporting considers three overarching sources of data, in line with UK Government GHG reporting requirements.

- **Scope 1 –** Activities owned or controlled by our organisation that release emissions straight into the atmosphere – direct emissions.
- **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.
- **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. For our reporting, we consider these as emissions by contractors.

Graph 1. Business Carbon Footprint from 2013-14 baseline year



Carbon Impact and Climate Change
Business Carbon Footprint continued

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 from 5 to 12 and in future years we will 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 2 (below) shows estimated contractor data in 2013/14 and 2014/15. Following this we moved away from estimated data, detailed in 2015/16 is accurate data as reported by a small number of contractors. Our current year 2016/17, details a greater number of our contractors reporting accurate data which has resulted in an increasing figure.

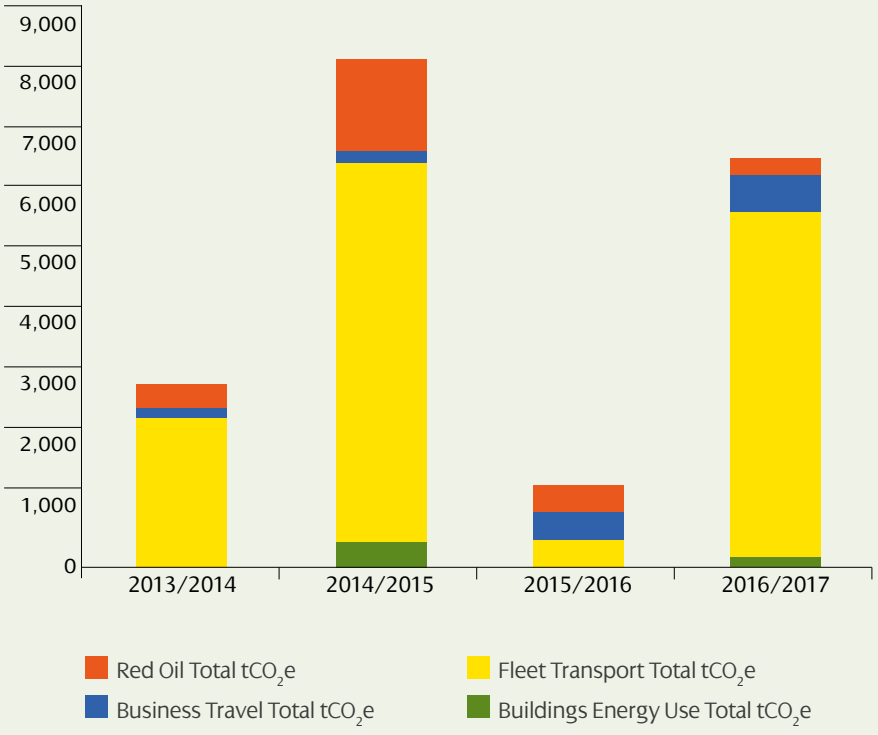
The second key aim following creation of the Sustainability Team in 2015 was to ensure ongoing compliance of ISO 14001. During 2016/17 transitioning to the ISO14001:2015 Standard has commenced. We will report on the progress of achieving recertification in upcoming 2017/18 Environment and Innovation Report.

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 interventions by Scottish Environmental Agency (SEPA) and Environmental Agency (EA) 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.

Table 6. Estimated tCO_2e Emissions for each SPEN Distribution Licence Areas

Activity	SPD (tCO_2e)	SPM (tCO_2e)	SPD and SPM combined (tCO_2e)
Scope 1 Activity	3,974	3,774	7,748
Scope 2 Activity	511,022	430,195	941,215
Scope 3 Activity	3,360	3,545	6,905

Graph 2. Contractor Business Carbon Footprint data



Carbon Impact and Climate Change
Business Carbon Footprint continued

Thirdly, we have identified and liaised with key environmental stakeholders to establish a single point of contact where possible. We have formed the Sustainability Stakeholder Working Group to hold quarterly meetings to discuss our activities to deliver the Sustainable Business Strategy and associated Goals. In the next year we will be discussing with our External Stakeholders the steps necessary to deliver the Strategy and how we can work together on our common Goals. Each of these aspects is designed to drive SPEN towards being a Sustainable Networks Business.

Over this 2016/17 ED1 reporting period, we have progressed in a number of areas relating to our Carbon Impact and our efforts to mitigate against Climate Change. This includes:

- Developing our Sustainable Business Strategy to lead business change and achieve our 2023 15% CO2 reduction target from a baseline year 2013/14.
- Making contact and building relationships with our external and internal stakeholders and collaborating with them in the development of the Sustainable Business Strategy to 2023 and beyond.
- Agreeing a building energy efficiency standard to ensure consistency when constructing new buildings and retrofitting existing buildings to such as our offices, depots and substations.
- Continuing to incorporate energy efficiency measures in our buildings. This year we have undertaken work at nine of our sites with improved insulation for the building envelope and installing energy saving equipment such as LED Lighting, PIR Sensors and energy efficient hand dryers.
- Continuing to review our data and make improvements where required.
- Contracting with a new travel provider and working with them to reduce travel by focussing on an expansion of video and telephone conference facilities, and improving training to support this.
- Continuing to collaborate with suppliers to identify SF6 alternatives and drive lower leakage rates, whilst working to provide robust reporting systems for SPD's SF6 equipment.
- Undertaking planned transformer replacements and installed lower loss transformers.

In the last year, we began implementation of Trackm8 to improve our ability to track the use of our fleet vehicles more effectively and drive towards lowering our carbon emissions. This system has now been fully launched and as a result, our vehicles are now connected with telematics, allowing accurate CO_2 and mileage data. We can measure individual journeys, the emissions generated and in the coming year we will identify areas for improvement.

Carbon Impact and Climate Change
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 plant containing oil.

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 Electrotechnical 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 gasses 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 who are developing other alternatives to SF6.

SPEN also provided training to operational staff on the appropriate processes around SF6 use, including the methods of recording leaks and the refill of equipment to reduce instances of escapes to the environment during planned maintenance.

As we move away from estimating SF6 emissions, it is important to make sure we capture all possible SF6 leakage scenarios. Data for SPM business is recorded by checking the volume of gas required to top up the tank to original capacity. However, in SPD 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 licensed scrap merchant.

Summarised SF6 information is presented in Table 7 (below) and more detailed information is available in Appendix 3, Environmental Reporting.

During this reporting year 2016/17, two pieces of our equipment were found to be leaking at ICI Wade and Sankey Bridges grid. At ICI Wade we have now fixed the leaking piece of equipment and have seen the equipment return to normal function. We switched off our equipment at Sankey Bridges Grid to avoid any further SF6 emissions whilst a repair was arranged. We prioritise leaking equipment for refurbishment or replacement on our network.

Table 7. Summary of SF6 Information

	SF6 Bank	SF6 Emitted	Actual leakage rate
SPD	25,115kg	1.04 kg	0.004%
SPM	16,922kg	46.69kg	0.28%

Carbon Impact and Climate Change
Distribution Losses

Introduction
In September 2015 we published our Losses Strategy which applies over the regulatory period 2015 – 2023. It 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".

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

The initiatives and actions set out in our Losses Strategy and Losses Discretionary Reward application have been developed to improve our understanding and management of network losses, deliver cost effective loss reduction activities that reduce customer energy bills, reduce carbon emissions and help reduce the pace of climate change.

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.

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 they 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 or heat losses rises as the square of the current and therefore if the peak current was 10 times the minimum, that 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.

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.

Carbon Impact and Climate Change
Distribution Losses continued

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 normally been replaced between 2023 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.

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 on how to manage electricity losses and to identify ways of reducing them and reduce costs for customers. The reward mechanism is split into 3 tranches over the ED1 period.

Following the success of our Tranche 1 submission we have been working to progress the initiatives included within our submission. Our initiatives considered both technical and non-technical losses and included, for example, improved modelling of rural networks and stakeholder-focussed initiatives aimed at encouraging end users to modify their electricity use in order to improve network loading. The results to date and next steps will be reported in our Tranche 2 submission, due at the end of February 2018. Tranche 2 is focused on specific outputs and actions to manage losses and shift expectations, and the concurrent improvements in understanding.

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.

To reduce losses we have brought forward the replacement of the 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 87 high loss transformers in 2016/17 that would otherwise have remained in service for an additional 16 years.

Carbon Impact and Climate Change
Distribution Losses continued

The total losses are presented in Table 8, this data relates to total losses including both Technical and Non-technical losses.

Tables 9 and 10 present the summary of losses costs and benefits in each licence, and Tables 11 and 12 present the summary of losses activities also for each licence.

Table 8. Assessment of Losses (Technical and Non-Technical) 2016/17

	SPD	SPM	SPEN Total
Units Entering (GWh	19,178	16,234	**35,412**
Units Exiting (GWh)	17,961	15,211	**33,172**
Losses (GWh)	1,217	1,023	**2,240**
Losses (%)	6.34%	6.30%	**6.32%**

Table 9. 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	£7m	7,680MWh	2,918 tCO_2	12,698MWh
Internal and External Revenue protection inspections	£0.0m	6,709MWh	2,549tCO_2	11,802MWh
Theft in conveyance	£0.0m	0MWh	0tCO_2	0.6MWh
Totals	**£7m**	**14,389MWh**	**5,467 tCO_2**	**24,500MWh**

Table 10. 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	£9.76m	6,153MWh	2,338tCO_2e	15,684MWh
Internal and External Revenue protection inspections	£9.76m	6,153MWh	2,338tCO_2e	15,684MWh
Theft in conveyance	£0.0m	0MWh	0tCO_2e	0MWh
Totals	**£9.76m**	**14,086MWh**	**5,352tCO_2e**	**29,476MWh**

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

Programme/ Project title	Description of unit	Volumes in Regulatory Reporting Year	Forecast volumes for Following Regulatory Year (Year 1)
Replace high loss transformers	Transformer Volumes	48	61
Revenue protection inspections	Visits made by revenue protection (metered supplies)	18,196 visits 1,533 irregularities	–
Theft in conveyance	Investigations	16 cases investigated 0 cases confirmed interference	–

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

Programme/ Project title	Description of unit	Volumes in Regulatory Reporting Year	Forecast volumes for Following Regulatory Year
Replace high loss transformers	Transformer Volumes	39	79
Revenue protection inspections	Visits made by revenue protection (metered supplies)	11,694 visits 1,018 irregularities	–
Theft in conveyance	Investigations	19 cases investigated 0 cases confirmed interference	–

Other Environment Related Activities

Other Environment Related Activities

Introduction

At SP Energy Networks we have an ambition to become a Sustainable Networks Business. To facilitate this we recognise the need to record and monitor our environmental, social and financial impacts, and to take action where required to fulfil this ambition. 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 2). 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.

Waste Management

The appointment of a new Sustainability Analyst in February 2016 has enabled SPEN to undertake an in-depth analysis throughout the 2016/2017 period. This included a review of waste management data recording and reporting to begin influencing decisions on new processes, methods and contractual relationships with suppliers.

We have worked to increase the number of contractors providing waste reporting by aiming to receive reports from our top 10 contractors. As a result we are now receiving monthly waste figures from 16 of our largest contractors.

Our OHL and underground cable contractors are providing monthly details of the waste they produce as they undertake projects on behalf of SPD and SPM. Analysis of their data has shown companies that adopt best practice in waste handling and recycling. The coming year will allow us to embed these best practices more widely across our contractors and reduce down the waste we currently send to landfill. Receiving this data has enabled us to look at different streams of waste and how the waste is disposed of. We have been able to identify opportunities to divert waste where it is currently sent to landfill and have sought to build a culture of recognition by highlighting the good work we already do in stripping down equipment and reusing parts that are in full working order.

We have renewed the contract with our main waste contractor and will continue to work with them to drive down the amount of waste sent to landfill. We are working together to meet improvement targets and meet waste reduction goals. SP Energy Networks are working towards a goal for diverting 95% of waste from landfill as per table 2 goals.

Other Environment Related Activities

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 humans.

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 a key regional contact, 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 for customers who are off supply, rather than ongoing noise issues related to static assets.

In the 2016/17 reporting year, SPEN received two complaints relating to noise from our substations. These complaints currently remain open as they require large noise abatement projects to be undertaken.

Where issues are highlighted with static assets, SPEN has a track record in mitigating negative effects. The solutions are often relatively straightforward once these are made known to us. Noise abatement projects carried out in the past have included solutions such as installing sound proofing, replacing transformers and the redesign of the substation. We keep in regular contact with affected customers involving them at each stage of the process.

Climate Change Resilience

The effects of Climate Change are now being felt across the World. In the UK, severe weather events manifest in several ways. More frequent and intense rain showers result in localised flooding. Frequent wind storms cause overhead line faults and therefore power cuts. Lastly, though immediately less apparent, instances of high temperatures, can cause both reduced operating efficiency of the network and an increase in vegetation growing. 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 resiliency of our overhead lines, we are continuing proactive tree management work undertaken through previous regulatory price control periods.

Last year we accelerated our programme of work to mitigate flood risk by completing 75% against a target of 43%. This year we are continuing to work through the remainder of our programme of work for ED1, 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.

Other Environment Related Activities
Biodiversity

SPEN is part of the wider Iberdrola Group. In addition to complying with the Iberdrola Policy on Biodiversity (available to view online here), the key principles have been included within the SPEN Environment Policy (available for download here). The key principle within the SPEN Environment Policy requires 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"

Although no goals or targets were specifically identified within the ED1 Business Plan, in the undertaking of licence activity the protection of the environment we operate in is a priority. In recognition of the importance of biodiversity, we have identified Land and Biodiversity Improvement as one of our seven Sustainability Drivers. The information presented on the Oswestry OHL project and our Natural Capital Pilot project highlights some of the work we are undertaking in this area.

Oswestry Overhead Line Project

SPEN went beyond standard environmental mitigation measures in the Legacy to Oswestry overhead line project. This involved working with Shropshire Wildlife Trust to employ a Survey & Monitoring Officer to carry out a range of species surveys in the White Mere Wetland, a Site of Special Scientific Interest (SSSI) and sites throughout the Meres and Mosses Nature Improvement Area. The updated survey records provided useful baseline data for the area and enabled the Meres and Mosses Partnership to collate information to deliver a conservation strategy for this area. The survey work was used by the Partnership to explain to Government funding sources how successful the project had been and was essential to attracting future investment.

SPEN funding enabled other initiatives such as training some 50 volunteers to partake in the extensive survey work, canoe surveys for water voles and restoring over 20 wetlands.

Natural Capital Pilot Project

SP Energy Networks (SPEN) and the Scottish Wildlife Trust (SWT) are conducting a natural capital pilot project within the Cumbernauld Living Landscape (CLL) area.

The Scottish Forum on Natural Capital is also providing input into the project at the scoping, implementation, and communication stage. The pilot is a collaborative project that, if successful, will enable SWT to share lessons learned and promote natural capital actions to businesses within the CLL area and across Scotland generally through the Scottish Forum on Natural Capital.

SPEN's involvement in the pilot project is motivated by a desire 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.

Priority Ecosystem Services (Impacts and Dependencies)

Through the undertaking of Phase I of the pilot, the ecosystems that SPEN Impact upon in the Cumbernauld Living Landscapes area were identified and their materiality ranked either low, medium or high. Four ecosystems were ranked high and were identified as priority ecosystems. These were Global Climate Regulation, Hazard Regulation, Recreation and Wild Species Diversity. No material ecosystem dependencies were identified during the exercise, though there are reputational and financial dependencies in SPEN minimising or avoiding impacts on each ecosystem applicable in the study area.

Through discussion between the steering group partners it was noted that the size of the study area, and the ecosystems present within it, did not fully predict the impacts and dependencies that SPEN may have in its activities elsewhere. A subsequent piece of work highlighted that in the wider licence area, SPEN would have impacts on Crops and Timber ecosystem services as a result of its business activities, and minor dependencies on each.

Alignment with wider Policy / Opportunities

Through completion of Phase I of the pilot project SPEN has 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.

In following the Natural Capital approach in identifying and then tackling these impacts, SPEN is gathering a reliable evidence inventory to support its decisions supplemented by credible and transparent costing information between options. In summary, the pilot has displayed the following potential benefits in adopting a Natural Capital approach to decision making:

- Aligning decision making with stakeholder expectation
- Gathering high quality evidence to inform decisions which can be added to existing datasets
- Will drive a cost effective delivery through shared solutions and joint working
- Requires the adoption of a customer focussed delivery
- Displays International leadership.

Application potential within the SP Energy Networks Business

Throughout the pilot project, SPEN has been 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 implement the deployment quickly.

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.

Other Environment Related Activities

Biodiversity continued

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, create more from its financial investment, and would create a transparent reporting framework in the process of doing so.

Recommendations for Phase II of the Pilot

Following completion of Phase I of the pilot project, and following careful consideration of the in-project lessons learned, a series of recommendations have been outlined for the proposed Phase II:

- Adopt the four ecosystem services identified in the Cumbernauld Living Landscapes Phase I study (*Global Climate Regulation, Wild Species Diversity, Recreation and Hazard Regulation*), and take forward to Phase II;
- 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. This could be achieved by incorporating projects out with the Lanarkshire District boundary within Phase II, and would include the Crops and Timber ecosystem services for assessment;
- Develop a tool for the six ecosystem services suitable for use by both intermediate users e.g. Managers and also 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, focussing on the three types of site/use identified as:
  - maintenance and working practices (e.g. depot grounds or substations),
  - overhead line rebuild;
  - mitigation options review.
- Continue to engage positively with stakeholders on Natural Capital and build mutual trust and respect through close collaboration on Phase II;

Share the experience of the Phase I pilot with other stakeholders at the Natural Capital World Forum to determine any additional lessons learned to advise Phase II and showcase SPEN as a responsible industry leader in line with its Sustainable Business Strategy

Phase II of the Natural Capital pilot project will be initiated shortly and we will report on progress in the 2017/18 Environment and Innovation Report.

Employee Engagement

Through the execution of the Open Innovation project our staff have been a central force in driving the project. From participating in the Hatch-A-Challenge programme to highlight the process and equipment challenges they have experienced first-hand, to participating in solver community workshops with our supply chain and academia, our staff are involved. As outlined in Section 5.3.3, the project has both facilitated and necessitated engagement with staff not typically considered as innovators, and helped cement the culture of innovation well beyond the teams tasked with delivering innovation. Our field staff now have a path to identify the innovation they will have a stake in deploying. Highlights of the engagement work include:

- Organising training in open innovation techniques for our staff in collaboration with the other 12 businesses and public bodies (including lectures and workshops from University College Cork, V&A Dundee, and NASA)
- Hosting a series of internal Hatch-a-Challenge events launched via the Yammer portal and supported by SPEN leaders to identify a variety of business process and equipment challenges
- Facilitating internal workshops using Design Thinking techniques to diagnose and define the challenges in conjunction with Strathclyde University Business School
- Disseminating learnings to members of the Energy Networks Association (ENA) and more widely through the publication of progress reports and contributions to the annual LCNI conference
- Participating in and presentations at events such as Utility Week Live in Birmingham and Venturefest in Glasgow.

We recognised that maintaining a knowledge exchange with feedback on progression of challenges is a fundamental principle of successful open innovation. We have sought to do this by:

- Implementing an internal intranet platform to further (Yammer) facilitate internal collaboration on innovation;
- Providing regular internal updates via Yammer; and
- Maintaining a close dialogue between suppliers of challenges
- Holding regular meetings with the cohort participating in the initiative.

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

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 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
- 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 is expected to deliver a secure connection at best value to customers. This has resulted in the dual strategy of maximum use of existing assets where feasible and the application of innovative technology and methods when it is not feasible. In choosing the optimisation of existing assets over construction of new lines, this can deliver the required improvement 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.

However, as a large proportion of our network is rapidly approaching the end of its current useful life, alternative innovative solutions may be required in the construction of new parts of the network. This approach required the business to provide a higher 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 the business rather than an aspiration.

Accelerating Renewable Connections

The Accelerating Renewable Connections (ARC) business as usual roll-out is one project benefiting from the innovation as usual approach. SPD committed as part of the ARC project to deliver nine successful delivery reward criteria to provide robust learning that would inform future DNO network policies and processes, and aid the deployment of a range of flexible and alternative connection solutions.

SPD was awarded second tier Low Carbon Network Funding (LCNF) of £7.62M in 2012 to carry out ARC with the project commencing in January 2013. A further £0.84M was invested by SPD with some additional contribution, through benefits in kind, from project partners to deliver the project and raised the total project funding to £8.46M.

The Scottish Borders and East Lothian area of the SPD network was chosen as the trial location as it had reached or was close to network limits in respect of DG connections. Using conventional planning assessment methodologies, this had already resulted in a number of developers wishing to connect distributed generation being constrained or subject to prohibitively expensive network reinforcement options.

The specific issues faced by SPD in the trial area location are mirrored across UK electricity distribution networks and the project provided the opportunity to implement a range of flexible technical and commercial solutions to address these. For the learning to be relevant, representative and robust, it was essential that there was a strong focus on verification of the trial and its ability to produce learning on the implementation of new technical and commercial solutions to facilitate flexible connections. These were critical factors in the trial site selection process as well as partnering with University of Strathclyde; Smarter Grid Solutions and Community Energy Scotland.

The ARC project aimed to implement a range of flexible technical and commercial solutions to accelerate the process and time to connect for distributed generation. It is recognised that there are some inherent conflicts between the ideal design, operation and management of a distribution network when seeking to implement new ways of delivering capacity. A significant advantage of applying a holistic approach has been that it has facilitated and recognised the requirement for greater interaction between business functions including planning, delivery, operations and asset management, to optimise the tools and techniques trialled.

Queue Management

In February 2016 SPEN launched a consultation on Queue Management, which aimed to test the appetite for enabling projects that are ready to connect to the network move ahead of those projects that are stalled and taking up available network capacity. After consulting on our proposals, which involved hosting a series of stakeholder events, we have now implemented Queue Management. SPEN has conducted a review of all queues, rolled the principles out across the business and provided milestones for all new and revised offers. We will continue to engage with National Grid to ensure adoption of the policy across the transmission/distribution boundary.

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

Connecting Low Carbon Technology

SPEN is working to support a number of Low Carbon Technology connections (LCT) for domestic scale users such as electric vehicle charging points, heat pumps and single generator connections referred to as G83 such as photovoltaic solar panels on houses. SPEN sought to identify LCT hotspots, to inform prospective generators of constraints, using network monitoring, data from smart meters and stakeholder engagement in support of ongoing updates to the heat maps. In 2016/17 we installed a total of 878 of Low Carbon Technologies in SPD (equivalent to 439MW) and 952 in SPM (equivalent to 149MW). This includes the facilitation of customers connecting Heat Pumps, PV and Electric vehicles to our network. The number of PV installations has significantly dropped off following the change in Feed in Tariffs (FITS).

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. In response to the Ofgem 2017 Network Innovation Competition (NIC), SPEN invited third parties for the first time to submit applications. These applications were requested to address the key challenges that our network faces now, or will face in the future. This has resulted in a healthy response with a range of innovation ideas being presented. As a consequence of this third party challenge we are currently developing two NIC project submissions:

- **LV Engine –** which aims to add flexibility to LV networks by informing the design and selection of intelligent secondary transformers to enable cost effective uptake of low carbon technologies.
- **FUSION –** which will implement the Universal Smart Energy Framework (USEF) across North East Fife as a new open access market place for flexibility.

Progress of the Innovation Strategy

SPEN defined its Innovation Strategy as one in which the expectations of stakeholders were paramount when setting out the areas of focus. These areas of focus included reducing the occurrence and duration of power cuts, investing for climate change resilience, preparing the network for low carbon technologies, and doing so while managing an ageing network. In 2016/17 we have taken steps to prepare for the forthcoming relaunch of our Innovation Strategy

Three priority areas of innovation activity were targeted and focussed on technology, operational and commercial innovation activities. Key areas of activity include the:

- Development of enhanced condition monitoring (for asset management and maintenance);
- Use of smart meter data for network planning and losses calculations (to avoid unnecessary asset upgrade); and,
- Use of innovative methods and technologies to extend asset lifespan (to delay asset replacement activity).

In 2016/17 SPEN registered 8 NIA distribution projects in addition to the 11 ongoing projects registered last year. We continue to collaborate with other distribution network operators on 8 projects.

Details of SPEN led projects can be found in the NIA Annual Report from 2016/17 page 10 onwards and details of collaborative projects are detailed from page 41 onwards.

Demand Side Response

In 2015 /16, the Smart Buildings pilot with Glasgow City Council successfully tested Demand Side Response potential in 10 council owned buildings as part of the smart grid development.

The pilot demonstrated that demand side measures can reduce overall building demand over the period of a working day by over 20% on average, and enabling the connection of more LCT on the network.

In 2016/17, the results of testing findings were fully analysed. Demand Side Response (DSR) is unlikely to initially be cost effective as a standalone implementation, and should run in conjunction with established load control mechanisms. As an increasing amount of load is controlled by the Building Management Systems (BMS), DSR will become more cost effective and could play a significant role for Distribution System Operators in the localised controlling of loads.

Distribution System Operator

With Project Evolution, SPEN is looking at the potential to become a Distribution System Operator (DSO). As the UK builds towards a low carbon future, the nature of the electricity grid is changing. There are fewer centralised energy generators and more distributed low carbon generators to supply demand customers. There are ever increasing volumes of Distributed Generation and Distributed Energy Resources, Smart Meters installed in customer homes and greater adoption of electric vehicles.

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

Progress of the Innovation Strategy continued

As network operators SPEN is adapting to meet these challenges whilst maintaining reliable energy distribution at low costs for our customers. In addition, as our customers increasingly become 'prosumers' (both consuming and producers of electricity), we need to facilitate a fair market for the services that they could provide to the electrical network.

The evolution of the energy sector towards a smarter system will only be possible if DNOs play an active coordinating role between all market participants, facilitating the markets and services in a neutral and non-discriminatory manner. This can be achieved by extending the current role of DNOs to that of DSOs.

The role of the System Operator is to balance supply and demand as cost effectively as possible. Historically, this active role has been confined to National Grid; working with predictable demand levels and substantial large scale generation supplies such as nuclear and coal-fired power stations. The output from low-carbon technologies is far less predictable and the traditional DNO model means that SPEN cannot take a fully active role in balancing supply and demand. An effective DSO model will optimise customer engagement, minimise costs, improve customer service, manage losses and optimise investment at a local level.

In 2016, SPEN created a DSO steering group bringing together industry figures representing key stakeholders. This was a result of discussion within the industry towards better defining the requirements for the future of DSO's. This resulted in SPEN publishing the industry's first Vision document in October 2016. The Vision document provided a clear message of SPEN's desire to transition towards becoming a DSO and has enabled the industry to accelerate the process.

In addition, the Energy Networks Association (ENA) has launched the open networks project which sets out to re-define how our networks will operate in the future Smart era.

The project brings together leading minds in the UK Energy Industry and will make the changes required to give the UK households, businesses and communities the ability to take advantage of new technologies such as renewable generation, battery storage, electric vehicles, providing the ability to control their energy and lower their costs.

Open Innovation

SPEN is participating in the Open Innovation project, sponsored by Scottish Enterprise and involving 12 other businesses and public organisations. We are investing over £1m in the project including applying process improvements, development of our people as well as funding the testing and deployment of specific initiatives. Scottish Enterprise has assembled the cohort of participant organisations and are supporting through funding, training and development in the skills required and ongoing support and monitoring in association with University of Strathclyde Business School

The purpose of the project is to provide a collaborative platform to collate and develop ideas and apply insights and experience from outside or our mutual sphere of influence and typical suppliers. The aim of the project is to help organisations innovate more effectively and quickly.

SP Energy Networks interest in the project is two-fold. By engaging differently with our existing contractors we can develop new collaborations and open the market to new suppliers. This will offer benefits to our customers, help with the challenges of managing our ageing network, whilst reducing costs and driving the low carbon transition.

A crucial aspect in the success of the project is enhancing the existing innovation culture within our organisation, ensuring that everyone has a part to play in innovation, particularly among our field staff and District teams who are at the forefront of managing these challenges daily.

The key principle of Open Innovation is that challenges are opened up to solver communities. We are working with the Scottish Enterprise community of Scottish small to medium enterprises (SMEs) together with two internationally recognised solver communities; Ennomotive and Nine Sigma, whom together have a reach comprising many thousands of solvers.

Through this initiative, SP Energy Networks has initiated work and established contracts with various SMEs that we would not normally have found within our sphere of influence. As well as the contracts arising from this project, this has opened new opportunities for future innovation projects with these companies.

Direct benefits include the identification of several opportunities that have subsequently been prioritised for testing and deployment that we would otherwise not have been able to explore. The estimated benefits to GB electricity customers from individual initiatives identified through the Open Innovation process include:

- Longer lasting tower paint, savings of over £4m
- G38 level detection in switchgear, savings estimated between £2m and £5m
- HV/LV cable detection tool saving over £1m
- Lone worker safety device savings over £1m

Through our involvement in the project we have developed an ability to deploy open innovation practices and techniques for collating and assessing future challenges where they arise through our engagement with academic institutions. We have built closer working relationships with our supply chain to emphasise how we value collaborative innovation, identified new potential suppliers to our company and the electricity industry. More fundamentally, we have extended the reach of our innovation culture to our District teams and field staff.

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

Roll Out of Smart Grids and Innovation into Business as Usual

SP Energy Networks aims to build a reputation for being the leading innovators among the GB DNOs. We have lead a number of projects that are transitioning to business as usual and are hopeful that the lessons we have learned on successful projects will be taken up and used by other DNO as we undertake our roll-out.

The Accelerating Renewable Connections (ARC) project, which concluded in December 2016, is an example of this. The initial trial focussed within the East Lothian and Borders region of our network and has been successful to date in accelerating around 113MW of renewable generation.

Upon completion of the project, a full policy guidance document Flexible Connections & Principles of Access Policy has been produced for use across all of SP Energy Networks electricity franchise areas.

Staff directly involved with the project have been redeployed to work within our local district offices bringing the range of flexible technical and commercial solutions used in ARC into business as usual scenarios .

The ARC project has successfully achieved its overall aim to accelerate the connection of renewable generation and engage positively with customers to facility distributed generation connections within constrained area of the network. There are a number of lessons that have been derived from this project around customer engagement, the technical challenges of facilitating flexible connection solutions; co-ordination between distribution and transmission networks to implement a wide area ANM solution and requirement for key enables such as enhanced network date in order to facilitate the design and offering of flexible connection solutions.

The ARC project has proven that flexible connection solutions are a desirable and viable alternative to conventional connection offers. Furthermore there has been a significant increase in the number of enquiries during the project from developers, operating throughout the SPEN distribution licenced franchise areas of SPD and SP Manweb, wishing to explore the possibility of connecting via similar connections solutions. In direct response to the success of the project and wishes of developers, SPEN has committed within our 2016/17 incentive on connections engagement (ICE) – to roll out the learning from ARC project into our Business As Usual connection process. We are already working on similar projects in SPD area in Dumfries and Galloway and in SPM area in North Wales.

Roll Out of Smart Meters

Up to the end of March 2017, UK wide delays to the Smart Metering Implementation Programme have impacted the planned delivery. So far, only Advanced Domestic and SMETS1 Smart Meters have been deployed and energised by Suppliers. These meter types cannot currently communicate with DNOs. Although this may change in the future, currently the technology would have no contribution to the DNO benefits case. Hence, whilst cost and volumes reporting pack table CV34 would suggest in the region of 8.5% of customers having Smart Meters installed in 2016/17, the volume contributing to any DNO benefits is zero. We expect that Suppliers will continue to install SMETS1 meters for the majority of the 2017/18 regulatory year, although some SMETS2 meters are expected to be installed from Autumn 2017.

SP Energy Networks have engaged with a market-leading IT and communications partner for the provision of a solution which allows us to manage Smart Metering communications and data management. The products are already well established in other world markets, and we expect to benefit from their continued development. The solution has been deployed, and most components are already operational whilst some remain in integration testing. We continue to refine the product, and are confident the final products will fit our needs, and those of our customers.

As indicated above, there are currently no Smart Meters in either of our service areas which we as a DNO can communicate with. Therefore, we have no Smart Meter data to make use of at present. However, we have taken the opportunity to refine our business processes, identifying areas where we can use the data to improve efficiency and deliver excellent customer service. In addition, we are running preparatory innovation projects to help maximise data use.

It is assumed that this refers to the current Regulatory Year, that being 2017/18. As the expected volume of SMET2 meters installed (those which DNOs can communicate with) is low, we will realise minimal benefits from Smart Meter data and there is a reasonable expectation that additional costs from analysing initial smart data behaviours may negate any benefits in real terms

However, we continue our preparations to be ready for the time when stable data at volume becomes available. We do this through continuing the development of our systems and our data modelling. In addition, we are refining our business processes with key stakeholders across the business, and making the appropriate changes to ensure the transition is quick and manageable at the time SMETS2 meters come online.

Appendices

References

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

SP Energy Networks ED1 Business Plan:
https://www.spenergynetworks.co.uk/pages/distribution_business_plan.aspx

SP Energy Networks Stakeholder Engagement Strategy:
https://www.spenergynetworks.co.uk/userfiles/file/20170608_SPEN_SEStrategy_V4.7FINAL.pdf

SP Energy Networks Losses Strategy:
https://www.spenergynetworks.co.uk/userfiles/file/SPEN_Revised_Losses_Strategy_Final_Issue_1.pdf

SP Energy Networks Losses Discretionary Reward Tranche 1 Submission:
https://www.ofgem.gov.uk/system/files/docs/2016/05/spen_ldr_tranche_1_submission.pdf

SP Energy Networks Climate Change Adaptation Report:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/479266/clim-adrep-sp-energy-networks-2015.pdf

Iberdrola Biodiversity Policy:
https://www.iberdrola.com/wcorp/gc/prod/en_US/corporativos/docs/responsabilidad_biodiversidad.pdf

Iberdrola Environmental Policy:
https://www.iberdrola.com/wcorp/gc/prod/en_US/corporativos/docs/responsabilidad_medio.pdf

SP Energy Networks NIA Annual Report:
https://www.spenergynetworks.co.uk/pages/innovation_funding_incentive_annual_report.aspx

List of Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
AC	Alternating Current	LCT	Low Carbon Technologies
ANM	Active Network Management	LV	Low Voltage (230/415V)
AONB	Area of Outstanding Natural Beauty	MVDC	Medium Voltage Direct Current
ARC	Accelerating Renewable Connections	MW	Megawatts
BCF	Business Carbon Footprint	MWh	Megawatt Hours
CBA	Cost Benefit Analysis	NIA	Network Innovation Allowance
CO_2	Carbon Dioxide	NIC	Network Innovation Competition
dBA	A-Weighted Decibels	NSA	National Scenic Area
DC	Direct Current	OHL	Overhead Line(s)
DNO	Distribution Network Operator	PV	Photovoltaic
DSO	Distribution System Operator	RIIO-ED1	Revenue = Incentives + Innovation + Outputs Electricity Distribution Period 1
DSR	Demand Side Response	RSPB	Royal Society for the Protection of Birds
ED1	Electricity Distribution Period 1	USEF	Universal Smart Energy Framework
EHV	Extra-High Voltage (33kV)	SEPA	Scottish Environment Protection Agency
FITS	Feed in Tariff	SF6	Sulphur Hexafluoride
G83	Domestic LCT's	SPD	SP Distribution Licence Area
GB	Great Britain	SPEN	SP Energy Networks
GWh	Gigawatt Hours	SPM	SP Manweb Licence Area
HV	High Voltage (11kV)	SSSI	Site of Special Scientific Interest
kV	Kilovolt	tCO_2e	Tonnes of Carbon Dioxide Equivalent
LCNI	Low carbon Network & innovation conference	UK	United Kingdom
LCNF	Low Carbon Networks Fund		

List of Figures, Tables and Graphs

Appendix 1
Environment

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 is currently working to implement the IT that will allow us to connect to the new SMART Data Communications Company (DCC). The DCC has experienced several delays and it will be late 2017 before SPEN will be able to access Smart Meter data.
●	Reduce costs to customers by developing modern 'Smart Grid' network solutions.	Factored into investment planning – and co-ordinated through Smart Grid Steering Group.
●	Connect 4.5GW of Distributed Generation by 2018, with up to 5.5GW of generation connected to our network by 2023.	Across both licensees to date we have connected 3.2GW of generation to the existing network across a variety of sources, and have in place contracts to connect 3.3GW of generation across a variety of sources in the ED-1 Period.
●	Carry out 'Smart' asset replacement — using future proofed assets where justified.	Implemented through investment planning systems and processes.
●	Identify low carbon technology hotspots using network monitoring, data from Smart Meters and stakeholder engagement.	We installed a total of 878 of Low Carbon Technologies in SPD (equivalent to 439MW) and 952 in SPM (equivalent to 149MW).
●	Underground 85km of overhead lines in Areas of Outstanding Natural Beauty.	We have removed 2km of overhead lines, 0.1km in Snowdonia, 0.9km in Llyn Peninsular and 1.0km in Ynys Mon/Anglesey.
●	Install lower loss transformers to reduce losses by 50% at more than 1.300 of our secondary substations.	Program led to the replacement of 87 high loss transformers in 2016/17.
●	Reduce our carbon footprint (excluding network losses) by 15% by 2023.	In 2016/17 we reduced our CO2 emissions on Buildings Energy use, operational vehicle use and business travel by 8%. We have continued to expand on the carbon data we receive from our contractors and have therefore seen an increase in this area.
●	Use electronic vehicle management system to optimise our vehicle utilisation keeping vehicle numbers, broadly similar in ED1.	We have now fully introduced our electronic vehicle management system and are progressing towards purchase of new fleet vehicles.

★ Substantially ahead of 2016/17 target ● On 2016/17 target ● Partially or marginally below 2016/17 target ● Substantially below 2016/17 target

Appendix 1
Environment continued

	Commitment	Jointly across SPD and SPM this year
●	Monitor and reduce the energy used within our substations, invest in lower carbon buildings and reduce energy use in existing buildings.	We have installed LED lighting at 9 of our sites and PIR lighting motion sensors at 6 sites. Site surveys revealed 4 of our properties that would benefit from enhanced wall insulation, work to complete insulation at these sites was completed in early 2017.
●	Utilise low carbon alternatives to travel, through the use of technology and smarter ways of working.	In 2016 we implemented a contract with a new travel provider, and will work with them to encourage a reduction in business travel across SPEN.
●	Increase the use of electric vehicles and charging points.	We have charging points at our office locations and have incentives in place for private electric vehicle use. We will continue to monitor electric vehicle development and benefits.
●	Install oil containment around all new and high risk plant containing high volumes of oil.	In 2016/17 we completed 12 oil mitigation schemes in SPM and 15 in SPD licence areas.
●	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.	Scheduled for later in ED1 period as planned.
●	Engage on the environmental impacts of our developments from a very early stage.	We have a dedicated Environment and Planning team who engage with our engineers and legal teams in our developments early stages as a standard business process.

★ Substantially ahead of 2016/17 target
● On 2016/17 target
● Partially or marginally below 2016/17 target
● Substantially below 2016/170target

Appendix 2
Visual Amenity

E1 Visual Amenity			2017 RIIO-ED1 £m	£m	RIIO-ED1 2016 #	2017 #
SPD						
Volume - Visual Amenity Inside Designated Areas						
OHL Inside Designated Areas	LV	km			95	95
OHL Inside Designated Areas	HV	km			303	303
OHL Inside Designated Area	EHV	km			7	7
OHL Inside Designated Area	132kV	km			2	2
Total OHL Inside Designated Areas					407.00	407.00
OHL (km) Removed	LV	km			-	
OHL (km) Removed	HV	km			-	
OHL (km) Removed	EHV	km			-	
OHL (km) Removed	132kV	km			-	
Total OHL (km) Removed During Year		km			-	-
UG Cables Installed	LV	km			-	
UG Cables Installed	HV	km			-	
UG Cables Installed	EHV	km			-	
UG Cables Installed	132kV	km			-	
Total UG Cables Install		km			-	-
Volume - Visual Amenity Outside Designated Areas (10% Allowance)						
OHL (km) Removed	LV	km			-	
OHL (km) Removed	HV	km			-	
OHL (km) Removed	EHV	km			-	
OHL (km) Removed	132kV	km			-	
Total OHL (km) Removed During Year					-	-
UG Cables Installed	LV	km			-	
UG Cables Installed	HV	km			-	
UG Cables Installed	EHV	km			-	
UG Cables Installed	132kV	km			-	
Total UG Cables Installed During Year (km)					-	-
Visual Amenity Spend						
Inside Designated Areas	LV	£m		-		
Inside Designated Areas	HV	£m	0.14	**0.14**		
Inside Designated Areas	EHV	£m		-		
Inside Designated Areas	132kV	£m		-		
Outside Designated Areas	LV	£m		-		
Outside Designated Areas	HV	£m		-		
Outside Designated Areas	EHV	£m		-		
Outside Designated Areas	132kV	£m		-		
Total Spend			0.14	0.14		

	Undergrounding Activity Under ED1 Visual Amenity Allowance																			
	OHL Inside Designated Areas at End of Reporting Year (km)					Visual Amenity Inside Designated Areas: OHL (km) Removed During Year					Visual Amenity Inside Designated Areas: UG Cables Installed During Year (km)					Visual Amenity Inside Designated Areas: Visual Amenity Expenditure (£m) on Visual				
	LV	HV	33kV & 66kV	132kV	Total	LV	HV	33kV & 66kV		Total	LV	HV	33kV & 66kV	132kV	Total	LV	HV	33kV & 66kV	132kV	Total
Loch Lomond & Trossachs	0.3	0.8	0.0	0.0	1.09	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
Nith Estuary	25.0	85.3	0.0	0.0	110.32	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
Eildon & Leaderfoot	8.8	45.3	0.0	0.0	54.03	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
Upper Tweedale	18.3	70.4	1.0	0.0	89.75	0.0	0.0	0.0	0.0	-	0.0	1.04	0.0	0.0	1.04	0.0	0.1	0.0	0.0	0.14
Fleet Valley	11.3	39.5	5.8	0.0	56.61	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
East Stewartry Coast	28.8	52.5	0.0	0.0	81.34	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
Northumberland Coast	2.1	8.9	0.0	0.0	11.06	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
	94.55	302.81	6.84	-	404.20	-	-	-	-	-	-	1.04	-	-	1.04	-	0.14	-	-	0.14

E1 Visual Amenity			2017 RIIO-ED1 £m	£m	2016	2017
SPM						
Volume - Visual Amenity Inside Designated Areas						
OHL Inside Designated Areas at I	LV	km			910.86	910.86
OHL Inside Designated Areas at I	HV	km			1,952.20	1,952.20
OHL Inside Designated Areas at I	EHV	km			-	
OHL Inside Designated Areas at I	132kV	km			-	
Total OHL Inside Designated Areas		km			2,863.06	2,863.06
OHL (km) Removed During Year	LV	km			-	0.38
OHL (km) Removed During Year	HV	km			-	1.59
OHL (km) Removed During Year	EHV	km			-	
OHL (km) Removed During Year	132kV	km			-	
Total OHL (km) Removed During Year		km			-	1.97
UG Cables Installed During Year	LV	km			-	0.4
UG Cables Installed During Year	HV	km			-	1
UG Cables Installed During Year	EHV	km			-	
UG Cables Installed During Year	132kV	km			-	
Total Cable Installed		km			-	1.62
OHL (km) Removed During Year	LV	km			-	
OHL (km) Removed During Year	HV	km			-	
OHL (km) Removed During Year	EHV	km			-	
OHL (km) Removed During Year	132kV	km			-	
Total OHL (km) Removed During Year					-	-
UG Cables Installed During Year	LV	km			-	
UG Cables Installed During Year	HV	km			-	
UG Cables Installed During Year	EHV	km			-	
UG Cables Installed During Year	132kV	km			-	
Total UG Cables Installed During Year (km)					-	-
Visual Amenity Spend						
Inside Designated Areas	LV	£m	0.05	**0.05**		
Inside Designated Areas	HV	£m	0.2	**0.2**		
Inside Designated Areas	EHV	£m				
Inside Designated Areas	132kV	£m				
Outside Designated Areas	LV	£m				
Outside Designated Areas	HV	£m				
Outside Designated Areas	EHV	£m				
Outside Designated Areas	132kV	£m				
Total Spend			0.25	0.25		

	Undergrounding Activity Under ED1 Visual Amenity Allowance																			
	OHL Inside Designated Areas at End of Reporting Year (km)					Visual Amenity Inside Designated Areas: OHL (km) Removed During Year					Visual Amenity Inside Designated Areas: UG Cables Installed During Year (km)					Visual Amenity Inside Designated Areas: Visual Amenity Expenditure (£m) on Visual				
	LV	HV	33kV & 66kV	132kV	Total	LV	HV	33kV & 66kV		Total	LV	HV	33kV & 66kV	132kV	Total	LV	HV	33kV & 66kV	132kV	Total
Snowdonia National Park	428.1	1155.6	210.3	51.3	1,845.3	0.1				0.1					-	0.03				0.03
Shropshire Hills	0.0	0.0	0.0	0.0	0.0					-					-					-
Bryniau Clwyd A Dyffryn Dyfrdw	204.5	379.4	28.8	2.1	614.8					-					-					-
Llyn Peninsular	115.6	179.7	6.4	0.0	301.7	0.3	0.7			0.9	0.3	0.5			0.8	0.00	0.00			0.01
Ynys Mon/Anglesey	162.3	236.0	6.3	1.2	405.7	0.0	0.9			1.0	0.1	0.7			0.8	0.02	0.16			0.18
	910.48	1,950.60	251.86	54.60	3,167.54	0.38	1.59	-	-	1.97	0.37	1.25	-	-	1.62	0.05	0.16	-	-	0.21

Appendix 3
Environmental

E2 - Environmental Reporting
SPD
2017

Costs

	Unit	2011 £m	2012 £m	2013 £m	2014 £m	2015 £m	2016 £m	2017 £m	2018 £m	2019 £m	2020 £m	2021 £m	2022 £m	2023 £m	Total DPCR5 £m	Total RIIO-ED1 £m
Environmental costs and volumes																
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	-							-	-
Oil Pollution Mitigation Scheme - Cables	#	-	-	-	-	-	-	-							-	-
Oil Pollution Mitigation Scheme - Operational Sites	#	0	-	1	0	0	0.45	0.32							**1**	**1**
Oil Pollution Mitigation Scheme - Non Operational Sites	#	-	-	-	-	-	-	-							-	-
SF6 Emitted Mitigation Schemes	#	-	-	-	-	-	-	-							-	-
Noise Pollution	# Interventions	0	0	-	-	0	-	-							**1**	-
Contaminated Land Clean Up	#	-	-	-	-	-	-	-							-	-
Environmental Civil Sanction	#	-	-	-	-	-	-	-							-	-
Total		**0.2**	**0.5**	**1.1**	**0.0**	**0.0**	**0.4**	**0.3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
Fluid-Filled Cables																
Fluid-Filled Cables in service	Circuit km															
Oil in Service in Cables	Fluid ltrs															
Fluid Used to Top Up Cables	Fluid ltrs															
Fluid Used to Top Up Cables as a percentage of volume in service	%															
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs															
SF6																
SF6 Bank	kg															
SF6 Emitted	kg															
SF6 Emitted as a percentage of SF6 Bank	%															
Noise Pollution																
Total complaints received	#															

Volumes/ Additions

	Unit	2011 #	2012 #	DPCR5 2013 #	2014 #	2015 #	2016 #	2017 #	2018 #	RIIO- 2019 #
Environmental costs and volumes										
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	-		
Oil Pollution Mitigation Scheme - Cables	#	-	-	-	-	-	-	-		
Oil Pollution Mitigation Scheme - Operational Sites	#	1.0	-	16.0	1.0	1.0	16.0	15.0		
Oil Pollution Mitigation Scheme - Non Operational Sites	#	-	-	-	-	-	-	-		
SF6 Emitted Mitigation Schemes	#	-	-	-	-	-	-	-		
Noise Pollution	# Interventions	11	10	10	14.0	39.0	-	-		
Contaminated Land Clean Up	#	8.0	10.0	-	-	-	-	-		
Environmental Civil Sanction	#	1.0	1.0	1.0	-	1.0	-	-		
Total										
Fluid-Filled Cables										
Fluid-Filled Cables in service	Circuit km	30	30	29	29	29	29	29		
Oil in Service in Cables	Fluid ltrs	-	-	-	-	-	86,700	86,700		
Fluid Used to Top Up Cables	Fluid ltrs	190	-	500	46	37	-	-		
Fluid Used to Top Up Cables as a percentage of volume in service	%	-	-	-	-	-	0%	0%	-	-
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		
SF6 Emitted	kg	55	69	61	62	62	1	1		
SF6 Emitted as a percentage of SF6 Bank	%	1%	1%	1%	0%	0%	0%	0%	-	-
Noise Pollution										
Total complaints received	#	-	-	-	-	-	-	-		

E2 - Environmental Reporting
SPM
2017

Costs

	Unit	2011 £m	2012 £m	2013 £m	2014 £m	2015 £m	2016 £m	2017 £m	2018 £m	2019 £m	2020 £m	2021 £m	2022 £m	2023 £m	Total DPCR5 £m	Total RIIO-ED1 £m
Environmental costs and volumes																
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	-							-	-
Oil Pollution Mitigation Scheme - Cables	#	-	-	-	-	-	-	-							-	-
Oil Pollution Mitigation Scheme - Operational Sites	#	-	-	-	-	-	-	0.42							-	**0**
Oil Pollution Mitigation Scheme - Non Operational Sites	#	-	-	-	-	-	-	-							-	-
SF6 Emitted Mitigation Schemes	#	-	-	-	-	-	-	-							-	-
Noise Pollution	# Interventions	-	-	-	-	-	-	0.23							-	**0**
Contaminated Land Clean Up	#	-	-	-	-	-	-	-							-	-
Environmental Civil Sanction	#	-	-	-	-	-	-	-							-	-
Total		**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
Fluid-Filled Cables																
Fluid-Filled Cables in service	Circuit km															
Oil in Service in Cables	Fluid ltrs															
Fluid Used to Top Up Cables	Fluid ltrs															
Fluid Used to Top Up Cables as a percentage of volume in service	%															
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs															
SF6																
SF6 Bank	kg															
SF6 Emitted	kg															
SF6 Emitted as a percentage of SF6 Bank	%															
Noise Pollution																
Total complaints received	#															

Volumes/ Additions

	Unit	2011 #	2012 #	DPCR5 2013 #	2014 #	2015 #	2016 #	2017 #	2018 #	RIIO- 2019 #
Environmental costs and volumes										
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	-		
Oil Pollution Mitigation Scheme - Cables	#	-	-	-	-	1.0	-	-		
Oil Pollution Mitigation Scheme - Operational Sites	#	-	-	9.0	-	2.0	8.0	12.0		
Oil Pollution Mitigation Scheme - Non Operational Sites	#	-	-	-	-	-	-	-		
SF6 Emitted Mitigation Schemes	#	-	-	-	-	-	-	-		
Noise Pollution	# Interventions	8	7	10	11.0	33.0	-	7.0		
Contaminated Land Clean Up	#	29.0	22.0	-	-	-	-	-		
Environmental Civil Sanction	#	12.0	7.0	7.0	1.0	1.0	-	-		
Total										
Fluid-Filled Cables										
Fluid-Filled Cables in service	Circuit km	-	-	-	-	-	159	159		
Oil in Service in Cables	Fluid ltrs	-	-	-	-	-	699,600	699,600		
Fluid Used to Top Up Cables	Fluid ltrs	4,722	10,443	4,326	5,535	3,555	13,600	9,315		
Fluid Used to Top Up Cables as a percentage of volume in service	%	-	-	-	-	-	2%	1%	-	-
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		
SF6 Emitted	kg	108	119	121	122	124	30	47		
SF6 Emitted as a percentage of SF6 Bank	%	1%	1%	1%	1%	1%	0.18%	0.28%	-	-
Noise Pollution										
Total complaints received	#	-	-	-	-	-	8	2		

Appendix 4

Business Carbon Footprint

SPD DATA	Volumes/ Additions 2011 #	DPCR5 2012 #	2013 #	2014 #	2015 #	RIIO-ED1 2016 #	2017 #	Total DPCR5 #	Total RIIO-ED1 #	RIIO-ED1 2016 #	2017 #	RIIO-ED1 2016 #	Total 2017 RIIO-ED1 #
Total BCF (excl. losses)	**34,235.07**	**35,595.94**	**35,029.61**	**31,076.89**	**24,549.36**	**16,719.84**	**16,880.42**	**160,486.88**	**33,600.27**				
TOTAL BCF (incl. losses)	**91,847.57**	**96,891.56**	**88,529.61**	**78,689.39**	**78,574.36**	**63,351.36**	**518,345.27**	**434,532.49**	**581,696.64**				
Buildings energy usage													
Buildings - Electricity	4,388.47	2,940.76	3,411.40	2,459.93	3,377.00	2,270.62	2,161.66	**16,577.56**	**4,432.28**	0.00	0.000412	4,912,735.82	5,246,118.36	**10,158,854.18**
Buildings - Other Fuels	132.82	57.17	104.20	17.00	28.00	25.21	46.89	**339.19**	**72.10**	0.00	0.000184	136,656.61	254,836.27	**391,492.88**
Substation Electricity	25,508.00	25,450.74	24,390.00	20,878.08	10,072.00	8,227.59	7,305.10	**106,298.82**	**15,532.69**	0.00	0.000412	17,801,325.00	17,728,669.00	**35,529,994.00**
Radio Base Stations	21.95	82.54	56.50	69.54	190.00	21.99	17.83	**420.53**	**39.82**	0.00	0.000412	47,588.10	43,260.84	**90,848.94**
Contractors	-	-	-	-	187.00	-	-	**187.00**	-	-	-	-	-	-
Total	**30,051.24**	**28,531.21**	**27,962.10**	**23,424.55**	**13,854.00**	**10,545.41**	**9,531.48**	**123,823.09**	**20,076.89**					
Operational Transport													
Road	968.01	3,476.51	3,948.30	3,825.04	3,599.00	3,770.14	2,944.24	**15,816.86**	**6,714.39**	0.00	0.00261	1,459,090.59	1,127,360.86	**2,586,451.44**
Rail	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Sea	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Air	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Contractors Road	-	-	-	700.77	3,121.00	-	-	**3,821.77**	**-**	-	-	-	-	**-**
Road (Petrol)	-	-	-	-	-	14.69	30.68	**-**	**45.37**	0.00	0.00220	6,693.31	13,965.60	
Road (LPG)	-	-	-	-	-	0.08	-	**-**	**0.08**	0.00	-	55.83	-	**55.83**
Total	**968.01**	**3,476.51**	**3,948.30**	**4,525.81**	**6,720.00**	**3,784.92**	**2,974.93**	**19,638.63**	**6,759.84**					
Business Transport													
Road	1,818.19	1,562.39	1,397.10	1,423.72	1,456.00	674.13	464.31	**7,657.40**	**1,138.44**	0.00	0.000295	2,297,540.90	1,576,014.55	**3,873,555.45**
Rail	-	6.33	7.90	7.46	11.00	12.78	5.00	**32.69**	**17.78**	0.00	0.00005	283,601.91	110,944.07	**394,545.98**
Sea	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Air	43.17	187.32	98.90	68.25	220.00	91.54	66.76	**617.64**	**158.30**	0.00	0.000147	580,951.53	453,071.37	**1,034,022.90**
	-	-	-	-	53.00	-	-	**53.00**	**-**	-	-	-	-	**-**
Air Miles European	-	-	-	-	-	28.94	40.77	**-**	**69.71**	0.00	0.0001	322,490.14	457,870.48	
Air Miles International	-	-	-	-	-	5.79	8.04	**-**	**13.83**	0.00	0.00010	55,249.81	79,370.33	
Hire Car Diesel							2.92				0.00029	-	9,898.74	
Hire Car Petrol							1.66				0.00031		5,376.48	
Road (Petrol)	-	-	-	-	-	100.65	85.22	**-**	**185.87**	0.00	0.00031	326,989.74	276,017.70	
Road (Unknown)	-	-	-	-	-	575.33	444.53	**-**	**1,019.86**	0.00	0.00030	1,918,402.79	1,477,422.80	**3,395,825.60**
Total	**1,861.36**	**1,756.04**	**1,503.90**	**1,499.42**	**1,740.00**	**1,489.16**	**1,119.21**	**8,360.73**	**2,608.37**					
Fugitive Emissions													
SF6	1,316.53	1,638.82	1,457.91	1,474.63	1,491.36	18.24	23.71	**7,379.26**	**41.95**	22.80	22.80	0.80	1.04	**1.84**
Gases Other	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
-	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
-	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Total	**1,316.53**	**1,638.82**	**1,457.91**	**1,474.63**	**1,491.36**	**18.24**	**23.71**	**7,379.26**	**41.95**					
Fuel Combustion													
Diesel	32.54	-	157.40	56.24	45.00	225.45	192.46	**291.18**	**417.91**	0.00	0.0030	77,504.02	64,896.00	**142,400.02**
Gas Natural	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Fuels Other	5.39	193.36	-	-	-	-	-	**198.75**	**-**	-	-	-	-	**-**
Contractors - Diesel & LPG	-	-	-	96.24	699.00	-	-	**795.24**	**-**	-	-	-	-	**-**
-	-	-	-	-	-	-	-	**-**	**-**	-	-	-	-	**-**
Total	**37.93**	**193.36**	**157.40**	**152.48**	**744.00**	**225.45**	**192.46**	**1,285.17**	**417.91**					
Losses													
Losses	57,612.50	61,295.62	53,500.00	47,612.50	54,025.00	46,631.52	501,464.85	**274,045.62**	**548,096.37**	0.00	0.00041	1,222,000,000.00	1,217,000,000.00	**2,439,000,000.00**
Buildings energy usage													
Buildings - Electricity						18.63	88.43	**-**	**107.06**	0.00	0.00046	40,310.00	191,331.00	**231,641.00**
Buildings - Other fuels						4.71	1.20	**-**	**5.91**	0.00	0.00018	25,531.50	6,528.00	**32,059.50**
Substation Electricity						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-	-	-	-	**-**
Total						**23.34**	**89.63**	**-**	**112.97**					
Operational Transport													
Road						65.26	2,134.22	**-**	**2,199.48**	0.00	0.0026	212,009.50	817,200.00	**1,029,209.50**
Rail						-	-	**-**	**-**	-	-	-	-	**-**
Sea						-	-	**-**	**-**	-	-	-	-	**-**
Air						-	-	**-**	**-**	-	-	-	-	**-**
-						-	223.91	**-**	**223.91**	-	0.0022	-	101,918.64	**101,918.64**
-						-	-	**-**	**-**	-	-	-	-	**-**
Total						**65.26**	**2,358.13**	**-**	**2,423.39**					
Business Transport													
Road						293.05	432.19	**-**	**725.23**	0.00	0.000295	998,750.00	1,466,976.00	**2,465,726.00**
Rail						-	-	**-**	**-**	-	-	-	-	**-**
Sea						-	-	**-**	**-**	-	-	-	-	**-**
Air						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-		-	53,508.00	**53,508.00**
-						-	-	**-**	**-**	-	-	-	-	**-**
Total						**293.05**	**432.19**	**-**	**725.23**					
Fugitive Emissions													
SF6						-	-	**-**	**-**	-	-	-	-	**-**
Gases Other						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-	-	-	-	**-**
Total						**-**	**-**	**-**	**-**					
Fuel Combustion													
Diesel						275.02	158.69	**-**	**433.71**	0.00	0.002966	94,546.52	53,508.00	**148,054.52**
Gas Natural						-	-	**-**	**-**	-	-	-	-	**-**
Fuels Other						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-	-	-	-	**-**
-						-	-	**-**	**-**	-	-	-	-	**-**
Total						**275.02**	**158.69**	**-**	**433.71**					

E4 Losses Snapshot
SPD

Activity						Units and estimated unit costs					Volumes		Estimated total costs		Estimated Distribution Losses-Justified Costs		Estimated Distribution Losses benefits over		RIIO-ED1 CBA Tool summary - estimated cumulative values for RIIO-ED1 and 45 years							
																			Distribution Losses-Justified Costs over 'Baseline Scenario'		Avoided DNO costs over 'Baseline Scenario'		Distribution Losses benefits over 'Baseline Scenario'		Cumulative discounted net benefits	
Category	Programme/project title	Type of Distribution Losses managed by the activity *(Select from list)*	Primary driver of activity *(Select from list)*	Please indicate where else in the RIGs the activity has been reported	Activity identified in DNO's final RIIO-ED1 Business Plan? *(Yes/No)*	Description of unit	Estimated unit cost of activity	Title of 'Baseline Scenario'	Estimated unit cost of 'Baseline Scenario'	Estimated Distribution Losses-Justified Cost	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17	RIIO-ED1	45 years (if appropriate)	RIIO-ED1	45 years (if appropriate)	RIIO-ED1	45 years (if appropriate)	RIIO-ED1	45 years (if appropriate)
Text	Text	Text	Text	Text	Text	Text	£k/unit	Text	£k/unit	£k/unit	#	#	£m	£m	£m	£m	MWh	MWh	£m	£m	£m	£m	£m	£m	£m	£m
Transformer	Undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)	Technical losses	Asset Replacement	Table - CV21	Yes	Transformer Volumes	7.0	Do not undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)	-	7.0	30.00	48.00	0.377	0.334	0.38	0.33	313.61	793.66	0.71	0.71	- 0.71	-	0.27	0.80	- 0.15	0.19
Relevant Theft of Electricity	Theft in Conveyance Investigations	Non-technical losses	Operational activities to manage losses	Table - I5	Yes	Number of cases investigated	-	Do not Investigate Theft in Conveyance and Relevant Theft of Electricity	-	-	1.00	-	-	-	-	-	0.60	0.60	-	-	-	-	0.00	0.00	0.00	0.00
Other (please specify)	Funding of Internal and External Revenue Protection Inspections	Non-technical losses	Operational activities to manage losses	Table - CV39	Yes	Inspections	0.04	Do not fund internal and external revenue protection and inspection	0.0	0.04	14,155	18,196	0.64	0.66	0.64	0.66	4,365	10,116	0.03	0.03	- 0.03	- 0.03	1.59	1.59	1.44	1.42

E4 Losses Snapshot SPM

Transformer	-	-	-	-	-	-	9.76	-	-	9.8	-	39	-	0.38	-	0.38	595.7	980.2	1.13	- 0.00	- 1.13	0.00	0.35	0.98	- 0.32	0.11
Relevant Theft of Electricity	-	-	-	-	-	-	0.0	-	0.0	0.0	0	-	0.0	-	0.0	0.0	1,782	1,782	0.2	0.2	- 0.2	- 0.2	0.8	1.8	0.8	1.5
Other (please specify)	-	-	-	-	-	-	0.04	-	0.0	0.04	-	11,694	-	0.48	-	0.5	5,022	11,822	0.06	0.06	- 0.06	- 0.06	1.85	1.85	1.67	1.63

Appendix 6
Smart Metering

E5 Smart Metering SPD	RIIO-ED1 2016 £m	 2017 £m
Smart Meter Communication Licensee Costs (pass through)	0.6	1.2
Smart Meter Information Technology Costs (pass through)	0.9	1.3
Elective Communication Services (outside price control)	-	-
Total	**1.5**	**2.5**
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 SPMW		
Smart Meter Communication Licensee Costs (pass through)	-	0.8
Smart Meter Information Technology Costs (pass through)	-	1.1
Elective Communication Services (outside price control)	-	-
Total	**-**	**1.9**
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	**-**	**-**

Appendix 7
Smart Metering

E6 - Innovative Solutions SPD 2017 Solution type	Unit	Voltage level of issue	RIIO Output	Worksheet (costs)	Worksheet (savings)	MVA released RIIO-ED1 2016 MVA	2017 MVA	RIIO-ED1 Total MVA	Estimated Gross Avoided Costs RIIO-ED1 2016 £m	2017 £m	RIIO-ED1 £m
Increase Network Capacity/Optimise Utilisation											
Flexible Networks -	deployments	LV	0	-0.0615	0.8775	2.9		**2.9**	0.9		**0.9**
Flexible Networks -	deployments	33kV/11k\	0	-0.215	0.28	2.1		**2.1**	0.3		**0.3**
Total						**5.0**	**-**	**5.0**	**1.2**	**-**	**1.2**
Improve Safety											
Smart Locks	0	All	0	0	0	-		**-**	-		**-**
Improve Connection Performance											
SPT2 004 ARC	deployments	Various	-	CV38	17.96	112.7		**112.7**	18.0		**18.0**
SPM **2017**											
Increase Network Capacity/Optimise Utilisation											
Flexible Networks -	deployments	LV	0	-0.0615	0.8775	2.9		**2.9**	0.9		**0.9**
Flexible Networks -	deployments	33kv/11kv		-0.2155	0.3838	2.0		**2.0**	0.3		**0.3**
Flexible Networks -	deployments	11kv/LV		-0.0565	0.0537	0.4		**0.4**			
Total						**5.3**	**-**	**5.3**	**1.2**	**-**	**1.2**
Improve Safety											
Smart Locks	0	All	0	0.18	0.007		0.2	**0.2**	0.1	0.1	**0.5**
									*0.1 yearly avoided cost		
Improve Asset Lifecycle Management											
Transformer Refurb	deployments	32kV/33K	-	0.27237	1.07093	0.3		**0.3**	1.1		**1.1**

Appendix 8
Low Carbon Technologies

E7 - LCT SPD	Units	2016	2017	RIIO-ED1
Estimated volumes of LCTs Installed				
Secondary network				
Heat Pumps	Number	20.0	45.0	**65.0**
EV slow charge	Number	405.0	226.0	**631.0**
EV fast charge	Number	-		**-**
PVs (G83)	Number	5,497.0	468.0	**5,965.0**
Other DG (G83)	Number	4.0	-	**4.0**
DG (non G83)	Number	-	40.0	**40.0**
Total		**5,926.0**	**779.0**	**6,705.0**
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	**244.0**
Total		**145.0**	**99.0**	**244.0**
Estimated size of LCTs Installed				
Secondary network				
Heat Pumps		0.1	0.3	**0.4**
EV slow charge	MW	2.7	1.4	**4.1**
EV fast charge	MW	-		**-**
PVs (G83)	MW	18.3	1.5	**19.8**
Other DG (G83)	MW	0.0		**0.0**
DG (non G83)	MW	-	3.8	**3.8**
Total		**21.1**	**7.0**	**28.1**
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	**556.2**
Total		**124.7**	**431.5**	**556.2**

E7 LCT SPM	Units	2016	2017	RIIO-ED1
Estimated volumes of LCTs Installed				
Secondary network				
Heat Pumps	Number	-	70.0	**70.0**
EV slow charge	Number	-	229.0	**229.0**
EV fast charge	Number	-		**-**
PVs (G83)	Number	-	579.0	**579.0**
Other DG (G83)	Number	-	-	**-**
DG (non G83)	Number	-	4.0	**4.0**
Total		**-**	**882.0**	**882.0**
Primary network				
Heat Pumps	Number	-		**-**
EV slow charge	Number	-		**-**
EV fast charge	Number	-		**-**
PVs (G83)	Number	-		**-**
Other DG (G83)	Number	-		**-**
DG (non G83)	Number	-	70.0	**70.0**
Total		**-**	**70.0**	**70.0**
Estimated size of LCTs Installed				
Secondary network				
Heat Pumps		-	0.6	**0.6**
EV slow charge	MW	-	1.5	**1.5**
EV fast charge	MW	-		**-**
PVs (G83)	MW	-	1.9	**1.9**
Other DG (G83)	MW	-	-	**-**
DG (non G83)	MW	-	0.4	**0.4**
Total		**-**	**4.3**	**4.3**
Primary network				
Heat Pumps	MW	-		**-**

Appendix 9
Losses Narrative

E4 – Losses Snapshot

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.

Activity 1 - (ROW12) - 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 take into account variable losses which are transformer and load dependant
- Consequential reduction of losses on the higher voltage distribution and transmission network is not modelled
- Note the Unit Cost values for the CBA tool have been revised proportional to actual expenditure and volume of units replaced, for SPM this includes averaging the Unit Cost for both New and Refurbished transformers.

Table of values used in the RIIO-ED1 CBA Tool

Figures for 2016/17 RRP Year							
License	Unit Cost 2012/13 (ED1 CBA)	Unit Cost 2016/17 (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	6.96k	16 years	6MWh	9MWh	16MWh	17MWh
SPM	10.6k	8.03k	16 years	6MWh	9MWh	16MWh	17MWh

Activity 2 - (ROW32) - Funding of Internal and External Revenue Protection Inspections

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

- The Volume/MWh/cost data provided by Revenue Protection includes internal and external suppliers; the total of both internal and external suppliers is used.
- The number of visits over the last RRP has been used as the volumetric figure.
- The MWh saved for the 2016/17 RRP is given over a 14 month period, which is the maximum period revenue protection can bill the customer this has been rationalised to a 12 month (annual period).
- It is assumed that the MWh losses saved in that year would have gone undetected for 3 years in total and the benefits are modelled accordingly. (Sensitivities modelled 1, 3, 16, 32, 45 years).
- Note 3 years was chosen as it represents a realistic value the theft would likely have gone undetected taking into account meter inspection frequency and the roll out of smart meters.
- This data is put into the RIIO-ED1 CBA tool as the accepted option, the baseline is "Do Nothing" which indicates models zero expenditure and zero losses reduced.

Figures for 2016/17 RRP Year							
License	**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	18196	1533	6709	5751	3	0.6643	0.6387
SPM	11694	1018	7933	6800	3	0.4810	0.4625

Activity 3 - (ROW27) – Theft in Conveyance Investigations

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

- The number of cases investigated over the last RRP has been used as the volumetric figure.
- The MWh saved for the 2016/17 RRP is assumed over a 12 month period.
- It is assumed that the MWh losses saved in that year would have gone undetected for 16 years in total and the benefits are modelled accordingly. (Sensitivities modelled 1, 16, 24, 32, 45 years).
- Note 16 years was chosen as it represents a realistic value the theft would likely have gone undetected taking into account the fact that as the supply is not registered it is very unlikely that it would be detected by routine inspections, however 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.

Figures for 2016/17 RRP Years							
License	**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	16	-	-	16	-	-	-
SPMW	19	-	-	16	-	-	-

Programme/Project Title
Please provide a brief summary and rationale for each of the activities in column C which you have reported against.

Activity 1 – (ROW12) Undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)

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

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

SPD
By continuing our program of early replacement of high loss transformers in 2016/17 that would otherwise have remained in service for an additional 16 years, we have enabled total savings of 12,698 MWh of losses and 4,894 tonnes of CO2 equivalent.

SPMW
By continuing our program of early replacement of high loss transformers in 2016/17 that would otherwise have remained in service for an additional 16 years, we have enabled total savings of 15,684 MWh of losses and 6,092 tonnes of CO2 equivalent.

Activity 2 - (ROW32) - 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 18,196 visits were conducted resulting in 1,533 irregularity cases detected, where it was possible to assess units. This resulted in an associated 6,709 MWh recovery over the 14 month recovery period, this figure can be rationalised to a 12 month period to 5751. 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 17,252 MWh.

SPMW
A total of 11,694 visits were conducted resulting in 1018 irregularity cases detected, where it was possible to assess units. This resulted in an associated 7,933 MWh recovery over the 14 month recovery period, this figure can be rationalised to a 12 month period to 6800. Assuming the irregularity or interference would have occurred on average for a further 3 years in total this has reduced non-technical losses by 20,399 MWh.

Activity 3 - (ROW27) – Theft in Conveyance Investigations

We have investigated and resolved a number of cases of theft in conveyance; this is typically where no meter is installed at the property.

SPD
16 instances were identified and following internal investigation it was concluded they required no further action. As such this regulatory year there are zero cases to report. Our theft in conveyance scheme is continuing with cases ongoing that we expect to report in the next regulatory year. Previous successes in this area have been rewarding.

SPM
19 instances were identified and following internal investigation it was concluded they required no further action. As such this regulatory year there are zero cases to report. Our theft in conveyance scheme is continuing with cases ongoing that we expect to report in the next regulatory year. Previous successes in this area have been rewarding.

Primary driver of activity
If, in column E, you have selected 'Other' as the primary driver of the activity, please provide further explanation.

N/A

Baseline Scenario
Please provide a brief description of the 'Baseline Scenario' inputted in column K for each activity.

Activity 1 - (ROW12) - 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 - (ROW32) - Funding of Internal and External Revenue Protection Inspections

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

Activity 3 - (ROW27) – Theft in Conveyance Investigations

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

Appendix 9

Losses Narrative continued

Use of the RIIO-ED1 CBA Tool DNOs should use the latest version of the RIIO-ED1 CBA Tool for each of the activities reported in column C. Where the RIIO-ED1 CBA Tool cannot be used to justify an activity, DNOs should explain why and provide evidence for how they have derived the equivalent figures for the worksheet. The most up-to-date CBA for each activity reported in the Regulatory Year under report must be submitted.
The following files have been submitted:- • 1.1 - 11kV Transformers SPD_MJ (2016_17 Volumes RRP).xlsx • 1.2 - 11kV Transformers SPM_MJ (2016_17 Volumes RRP).xlsx • E4 LOSSES CBA – SPD REVENUE PROTECTION 2016_17.xlsx • E4 LOSSES CBA – SPM REVENUE PROTECTION 2016_17.xlsx • E4 LOSSES CBA – SPD THEFT IN CONVEYANCE 2016_17.xlsx • E4 LOSSES CBA – SPM THEFT IN CONVEYANCE 2016_17.xlsx

SP ENERGY NETWORKS

spenergynetworks.co.uk