SP Energy Networks

ED1 Environment & Innovation Report

2015/16

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Executive Summary

I. EXECUTIVE SUMMARY

The past year has been an exciting time for SP Energy Networks. We undertook a major restructure of our business, and in doing so, created a new Sustainability Team that is tasked with improving environmental performance across the business. SP Energy Networks has continued to incorporate sustainability aims within our business decision making and work activities in line with our eight Sustainability Drivers and in recognition of our target to reduce carbon dioxide emissions by 15% by 2023.

In this report we have focussed on the key areas where we can make most positive impact on the environment. These are supporting the development of low-carbon energy generation and accelerating the low carbon transition generally, reducing energy losses in our network, improving visual amenity of new and existing assets, reducing the potential for oil leaks from ageing equipment and reducing our overall business carbon footprint while doing so.

We have taken up the challenge of connecting an increasing amount of large-scale and domestic renewable energy sources connecting to a network that wasn't designed for it through our industry leading innovation activity. We have expanded on our Accelerating Renewable Connections program in Scotland, connecting 113 MW of renewable energy that would not have otherwise been possible. In deploying the Accelerating Renewable Connections program with Berwickshire Housing Association we have enabled the connection of 2.2 MW of solar photovoltaic panels, saving tenants an estimated £1.9million through the 20-year life of the project. In our England and Wales licence area we have developed the Angle-DC project which aims to demonstrate a new network reinforcement technique that could save UK electricity customers up to £400million by 2050 while increasing opportunities to connect new low-carbon generation.

We have undergrounded previously overhead lines in the Snowdonia National Park and Llŷn Peninsula Area of Outstanding Natural Beauty. 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 90 new lower loss transformers, resulting in estimated savings of 14,549MWh equivalent to supplying the annual electricity use of approximately 3,829 homes and saving 5,678 tonnes of carbon dioxide.

We believe that the biggest leaps of progress are delivered through collaborating with our stakeholders and so we will continue to be positive about developing open 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 look to progress towards being a Sustainable Networks Business.

List of Abbreviations

II. LIST OF ABBREVIATIONS

Abbreviation	Meaning
AC	Alternating Current
ANM	Active Network Management
AONB	Area of Outstanding Natural Beauty
ARC	Accelerating Renewable Connections
BCF	Business Carbon Footprint
CBA	Cost Benefit Analysis
CO2	Carbon Dioxide
dBA	A-Weighted Decibels
DC	Direct Current
DNO	Distribution Network Operator
DSO	Distribution Service Operator
ED1	Electricity Distribution Period 1
EHV	Extra-High Voltage (33kv)
GB	Great Britain
GWh	Gigawatt Hours
HV	High Voltage (11kv)
kV	Kilovolt
LCNF	Low Carbon Networks Fund
LCT	Low Carbon Technologies
LV	Low Voltage (230/415v)
MVDC	Medium Voltage Direct Current
MW	Megawatts
MWh	Megawatt Hours
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
NSA	National Scenic Area
OHL	Overhead Line(s)
PV	Photovoltaic
RIIO-ED1	Revenue = Incentives + Innovation + Outputs Electricity Distribution Period 1
RSPB	Royal Society for the Protection of Birds
SEPA	Scottish Environment Protection Agency
SF6	Sulphur Hexafluoride
SPD	SP Distribution Licence Area
SPEN	SP Energy Networks
SPM	SP Manweb Licence Area
tCO2e	Tonnes of Carbon Dioxide Equivalent
UK	United Kingdom

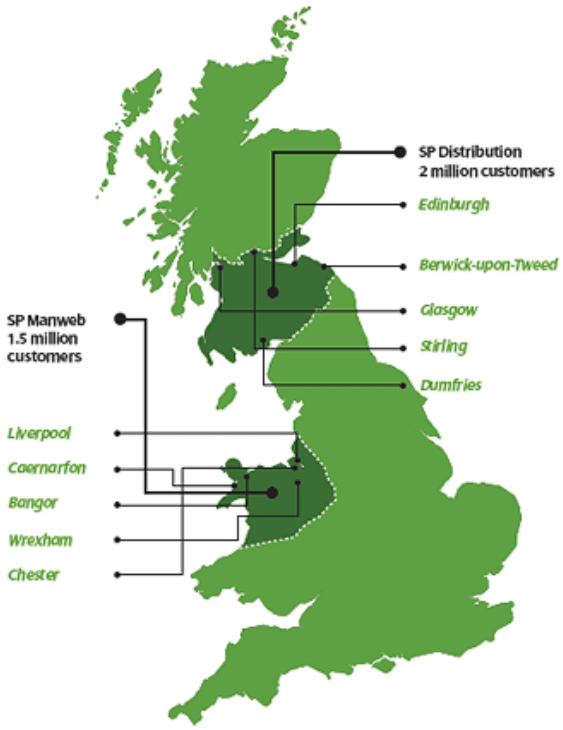
Introduction – Who We Are

1. INTRODUCTION

1.1. Who We Are

SP Energy Networks own and operate the electricity distribution network in central and southern Scotland (SP Distribution/SPD) and the distribution network in Merseyside and North Wales (SP Manweb/SPM). SPEN is part of the Iberdrola Group – a Dow Jones Sustainability Index and Global 100 listed company.

Diagram 1. SP Energy Networks Distribution Licence Areas



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. A summary of the headline network statistics is shown in Table 1.

Table 1. Selected SP Energy Networks Statistics

	SPD	SPM
Customer numbers	2 million	1.5 million
Overhead lines	18,648 kilometres	20,070 kilometres
Underground cables	39,337 kilometres	26,774 kilometres

Within this context of maintaining existing assets, we are also continually expanding our network to support the connection of new low carbon generation as part of the transition to the low carbon economy. We are also undertaking a network renewal programme involving the rebuilding of hundreds of kilometres of overhead lines and underground cables and substations, which will inevitably increase the overall volume of waste we generate.

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 naturally 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 have a responsibility to stakeholders to ensure a consistent and secure supply of electricity that seeks to reduce environmental impacts.

As reported in our ED1 Business Plan, we consider our main environmental impacts to be:

- (Energy) Losses;
- Business carbon footprint (excluding energy losses);
- Oil leakage; and,
- Visual amenity.

As a company our reputation for excellence is valued and respected among stakeholders. As employees we live in our Distribution licence areas and instinctively want to protect and improve the environment we live in. 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.

Purpose of the Report

2. PURPOSE OF THE REPORT

Our ED1 Business Plan 2015-2023 set out our goals and targets to reduce the four key impacts of losses, Business Carbon Footprint (BCF), oil leakage and visual amenity. The Plan described that this would be undertaken through capital investments, innovation activity and through amending our business as usual approach. As a responsible business, we are taking the opportunity to communicate the first year results of these measures to our stakeholders via this report.

This report will re-state the commitments set in the ED1 Business Plan for the period 2015 – 2023 and will provide a progress update on the achievement of them. We also want to take the opportunity to update stakeholders on the development of our Sustainability Strategy as well as other progressive changes we are making in pursuit of our sustainability goals.

Appendix 1 provides a summary of those ED1 commitments and progress against them.

Stakeholder Engagement is critical to the delivery of our planned commitments and few if any of our commitments can be delivered independently of co-operative working.

In the modernisation of our network we are engaging with the supply chain to influence the design of more efficient equipment, for example in the replacement of transformers we are driving the development of equipment with much lower losses. In support of the connection of low carbon generation we are working more closely with project developers to set realistic connection programmes earlier in the process than before and working to remove capacity constraints through the deployment of our Accelerated Renewable Connections scheme. Designing and implementing innovation projects and process changes also depends upon building trust with stakeholders, and drawing in expert input on where to share ideas, risks and opportunities.

The SPEN approach to engaging with stakeholders is to be proactive, clear in our aims and expectations and openness in working with new individuals and organisations.

3. MANAGING OUR ENVIRONMENTAL IMPACT

3.1 Introduction

SPEN set out eight Sustainability Drivers in 2014 which were developed following consultation with a broad range of stakeholders including, Ofgem, customers, Statutory Authorities, our own staff and interested parties. These drivers are presented in Diagram 2.

Diagram 2. Sustainability Drivers

The Sustainability Drivers enable us to consider the effects on low carbon generation connections and our own environmental impacts during business planning. They encourage the removal of time barriers to ensure quicker connections. This strengthens existing stakeholder networks to better predict where future upgrading works will be required, and enables development of new mitigation options where conflicts with stakeholders may arise. As well as removing the time barriers, cost

barriers are also reduced, thereby helping renewable energy generators to reduce and stabilise the levelised cost of energy.

The Drivers encourage SPEN to lead technical innovation and collaboration to promote solutions that avoid or minimise negative environmental effects and outages, without negatively affecting performance. As a result, innovative projects are already using cheaper and safer alternatives that use fewer resources, thereby reducing future waste disposal and accidental releases to the environment. Each year we develop scorecard key metrics for the individual Sustainability Drivers which we use to track our progress as part of our ongoing commitment to being ISO14001 Environmental Management certified. Crucially, the drivers are also used to provide a stimulus for achieving the ED1 commitments.

In late 2015, SPEN established a new Sustainability team whose responsibility is to develop the Sustainability Strategy for the period to 2030 and beyond. The Strategy is being developed through consultation with external stakeholders. The team will also analyse the data that has been collected over many years and track the improvements that result from initiatives to reduce environmental impact and improve sustainability, some of which are described in this document. We plan to report relevant data and trends in future Environmental Reports, where appropriate.

This report will provide an update on the following areas:

- Visual amenity
- Oil leakage
- Business Carbon Footprint
- Sulphur Hexafluoride Emissions
- Distribution Losses
- Smart Grids and Innovation
- Other Environmental factors such as noise, waste,
- Climate change adaptation
- Habitat protection and enhancement

As SPEN own and operate two distribution licences, results data will be presented separately for the SPEN Distribution licence area in Scotland (SPD) and in England and Wales (SPM)

Managing Our Environmental Impact – Visual Amenity

3.2 Visual Amenity

Distribution networks in the UK have been historically constructed using overhead lines and take the most expedient route to electricity consumers. As the network of protected sites such as National Parks, Areas of Outstanding Natural Beauty (AONB) and National Scenic Areas (NSA) has developed, 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, Llŷn Peninsula, and Denbighshire AONBs, and in SPD with the Loch Lomond & The Trossachs National Park.

The process of identifying overhead lines for mitigation through undergrounding is dependent on maintaining a close working relationship with stakeholders. For high-profile projects SPEN seek 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 would liaise directly with the officers employed by the relevant Local Planning Authority, proactively meeting every 6 months. SPEN anticipate 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 was affected by the works) would be for SPEN to provide an update on progress of existing work on circuits and to collaboratively look at new areas within AONB 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.

In the 2015/2016 reporting year SPEN completed undergrounding mitigation at two locations in the SPM area, and plan a further four areas for undergrounding. No imminent underground works are planned in the SPD area but discussions are ongoing in respect of supporting the undergrounding of major transmission works in SPENs Transmission licence area. Table 2 lists the visual amenity mitigation projects undertaken and their respective locations/designations. Further information can be found in Appendix 2 Visual Amenity.

Table 2. Progress of Visual Amenity Mitigation Projects (all SPM)

Voltage	Location of OHL	AONB	Progress
33kV	Maentwrog - Llanfrothen 33kV	Snowdonia National Park	completed Sept 2015
11kV	Rhiw Village	Llŷn Peninsula	approved - work delayed
11kV	Y Swnt, Moelfre GRP	Anglesey	approved at planning stage
11kV	Yr Ysgwrn, Trawsfynnydd (LL41 4UW)	Snowdonia National Park	approved at planning stage
11kV	Cilan Mountain (Cilan Uchaf) - PH 1	Llŷn Peninsula	approved at planning stage
11kV	Cilan Mountain (Pen Y Mynydd) - Ph 2	Llŷn Peninsula	approved at planning stage

Managing Our Environmental Impact - Oil Leakage

3.3 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 does escape from equipment. In many cases where oil is in use on our network the containment to stop the oil leaks escaping to the environment is not up to current standards as a result of the age and number of assets. This has the potential to cause pollution of watercourses and soils and related environmental damage.

To limit oil releases to the environment we are undertaking a civil asset review to feed into 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 mitigation works are most likely to comprise the construction of pollution prevention bunds, or renovation works of existing bunds.

Over the ED1 period, SPEN plans to construct enhanced oil containment around 526 new and existing transformers and replace poorly performing oil filled cables. SPEN expects to remove 1.5million litres of insulating mineral oil as part of our circuit breaker replacement programme. It is anticipated that through the replacement of specific oil filled cables alone, incidents of oil leakage would be cut by up to 50%. With the additional measures adopted, it is anticipated that leakages to the environment causing pollution events would be avoided. SPEN is also taking tentative steps to identifying alternatives to mineral oil by engaging with suppliers of biodegradable oils to determine capability, environmental credentials and costs.

SPEN report oil leakage data to Ofgem on an annual basis as part of the E2 - Environmental Reporting requirement, and is attached to this report under Appendix 3 Environmental Reporting.

It is currently too early in the ED1 period to provide comment on the actual impact of the benefits of adopting the works. The actual and estimated costs are presented in Table 3. Works are underway for the sixteen SPD sites and at eight SPM sites the works have been completed.

Table 3. Summary of Transformer Replacement and Associated Costs

Site Name	Network Area	Work Undertaken	Cost
East Mains	SPD	Transformer Modernisation	£4,768.41
Balmore Village	SPD	Transformer Modernisation	£47,456.18
Barrhead Primary	SPD	Transformer Modernisation	£24,730.15
Barterholm 11KV	SPD	Primary Circuit Breakers	£56,656.07
Carrutherstown	SPD	Primary Circuit Breakers	£61,324.20
Dunscore Primary	SPD	Transformer Modernisation	£26,110.86
Fairlie Transformer	SPD	Transformer Modernisation	£3,167.66
Gorgie T2 Primary	SPD	Transformer Modernisation	£27,414.17
Hunterston	SPD	Transformer Modernisation	£60,657.88
Langside Primary	SPD	Primary Circuit Breakers	£1,313.15
Muirhouse T1	SPD	Transformer Modernisation	£48,222.01
Newhouse Primary	SPD	Transformer Modernisation	£618.81
Pentcaitland T1	SPD	Transformer Modernisation	£15,868.81
Pinwherry Primary	SPD	Transformer Modernisation	£5,340.43
Towers Road T2	SPD	Transformer Modernisation	£89,423.73
Uddingston Primary	SPD	Transformer Modernisation	£3,248.93
HPO Copperas	SPM	Transformer Modernisation	£52,891.28
Acer Avenue	SPM	Transformer Modernisation	£37,725.21
Crosby Primary	SPM	Transformer Modernisation	£56,580.71
Allerton Primary	SPM	Transformer Modernisation	£44,915.05
Mannings Lane Primary	SPM	Transformer Modernisation	£43,476.64
		Total	£847,865.05

4. CARBON IMPACT AND CLIMATE CHANGE

4.4 Business Carbon Footprint

SPEN has been recording and reporting BCF data for many years. Since 2007, this reporting has been made public through the Iberdrola group global reporting as well as through SPEN specific BCF annual reports. Both the Iberdrola and SPEN BCF reporting are freely available through the SPEN website. SPEN is committed to reducing our carbon footprint by 15% by 2023 (not including network losses) and are in the process of reviewing targets for future emissions reductions. Information on our network losses strategy is presented in Section 4.6.

The BCF reporting considers three overarching sources of data:

- **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 the purposes of our reporting, we consider these as emissions by Contractors.

In the period 2015-2016, the data shows a total estimated Business Carbon Footprint equivalent to 115,351 tonnes of CO2 (tCO2e). 85,516 tCO2e of this is estimated to be as a result of network losses in distributing electricity to customers. Table 4 presents the breakdown of estimated tCO2e between SPD and SPM with respect to each of Scope 1, 2, and 3 activity. Full BCF details can be found in Appendix 4 Business Carbon Footprint.

Table 4. Estimated tCO2e Emissions for each SPEN Distribution Licence Area

Activity	SPD (tCO2e)	SPM (tCO2e)
Scope 1 Activity	4053.81	3380.26
Scope 2 Activity	10,520.21	8,405.61
Scope 3 Activity	2,115.11	1,328.11

During the first year of the ED1 period, SPEN formed a Sustainability Team. The aim of the work of this team was to highlight possible improvements to data collection, recording and reporting. The second key aim was to ensure ongoing compliance, and thirdly to liaise with key environmental

stakeholders to establish a point of contact, and to begin the roadmap to becoming a Sustainable Networks Business.

Key works in progress over the 2016-2017 ED1 reporting period include:

- Development of a Sustainability Strategy to lead business change and achieve our 2023 CO2 reduction target.
- Liaise with external and internal stakeholders in the development of the Sustainability Strategy to 2023 and beyond.
- Developing a building energy efficiency standard to ensure consistency when constructing new buildings and retrofitting existing buildings.
- Incorporating energy efficiency measures in planned building renovation works to cut energy demand at our Bonnybridge and Glenrothes depots.
- Reviewing our data recording packages and liaising with suppliers and contractors to identify instances of over and under-reporting of data.
- Developing a company travel reduction initiative focussing on an expansion of video and telephone conference facilities, and training to support this.
- Continue to collaborate with suppliers to identify SF6 alternatives and drive lower leakage rates.
- Undertake planned transformer replacements and install lower loss transformers

Carbon Impact and Climate Change - Sulphur Hexafluoride Emissions

4.5 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 Sulphur Hexafluoride (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 some 23,000 times that of CO2 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 'bank', will increase as the oil replacement programme proceeds. Therefore, efforts to minimise escape of SF6 from equipment to the environment is of a paramount importance.

SPEN sought to drive the supply chain towards developing equipment with reduced SF6 leakage rates. The International Electrotechnical Commission, 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 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.

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. Summarised SF6 information is presented in Table 5 and more detailed information is available in Appendix 3, Environmental Reporting.

Table 5. Summary of SF6 Information

	SF6 Bank	SF6 Emitted	Actual leakage rate
SPD	12,710 kg	0.80 kg	0.01%
SPM	16,893 kg	29.87 kg	0.18%

4.6 Distribution Losses

Introduction

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.

Distribution Losses Strategy

In September 2015 we published our Losses Strategy which supports our vision to “consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers”. We are committed to modifying processes and technical

documents to ensure that 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.

Within our Strategy, we publish a plan with a list of investments which we will undertake to support our Vision in respect of both Technical and Non-Technical Losses. Our plan for Technical Loss reduction is based upon calculated benefits and our actions for Non-technical loss reduction are based upon our experience.

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.
- Review substation civil specifications with a view to improving energy efficiency.
- 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 tCO2e and 44,977 tCO2e 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

In addition, and to further support our commitment to reduce network losses, we submitted a proposal to Ofgem outlining a number of initiatives for consideration under Tranche 1 of the 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 to improve service and bring costs down for customers.

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.

In July 2016 it was announced that we had achieved a reward of £770,000, 58% of the total reward available to us, placing us in the top three DNOs.

The total losses are presented in Table 6 and relate to total losses including both Technical and Non-technical losses.

Table 6. Assessment of Losses (Technical and Non-Technical) 2015/2016

	SPD	SPM	SPEN Total
Units Entering (GWh	19,570	16,468	36,038
Units Exiting (GWh)	18,348	15,449	33,797
Losses (GWh)	1,222	1,019	2,241
Losses (%)	6.24%	6.19%	6.22%

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 model 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.

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. Information on these projects is detailed below Tables 7 to 10. Further information is available in Appendix 5, Losses.

Table 7. 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	£12.6 m	5,018 MWh	191 tCO2	5,018 MWh
Internal and External Revenue protection inspections	£0.0 m	5,093 MWh	194 tCO2	5,093 MWh
Theft in conveyance	£0.05 m	0.6 MWh	0.02 tCO2	0.6 MWh
Totals	£12.65 m	10,111.MWh	385.02 tCO2	10111.6 MWh

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

Programme/Project title				
	Distributed Losses- Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative reduced losses to date (Year 1)
Replace high loss transformers	£12.65m	9,531 MWh	363 tCO2e	9531 MWh
Internal and External Revenue protection inspections	£0.0	5,859 MWh	223 tCO2e	5859 MWh
Theft in conveyance	£0.10	0.6 MWh	0.02 tCO2e	0.6 MWh
Totals	£12.7	15,391 MWh	586.02 tCO2e	15,391 MWh

Table 9. 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	30	60
Revenue Protection Inspections	Visits made by revenue protection (metered supplies)	14,155 visits, 1,171 irregularities	-
Theft in conveyance	Investigations	1 case investigated 1 case confirmed interference	-

Table 10. 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	60	78
Revenue Protection Inspections	Visits made by revenue protection (metered supplies)	9,470 visits 728 irregularities	-
Theft in conveyance	Investigations	7 cases investigated 7 cases confirmed interference	-

5. OTHER ENVIRONMENT-RELATED ACTIVITIES

5.1 Introduction

SPEN has stated an ambition to become a Sustainable Networks Business. As a result, there is a 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 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.

5.2 Waste Management

The appointment of a Sustainability Analyst in February 2016 has enabled SPEN to undertake an in-depth review of waste management data recording, reporting and ability to influence decisions on new processes, methods and contractual relationships with suppliers.

The first activity was aimed at ensuring accurate data was being reported by contractors and saw contractor training workshops being held in the SPM area. At these workshops, the Sustainability Analyst and an Environmental Specialist from the Sustainability Team met with cable contractor teams and briefed on the importance of providing waste, mileage and energy use data. Further details including how the data would be used within our business and reported to regulatory bodies was discussed along with an explanation of Defra conversion factors and CO2 emissions.

The second key activity was to engage with data reporters in the waste management Contractor community who serve SPEN. Data inputs were reviewed and lessons learned shared with our Contractors. The results of this are currently being used to amend our data recording software to collect data in a way that is more useful than before.

Waste reduction is a headline goal of our Sustainability Strategy. The improvement in the quality of data and ability to model future trends such as waste volumes, waste categories and predicted costs is already influencing future targets. By the end of 2016 we aim to introduce a Waste Management and Minimisation Plan to enable us to move up the waste hierarchy: continuing to increase reuse and recycling but also starting to focus on reducing how much waste we produce in the first place.

5.3 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 humans.

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 contact within the appropriate region with actions and a strict deadline to review incidents and take action.

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

In the 2015/2016 reporting year SPEN received eight complaints relating to noise from our substations. One of these is featured below. Two were reports of rattling noises, which were easily fixed by tightening bolts on fences. Two complaints were resolved by adding rubber feet to transformers. Three complaints remain open as they require larger noise abatement projects. Projects include installing sound proofing, replacing transformers and the redesign of the substation. We keep in regular contact with these customers involving them at each stage of the process.

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.

Where issues are highlighted with static assets SPEN has a track record in mitigating effects. The solutions are often relatively straightforward. A neighbour contacted us regarding noise that he suspected came from our substation. We visited him at his property and noted the side of our substation faced directly on to his garden and acted as a boundary wall. To reduce noise levels we installed a high quality wooden fence which provided sound proofing and hid the metal substation vents. Following completion of the work he reported a huge difference and advised the noise no longer disturbs him.

5.4 Climate Change Resilience

Incidents of adverse weather patterns over recent years suggest that the effects of Climate Change are now being felt. In the UK these effects have been more frequent and intense rain showers resulting in localised flooding, more frequent wind based storms causing overhead line faults and therefore power cuts, coastal erosion caused in part by seawater surges during those storms, and, though immediately less apparent, instances of high temperatures that can cause both reduced operating efficiency of the network and an increase in vegetation growing seasons.

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. The report was conducted on a risk based approach and the results are identified in pages 12 to 15 of the main document.

Three key risks were highlighted in the report and were the same as those identified in the first adaptation report published in 2011:

- **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.

A further three operational risks specific to SPEN were identified in the report and were the same as those identified in the first adaptation report published in 2011:

- **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.

In the 2015/2016 reporting period we accelerated our programme of work to mitigate flood risk at 28 high-risk substations. We completed 75% against a target of 43%. This is one step towards our long-term goal of making our whole network resilient to severe weather events. The mitigation includes the installation of flood proof doors, waterproof membrane applications and increasing the height of bunds around transformers. SPEN also expects to rebuild 2% of the 11kV mainline network, refurbish 6% of the 33kV and 7.2% of the 11kV networks annually.

SPEN will build upon proactive tree management work undertaken through previous regulatory price control periods with an enhanced tree management programme. The programme will see 25% of our main line network at EHV and HV main lines become resilient to severe wind events by the end of 2023.

Work to improve emergency planning and post-incident recovery time has also been progressed. This has included both planning measures and practical infrastructure measures. Planning measures include, for example, developing a list of at-risk substation sites and ensuring all staff members have a role during an emergency. Practical infrastructure measures include, for example, introducing an increasing number of modern reclosers and remotely operated switchgear, which allow electrical faults to be isolated, and the network reconfigured remotely without requiring immediate site visits.

5.5 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 SPEN 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, and, where possible, we seek to implement complementary enhancement measures. We have provided wood poles and steelwork for Osprey nesting and feeding platforms in a couple of locations, one in North Wales and one in the Scottish Borders. We provided badger runs around our site compound to reduce impacts during cable replacement works beneath the Manchester Ship Canal near Warrington. Our staff also support biodiversity enhancement work through volunteering activities, having worked to plant wildflowers and trees at the Blind Veterans UK sensory garden in Glan Y Don, Llandudno and are involved in ongoing maintenance.

In the 2016-2017 ED1 reporting period SPEN will review existing processes on biodiversity protection, invasive non-native species and injurious weeds in the development of an overarching Biodiversity Strategy. This work will be supported by the roll-out of e-learning training to site operations and work planning teams to ensure the staff at the forefront of delivering positive change are equipped to succeed.

5.6 Employee Engagement

In pursuit of becoming a Sustainable Networks Business, SPEN is working to engage staff to raise awareness of issues and new requirements, and also to empower staff to identify and develop new methods of working.

SPEN operates an internal social media platform called Yammer to reach out to the thousands of staff in our employment spread across multiple locations in the UK. Specific portals exist for key themes, such as Sustainability, and are open to all staff to become members of that portal. An individual is welcome to join a portal based on related work tasks or areas of personal interest and development. Examples of good practice, new Business as Usual approaches and awareness raising are shared regularly through Yammer, and staff are encouraged to share their knowledge.

Recent initiatives around energy efficiency and recycling were promoted through Yammer using information provided by Zero Waste Scotland and the Carbon Trust. For those staff members who do not use Yammer or have regular access to the internet more direct engagement was undertaken. A poster campaign using resources from the Carbon Trust and SEPA was launched with support from Environmental Champions at depots, with a focus on improving waste management and recycling rates and increasing energy efficiency awareness.

SPEN is active at improving the environment in our licence areas and look to facilitate and support staff who wish to engage on a voluntary basis. One recent activity included the clearance of Rhododendron ponticum in support of RSPB and Castlemilk Housing Association biodiversity aims. SPEN also promoted a Cycle to Work scheme amongst staff. The scheme aims to provide staff with financial support to buy a bicycle to enable them to commute to work, thereby avoiding vehicle emissions and improving physical wellbeing.

This business focus and support for Sustainability over a number of years is enabling staff to drive change within their departments and work activities. For example, when wood pole line rebuilding work is being undertaken, consideration is being given to the use of existing poles by birds. This has resulted in some poles being left in-situ for use by the birds to avoid injury caused by use of active poles. In another example, unsafe trees that require removal from site are being replaced by lower impact native species. These activities are described by the staff themselves and posted to Yammer as a guide for improving the business as usual, and encouraging others to identify similar low cost creative solutions in their work areas.

6. SMART GRIDS, INNOVATION AND OUR ROLE IN THE LOW CARBON TRANSITION

6.1 Introduction

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.

In our licence areas, SPEN has connected several gigawatts of new generation projects, almost all of which are low carbon projects, such as onshore wind, solar and hydro. These projects have been driven by a financial support mechanism to encourage developers to maximise the proliferation of renewable energy where it is feasible and acceptable to do so. This tends to be in remote rural areas with a limited electricity network. In this instance therefore, SPEN has a role that facilitates the low carbon transition through supporting developer requirements rather than as a driver of the low carbon transition.

The announcement of the ending of the Renewable Obligation Certificate financial support mechanism in April 2017 resulted in a surge of renewable energy connection applications in excess of previous years. This year we received 45,000 enquiries, of which 7,800 were from generators – and issued nearly 13,000 quotes. Our average time to quote was 5.4 working days for single premises, and 7.1 days for multiple premises. The corresponding average time to connect was 35.65 days and 42.94 days, from acceptance and payment. These were significantly quicker than our targets.

In our Low Carbon Network Fund Tier 2 project Accelerating Renewable Connection (ARC) we continued our trialling of Active Network Management in East Lothian & Borders in partnership with Community Energy Scotland, Smarter Grid Solutions and the University of Strathclyde. The project aimed to speed up, and cut the cost of renewable connection and concludes in 2016. It functions by offering renewable energy generation projects the opportunity to connect to the distribution power network sooner if they accept that their energy export will be matched to meet network constraints

on a minute by minute basis. It has to date benefited 113MW of low carbon generation. Through ARC, we were also the first DNO to retrofit Active Network Control to an existing large windfarm.

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. The consultation is anticipated to be of most relevance to low carbon connections, with the potential to increase the rate of projects being constructed. The consultation closed in March 2016 and although no change has yet been implemented, a workshop facilitated consultation with developers was effective in determining stakeholder views on the proposed changes.

SPEN is also working to support an increase in the number of Low Carbon Technology connections (LCT) for 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 2015/16 we installed a total of 6,071 of LCT in SPD (equivalent to 146MW) and 8,566 in SPM (equivalent to 98MW). See table 11 below for an analysis of this year's data compared to previous years. Further information is available in Appendix 8. LCTS

Table 11. Summary of Connected MW by Technology

Installed power							
Year	Thermal	Solar	Wind	Hydro	Biomass & Waste	Other renewables	Total
2012	13	0	741	17	136	-	907
2013	18	2	832	17	136	2	1007
2014	18	3	998	19	188	5	1231
2015	25	5	1109	20	190	5	1355
2016	26	8	1222	22	192	5	1475

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. SPEN has identified a number of projects through the Networks Innovation Competition (NIC) and the Networks Innovation Allowance (NIA) that support the low carbon transition as outlined in our Innovation Strategy published as part of the ED1 Business Plan. The following sections review progress in delivering against our Innovation Strategy, the roll out of Smart Grids, and Smart Metering.

6.2 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.

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).

Since the publication of the Strategy, SPEN has engaged in the NIC and NIA process and submitted 11 projects for NIA and 1 project (shortlisted from twelve potential projects) for NIC Distribution, as well as 10 projects in collaboration with others for the NIA. A list of the 11 SPEN NIA led and 10 SPEN partnered projects submitted can be found on page 10 Progress Summary of the NIA Annual Report. Projects identified are at various stages of development from completion to initiation depending on their launch date.

Three specific SPEN led projects stand out from the reporting year as contributions to achieving the low carbon transition:

- SPEN 0001 Smart Building Potential Within Heavily Utilised Networks;
- SPEN 0010 EVOLUTION; and,
- ANGLE-DC.

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.

With Project Evolution, SPEN is looking at the potential to become a Distribution Service 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.

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. An effective DSO model will reduce system balancing costs, whilst enabling the flexible networks necessary to facilitate customer's use of low carbon technologies.

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. In recent years there has been significant discussion across the electricity industry globally about the development of the DSO role. The DSO will adopt the responsibility of local management of the network, bridging the gap between the current system operator and customers connected to the distribution network to enable a greater penetration of LCT.

Over the 2015/2016 reporting year we developed the cutting-edge ANGLE-DC innovation project. Angle-DC seeks to use an existing 60 year old 33kV Alternating Current circuit between the isle of Anglesey and North Wales, where uncontrolled power flows are forecast to exceed thermal limits of the cables and overhead lines. The circuit will be converted to ±27kV Direct Current operation in order to enhance the capability of existing assets and avoid other more costly and disruptive reinforcement options.

The converted link will provide security of supply and extra capacity for the integration of renewable generation connecting to the island's distribution network. It will be the first Medium Voltage Direct Current (MVDC) link in Europe and one of the first tests to convert circuits from AC to DC operation. This novel network reinforcement technique could save UK electricity customers up to £400m by 2050.

The key themes of these three initiatives and the others presented in Section 6 of NIA report (from page 41 onwards) is that whole system planning needs to be considered and to move away from piecemeal development, and that multiple solutions will need to be deployed to achieve the desired outcome. The studies show that control of data is essential. The ability to appropriately record, access, share and recall that data is necessary to shape responses to issues and ensure that targets are appropriate, and are being delivered. The success of collaborative working, with those within and external to the electricity sector, is a strong theme, and is essential for achieving the aims of the Innovation Strategy and the low carbon transition of the energy economy.

6.3 Roll Out of 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 project, which concludes 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. This has been achieved through the implementation of a variety of alternative connection solutions and which are detailed in table 12 below.

Table 12 Summary of Deployed Alternative Connection Solutions

Constraint	Generation Projects	Technology	MWs Advanced	Cost Savings £m	Acceleration Years	Alternative Connection
Dunbar GSP	5	Wind, Energy From Waste	50	20.00	5	ANM Stage 1
Berwick GSP	3	Wind	60	12.00	2	ANM - Enduring
Galashiels GSP	1	Anaerobic Digestion	0.2	N/A	Infinite	Virtual Private Wire
11kV Voltage Rise	1	Solar PV	0.08	0.15	Infinite	Local ANM Control
11kV Voltage Rise	1	Anaerobic Digestion	0.2	0.20	Infinite	Voltage Reduction
11kV Voltage Rise	2	Combined Wind & PV	0.2	0.71	Infinite	Matching Load to Gen + ANM + Diversity
G83 PV Voltage Rise	749	Domestic PV	2.2	1.90*	Infinite	Flexible Networks + Advanced Modelling
Total	771		113**	33.00		

Notes:

* Represents forecast saving in home energy costs that will be realised by tenants living in social landlord homes over the 20 year life of the PV installation

** Excludes the retrofit of 48MW wind farm to facilitate generation during network fault, equates to an average of an additional 6,500 MWh/p.a. of renewable generation export

As part of the process to implement the learning developed through ARC upon completion of the project, a full policy guidance document will be implemented for use across all of SP Energy Networks electricity franchise areas. This is the case with all innovation roll-out projects. In the case of ARC, this will ensure that all customers are offered a consistent service to connect via a variety of alternative connection solutions, are able to access the network quicker and at an optimised economic cost. The roll-out of the learning for the ARC project into business as usual is further reinforced by our commitment as part of our 2016/2017 Incentive for Customer Engagement plan that all customers shall be able to request an alternative connection solution.

When rolling out and delivering innovation projects the business tracks closely the deliverables of those projects with current Ofgem guidance around LCNF, NIC and NIA funding. This involves a number of activities being undertaken including regular and annual reporting, as well as bespoke learning workshops whereby customers, other DNOs and stakeholders attend and share experience to improve the project roll-out process.

Following a recent reorganisation within SPEN it was recognised that greater focus had to be given to transitioning projects from trials to business as usual product offerings. Therefore, a new department has been formed within our Network Planning and Regulation directorate that has been tasked with updating and writing policy documentation to support the deployment of innovative solutions into business as usual activity. As we identify and consider future innovation projects, the aims of these are aligned closely with an overall business strategy for delivering our RIIO-ED1 outputs and based upon stakeholder needs.

When considering new innovative projects, the process follows closely the CBA that is prescribed as part of the network innovation and network innovation allowance guidelines. As outlined previously within this report, the identification of possible innovation projects and the setting of project aims are developed to meet stakeholder needs and expectations. Innovation projects that are deemed successful and rolled-out will also display a financial, safety or environmental benefit(s).

With respect to the ARC project there are a number of benefits including financial, environmental and social benefits by improving access to the network, resulting in a truly sustainable project.

From a financial point of view, delivery of a variety of alternative connection solutions has either mitigated or deferred additional reinforcement to the value of approximately £33million. In addition this project has accelerated around 113MW of renewable generation connections, reducing the time to connect by approximately four years compared to traditional network solutions.

By working closer with those customers seeking to connect we have also been able to mitigate the requirement for new infrastructure, particularly overhead infrastructure, around those communities we serve. This has reduced environmental impacts that can arise through construction activities, and represents an associated financial saving for individual connections.

Through working with a variety of customers including large multi-national developers and local agricultural businesses, as well as community groups and social landlords, we have been able to derive further social benefits from connecting renewable projects. The social benefits include creating and securing local employment in and around agricultural businesses, and securing those businesses in a potentially subsidy free future.

Working with social landlord Berwickshire Housing Association, ARC has facilitated around 8.7MW of renewable generation projects including a windfarm (7.5MW), whereby the revenue generated from this site will be used to construct around 20 properties per annum to satisfy local housing needs. The collaboration activity has also facilitated 2.2MW of G83 PV arrays across 749 homes which also generate a revenue stream for the housing association. More importantly it is estimated by Berwickshire Housing Association that tenants of those properties will save in the order of £1.9million through saved energy costs over the lifetime of the projects (calculated to 20 years). Further information can be found in Appendix 7 Innovation.

Smart Grids, Innovation and Our Role in the Low Carbon Transition
Roll Out of Smart Meters

6.4 Roll Out of Smart Meters

Up to the end of March 2016, 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 meters cannot currently communicate with DNOs, although this may change in the future, and hence have no contribution to the DNO benefits case. Hence, whilst the volumes reported in CV34 would suggest in the region of 1.5% of customers having Smart Meters installed in 2015/16, the volume contributing to any DNO benefits is effectively zero, and this is likely to be the case for 2016/17 as well.

SP Energy Networks have engaged with a market-leading information technology 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. This has been deployed, and some components already operational whilst some are in use for integration testing purposes. Although further refinement will continue, we are confident the final products will fit our needs, and those of our customers.

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 are currently in the process of refining the systems to support customer service improvement opportunities this data will present to us. Our main purpose in using this data will be to make most efficient use of our costs, whilst some benefits to our customers will take the form of improved service. As such, we have realised no actual benefits so far. We anticipate this will also be the case in 2016/17.

In the current Regulatory Year, that being 2016/17, the continued absence of SMETS2 Smart Meters (those which DNOs can communicate with), we will not realise any benefits from Smart Meter data. However, we continue our preparations to be ready for the time when this data becomes available. We do this through continuing the development of our systems and our data modelling. In addition, we are reviewing 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 DCC systems go-live and SMETS2 meters come online. Further cost information can be found in Appendix 6, Smart Metering.

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Annexes and Appendices

8. ANNEXES AND APPENDICES

Appendix 1

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.

RAG	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 early 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 SmartGrid 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 Licenses to date we have connected 3.15GW of generation to the Existing Network across a variety of sources, and have in place contracts to connect 3.334GW 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.	Ongoing development of externally published "heat maps".
●	Underground 85km of overhead lines in Areas of Outstanding Natural Beauty	We removed 1.6km of overhead lines during 2016 (1.1km in Snowdonia National Park and 0.5km within the Llyn Peninsula).
●	Install lower loss transformers to reduce losses by 50% at more than 1300 of our secondary substations.	We plan to replace high loss transformers which were historically commissioned prior to 1962. In addition our equipment specification reflects the current EU ecdesign standard.
●	Reduce our carbon footprint (excluding network losses) by 15% by 2023.	Reduction of 21% this year – although includes effect of move to more accurate method of measurement
●	Use electronic vehicle management system to optimise our vehicle utilisation keeping vehicle numbers, broadly similar in ED1.	We have commenced introduction of an electronic vehicle management system to optimise our vehicle utilisation. Trials and feasibility testing ongoing.

Appendix 1
(continued)

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.

RAG	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.	In development.
●	Utilise low carbon alternatives to travel, through the use of technology and smarter ways of working.	Rolled out video-conferencing capability on all laptops. Ongoing promotion of rail travel.
●	Increase the use of electric vehicles and charging points.	We have charging points at our office locations and we 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.	New grid transformers and oil containment equipment at Southport, Speke, Aberstwyth and Newtown.
●	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.	In 2015, we 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.

SPD

			2011	2012	2013	2014	2015	2016	DPCR5	ED1
Over Head Lines inside Designated Areas at End of Reporting Year March to April	Low Voltage	km	98	98	96	95	96	95	**483**	**95**
Over Head Lines inside Designated Areas at End Reporting Year March to April	High Voltage	km	322	322	315	325	327	303	**1,612**	**303**
Over Head Lines inside Designated Areas at End of Reporting Year March to April	Exta High Voltage AC cables	km	7	7	15	11	11	7	**51**	**7**
Over Head Lines inside Designated Areas at End of Reporting Year March to April	132kV	km	-	-	-	3	3	2	**5**	**2**
Total OHL Inside Designated Areas at End of Reporting Year (km)		km	427.47	427.47	426.67	433.28	436.17	407.00	**2,151**	**407**
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		km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	LV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	HV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	EHV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	132kV	km	-	-	-	-	-	-	-	-
Total UG Cables Installed During Year (km)		km	-	-	-	-	-	-	-	-

Volume - Visual Amenity Outside Designated Areas (10% Allowance)

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 (km)	LV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	HV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	EHV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	132kV	km	-	-	-	-	-	-	-	-
Total UG Cables Installed During Year (km)			-	-	-	-	-	-	-	-

Costs			2011	2012	2013	2014	2015	2016	DPCR5	ED1
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	LV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	HV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	EHV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	132kV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	LV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	HV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	EHV	£m	-	-	-	-	-	-	-	-
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	132kV	£m	-	-	-	-	-	-	-	-
Total Visual Amenity Expenditure			-	-	-	-	-	-	-	-

Undergrounding Activity Under ED1 Visual Amenity Allowance

Designated NSA (National Scenic Areas) within SPD's Network Area		OHL Inside Designated Areas at End of Reporting Year (km)					Visual Amenity Inside Designated Areas: OHL (km) Removed During Year to March 2016				
		LV	HV	33kV & 66k	132kV	Total	LV	HV	33kV & 66k	132kV	Total
Loch Lomond & Trossachs	DA1	0.25	0.841	0	0	1.091	0	0	0	0	0
Nith Estuary	DA2	25.009	85.311	0	0	110.32	0	0	0	0	0
Eildon & Leaderfoot	DA3	8.769	45.256	0	2.081	56.106	0	0	0	0	0
Upper Tweedale	DA4	18.283	70.449	1.018	0	89.75	0	0	0	0	0
Fleet Valley	DA5	11.304	39.488	5.82	0	56.612	0	0	0	0	0
East Stewartry Coast	DA6	28.788	52.547	0	0	81.335	0	0	0	0	0
Northumberland Coast	DA7	2.142	8.922	0	0	11.064	0	0	0	0	0
Totals		**95**	**303**	**7**	**2**	**406**					

Designated NSA (National Scenic Areas) within SPD's Network Area	Visual Amenity Inside Designated Areas: UG Cables Installed During Year to March 2016 (km)					Visual Amenity Inside Designated Areas: Visual Amenity Expenditure (£m) on Visual Amenity Inside Designated Areas by voltage to year March 2016				
	LV	HV	33kV & 66k	132kV	Total	LV	HV	33kV & 66k	132kV	Total
Loch Lomond & Trossachs	0	0	0	0	0	0	0	0	0	0
Nith Estuary	0	0	0	0	0	0	0	0	0	0
Eildon & Leaderfoot	0	0	0	0	0	0	0	0	0	0
Upper Tweedale	0	0	0	0	0	0	0	0	0	0
Fleet Valley	0	0	0	0	0	0	0	0	0	0
East Stewartry Coast	0	0	0	0	0	0	0	0	0	0
Northumberland Coast	0	0	0	0	0	0	0	0	0	0
Totals										

Designated NSA (National Scenic Areas) within SPD's Network Area	Visual Amenity Outside Designated Areas: OHL (km) Removed During Year to March 2016					Visual Amenity Outside Designated Areas: UG Cables Installed During Year to March 2016 (km)					Visual Amenity Outside Designated Areas: Visual Amenity Expenditure (£m) on Visual Amenity Outside Designated Areas by voltage Dureing year to March 2016				
	LV	HV	33kV & 66k	132kV	Total	LV	HV	33kV & 6(	132kV	Total	LV	HV	33kV & 6(	132kV	Total
Loch Lomond & Trossachs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nith Estuary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eildon & Leaderfoot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tweedale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fleet Valley	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Stewartry Coast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northumberland Coast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals															

SPM

Volume - Visual Amenity Inside Designated Areas			2011	2012	2013	2014	2015	2016	DPCR5	ED1
Over Head Lines inside Designated Areas at End of Reporting Year (March to April)	Low Voltage	km	974	973	980	936	947	911	**4,812**	**911**
Over Head Lines inside Designated Areas at End of Reporting Year (March to April)	High Voltage	km	2,068	2,063	2,046	1,982	1,978	1,952	**10,137**	**1,952**
Over Head Lines inside Designated Areas at End of Reporting Year (March to April)	Exta High Voltage AC cables	km	359	358	357	266	266	252	**1,606**	**252**
Over Head Lines inside Designated Areas at End of Reporting Year (March to April)	132kV	km	54	54	54	53	76	55	**292**	**55**
Total OHL Inside Designated Areas at End of Reporting Year (km)		km	3,456	3,449	3,438	3,237	3,267	3,170	**16,848**	**3,170**
OHL (km) Removed During Year	LV	km	1	1	1	-	-	1	**2**	**1**
OHL (km) Removed During Year	HV	km	5	5	3	-	4	1	**15**	**1**
OHL (km) Removed During Year	EHV	km	6	1	1	-	0	-	**8**	-
OHL (km) Removed During Year	132kV	km	-	-	-	-	-	-	-	-
Total OHL (km) Removed During Year		km	11	7	4	-	4	2	**26**	**2**
UG Cables Installed During Year (km)	LV	km	1	1	1	-	-	-	**2**	-
UG Cables Installed During Year (km)	HV	km	5	5	3	-	4	-	**16**	-
UG Cables Installed During Year (km)	EHV	km	6	1	1	-	-	-	**8**	-
UG Cables Installed During Year (km)	132kV	km	-	-	-	-	-	-	-	-
Total UG Cables Installed During Year (km)		km	11	7	4	-	4	-	**26**	-

Volume - Visual Amenity Outside Designated Areas (10% Allowance)

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 (km)	LV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	HV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	EHV	km	-	-	-	-	-	-	-	-
UG Cables Installed During Year (km)	132kV	km	-	-	-	-	-	-	-	-
Total UG Cables Installed During Year (km)			-	-	-	-	-	-	-	-

Costs										
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	LV	£m	0.01	0.00	0.05	0.00	0.00	0.10	**0.06**	**0.06**
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	HV	£m	0.54	0.62	0.29	0.25	0.34	0.00	**2.05**	**0.00**
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	EHV	£m	0.06	0.00	0.30	0.00	0.00	0.00	**0.36**	**0.03**
Visual Amenity Expenditure on Visual Amenity Inside Designated Areas	132kV	£m	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	LV	£m	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	HV	£m	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	EHV	£m	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Visual Amenity Expenditure on Visual Amenity Outside Designated Areas	132kV	£m	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Total Visual Amenity Expenditure			**0.60**	**0.62**	**0.64**	**0.26**	**0.34**	**0.10**	**2.47**	**0.09**

Undergrounding Activity Under ED1 Visual Amenity Allowance

Designated AONB (Areas of outstanding National beauty within SPM's Network Area		OHL Inside Designated Areas at End of Reporting Year March 2016 (km)					Visual Amenity Inside Designated Areas: OHL (km) Removed During Year to March 2016				
		LV	HV	33kV & 66k	132kV	Total	LV	HV	33kV & 66k	132kV	Total
Snowdonia National Park	DA1	428.125	1155.588	210.33	51.349	1845.392	0	0	1.1	0	1.1
Shropshire Hills	DA2	0.009	0	0	0	0.009	0	0	0	0	0
Bryniau Clwyd A Dyffryn Dyfrdw	DA3	204.511	379.386	28.807	2.083	614.787	0	0	0	0	0
Llyn	DA4	115.902	180.326	6.4	0	302.628	0.5	0	0	0	0.5
Ynys Mon/Anglesey	DA5	162.315	236.888	6.325	1.166	406.694	0	0	0	0	0
Totals		**911**	**1952**	**252**	**55**	**3170**	**0.5**	**0**	**1.1**	**0**	**1.6**

Designated AONB (Areas of outstanding National beauty within SPM's Network Area	Visual Amenity Inside Designated Areas: UG Cables Installed During Year to March 2016(km)					Visual Amenity Inside Designated Areas: Visual Amenity Expenditure (£m) on Visual Amenity Inside Designated Areas by voltage				
	LV	HV	33kV & 66k	132kV	Total	LV	HV	33kV & 66k	132kV	Total
Snowdonia National Park	0	0	0.031173	0	0.031173	0	0	0	0	0
Shropshire Hills	0	0	0	0	0	0	0	0	0	0
Bryniau Clwyd A Dyffryn Dyfrdw	0	0	0	0	0	0	0	0	0	0
Llyn	0.062009	0	0	0	0.062009	0	0	0	0	0
Ynys Mon/Anglesey	0	0	0	0	0	0	0	0	0	0
Totals	**0.06201**	**0**	**0.03117**	**0**	**0.09318**	**0**	**0**	**0**	**0**	**0**

Designated AONB (Areas of outstanding National beauty within SPM's Network Area	Visual Amenity Outside Designated Areas: OHL (km) Removed During Year to March 2016					Visual Amenity Outside Designated Areas: UG Cables Installed During Year (km)					Visual Amenity Outside Designated Areas: Visual Amenity Expenditure (£m) on Visual Amenity Outside Designated Areas by voltage				
	LV	HV	33kV & 66k	132kV	Total	LV	HV	33kV & 6(	132kV	Total	LV	HV	33kV & 6(	132kV	Total
Snowdonia National Park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shropshire Hills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryniau Clwyd A Dyffryn Dyfrdw	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Llyn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ynys Mon/Anglesey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Oil, SF6 & Noise pollution Appendix 3 SPD & SPM 2016
E2 - Environmental Reporting

SPD

Description	Measurement	Volumes 2011	2012	2013	2014	2015	2016	DPCR5	ED1	Cost 2011	2012	2013	2014	2015	2016	DPCR5	ED1
Over head cables undergrounded for Visual Amenity	km removed	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Visual Amenity Schemes	Interventions	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Schemes to reduce oil leaks in cables	Interventions	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Schemes to reduce oil leaks in operational sites	Interventions	1.00	0.00	16.00	1.00	1.00	16.00	**19.00**	**16.00**	0.11	0.00	1.14	0.03	0.03	0.45	1.31	0.45
Schemes to reduce oil leaks in non-operational sites	Interventions	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Schemes to reduce SF6 Emitted	Interventions	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Noise Pollution	Interventions	11.00	10.00	10.00	14.00	39.00	0.00	**84.00**	**0.00**	0.11	0.45	0.00	0.00	0.01	0.00	0.57	0.00
Contaminated Land Clean Up	Interventions	8.00	10.00	0.00	0.00	0.00	0.00	**18.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Environmental Civil Sanction	Interventions	1.00	1.00	1.00	0.00	1.00	0.00	**4.00**	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
										0.21	**0.45**	**1.14**	**0.03**	**0.04**	**0.45**	**1.87**	**0.45**
Length Fluid-Filled Cables in use	Circuit km	30.00	30.00	29.30	29.00	29.00	28.90										
Amount of fluid in Cables	Fluid ltrs	0.00	0.00	0.00	0.00	0.00	86700.00										
Amount of fluid used to Top Up Cables	Fluid ltrs	190.00	0.00	500.00	46.00	37.00	0.00	**773.00**	**0.00**								
Percentage of fluid topped up	%	-	-	-	-	-	-										
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**								
SF6 (amount currently stored by SPD) (banked)	kg	11,017.00	11,397.00	11,855.80	12,564.00	13,259.00	12,709.96										
SF6 Emitted	kg	55.09	68.57	61.00	61.70	62.40	0.80	**309.00**	**0.80**								
SF6 Emitted as a percentage of SF6 Bank	%	0.5%	0.6%	0.5%	0.5%	0.5%	0.01%										
Total complaints received regarding noise	Number of complaints	-	-	-	-	-	-	**-**	**-**								

Description	Measurement	Volumes 2011	2012	2013	2014	2015	2016	DPCR5	ED1	Cost 2011	2012	2013	2014	2015	2016	DPCR5	ED1
Over head cables undergrounded for Visual Amenity	km removed	0.00	0.00	0.00	0.00	0.00	2.29	**0.00**	**2.29**	0.00	0.00	0.00	0.00	0.00	0.21	**0.00**	**0.21**
Other Visual Amenity Schemes	Interventions	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Schemes to reduce oil leaks in cables	Interventions	0.00	0.00	0.00	0.00	1.00		**1.00**	**0.00**	0.00	0.00	0.00	0.00	0.02		**0.02**	**0.00**
Schemes to reduce oil in operational sites	Interventions	0.00	0.00	9.00	0.00	2.00	8.00	**11.00**	**8.00**	0.00	0.00	0.18	0.27	0.12	0.37	**0.57**	**0.37**
Schemes to reduce oil in non-operational sites	Interventions	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Schemes to reduce SF6 emitted	Interventions	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
Noise Pollution	Interventions	8.00	7.00	10.00	11.00	33.00	0.00	**69.00**	**0.00**	0.00	0.00	0.00	0.06	0.22		**0.28**	**0.00**
Contaminated Land Clean Up	Interventions	29.00	22.00	0.00	0.00	0.00		**51.00**	**0.00**	0.00	0.21	0.00	0.10	0.00		**0.31**	**0.00**
Environmental Civil Sanction	Interventions	12.00	7.00	7.00	1.00	1.00		**28.00**	**0.00**	0.00	0.00	0.00	0.00	0.00		**0.00**	**0.00**
										-	**0**	**0**	**0**	**0**	**1**	**1.18**	**0.58**
Length Fluid-Filled Cables in use	Circuit km	0.00	0.00	0.00	0.00	0.00	159.00										
Amount of Oil in Cables	Fluid ltrs	0.00	0.00	0.00	0.00	0.00	699,600.00										
Amount of Oil used to Top Up Cables	Fluid ltrs	4722.00	10443.00	4326.00	5535.00	3555.00	13,600.00	**28,581**	**13,600**								
Percentage of oil topped up	%	-	-	-	-	-	0.02										
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs	0.00	0.00	0.00	0.00	1.00	4500.00	**1**	**4,500**								
SF6 (amount currently stored by SPM) (banked)	kg	21,691.00	21,949.00	21,691.00	22,193.00	23,117.00	16,893.36										
SF6 Emitted	kg	108.46	119.04	121.00	121.80	124.20	29.87	**594**	**30**								
SF6 Emitted as a percentage of SF6 Bank	%	0.5%	0.5%	0.6%	0.5%	0.5%	0.18%										
Total complaints received regarding noise	Number of complaints	-	-	-	-	-	8	**-**	**8**								

Business Carbon Footprint Appendix 4 SPD & SPM 2016
E3 BCF

Volumes in tCO2e

DPCR5

We used conversion factors from DEFRA detailed to calculate CO2 emissions from our units of measure. For example electricity is measured in KWH. We get the electricity used in Kwh and multiply it by the Defra conversion rate.

			2011		2012		2013		2014		2015		2016		2016		Volume		
		Units	SPD	SPM	SPD	SPM	SPD	SPM	SPD	SPM	SPD	SPM	SPD	SPM		Defra Conversion	SPD	SPM	Unit of Measure
Totals	**Total BCF (excl. losses)**	tCO2e	34,235.07	15,806.07	35,595.94	15,278.15	35,029.61	15,485.50	31,076.89	15,143.10	24,549.36	26,026.38	16,719.84	13,114.32	n/a	n/a			
	Total BCF (incl. losses)	tCO2e	91,847.57	63,739.67	96,891.56	63,462.82	88,529.61	59,997.50	78,689.39	54,756.70	78,574.36	80,051.38	63,351.36	51,999.36	n/a	n/a			
Buildings Energy Usage	Buildings - Electricity	tCO2e	4,388.47	4,270.90	2,940.76	3,851.92	3,411.40	3,545.90	2,459.93	3,068.81	3,377.00	3,377.00	2,270.62	2,842.31	Buildings - Electricity	0.46219	4912735.817	6149664	kwh
	Buildings Natural Gas	tCO2e	132.82	59.78	57.17	4.28	104.20	7.10	17.00	9.89	28.00	28.00	25.21	5.00	Buildings - Other fuels	0.18445	136656.607	2711	kwh
	Substation Electricity	tCO2e	25,508.00	3,546.60	25,450.74	3,656.27	24,390.00	3,471.00	20,878.08	2,952.98	10,072.00	10,072.00	8,227.59	5,561.38	Buildings - Electricity	0.46219	17801325	12032680	kwh
	Radio Base Stations	tCO2e	21.95	64.88	82.54	21.11	56.50	18.20	69.54	21.53	190.00	190.00	21.99	1.91	Buildings - Electricity	0.46219	47588.103	4131	kwh
	Total		**30,051.24**	**7,942.16**	**28,531.21**	**7,533.58**	**27,962.10**	**7,042.20**	**23,424.55**	**6,053.22**	**187.00**	**13,667.00**	**10,545.41**	**8,410.61**					
Operational Transport	Rail	tCO2e	-		-		-		-		-		-		Rail	n/a			
	Sea	tCO2e	-		-		-		-		-		-		Sea	n/a			
	Air	tCO2e	-		-		-		-		-		-	-	Air	n/a			
	Road (Diesel)	tCO2e	968.01	3,602.16	3,476.51	3,198.98	3,948.30	3,388.70	3,825.04	3,282.94	3,599.00	3,599.00	3,770.14	2,681.16	Road (Diesel)	2.5839	1459090.586	1037639.596	Miles
	Road (Petrol)	tCO2e											14.69	1.04	Road (Petrol)	2.1944	6693.309873	4759.980921	Miles
	Road (LPG)	tCO2e	-		-		-				-		0.08	59.93	Road (LPG)	1.50938	55.831443	39.704811	Miles
	Total	tCO2e	**968.01**	**3,602.16**	**3,476.51**	**3,198.98**	**3,948.30**	**3,388.70**	**3,825.04**	**3,282.94**	**3,599.00**	**3,599.00**	**3,784.92**	**2,742.13**					
Business Transport	Rail	tCO2e	-		6.33	5.44	7.90	6.80	7.46	6.40	11.00	11.00	12.78	9.09	Rail	0.045057182	283601.9078	201684.9206	Kilometres
	Sea	tCO2e	-		-		-		-		-		-		Sea	n/a	n/a		
	Air Miles Domestic	tCO2e	43.17	37.44	187.32	160.77	98.90	84.90	68.25	58.58	220.00	220.00	91.54	65.10	Air Miles Domestic	0.15757	580951.5299	413146.5972	Kilometres
	Air Miles European	tCO2e											28.94	20.58	Air Miles European	0.08974	322490.1362	229340.4795	Kilometres
	Air Miles International	tCO2e	-		-		-		-		-		5.79	4.12	Air Miles International	0.10477	55249.81187	39291.1811	Kilometres
	Road Diesel	tCO2e	**1,818.19**	**1,576.82**	**1,562.39**	**1,340.96**	**1,397.10**	**1,199.10**	**1,423.72**	**951.16**	**1,456.00**	**1,456.00**	**674.13**	**520.18**	Road (Diesel)	0.293415598	2297540.897	1772829.315	Miles
	Road (Petrol)	tCO2e											100.65	85.50	Road (Petrol)	0.307803133	326989.7398	277785.571	Miles
	Road (Unknown)	tCO2e											575.33	223.74	Road (unknown)	0.299901254	1918402.792	746057.1553	Miles
	Total	tCO2e	**1,861.36**	**1,614.26**	**1,756.04**	**1,507.17**	**1,503.90**	**1,290.80**	**1,499.42**	**1,016.13**	**1,687.00**	**1,687.00**	**1,489.16**	**928.31**					
Fugitive Emissions	SF6	tCO2e	1,316.53	2,592.07	1,638.82	2,845.06	1,457.91	2,891.90	1,474.63	2,911.02	1,491.36	2,968.38	18.24	681.04	SF6	22800	0.8	29.87	kg
	Gases Other	tCO2e	-		-								-		Gases Other	n/a	n/a		n/a
	Total	tCO2e	**1,316.53**	**2,592.07**	**1,638.82**	**2,845.06**	**1,457.91**	**2,891.90**	**1,474.63**	**2,911.02**	**1,491.36**	**2,968.38**	**18.24**	**681.04**					
Fuel Combustion	Diesel	tCO2e	32.54	50.03	-		157.40	157.40	56.24	56.24	45.00	45.00	225.45	7.06	Diesel	2.90884	77504.02		litres
	Fuels Other	tCO2e	5.39	5.39	193.36	193.36	-	-	-	-	-		-		Fuels Other	2.90884		2427	litres
	Total	tCO2e	**37.93**	**55.42**	**193.36**	**193.36**	**157.40**	**157.40**	**56.24**	**56.24**	**45.00**	**45.00**	**225.45**	**7.06**					
Losses	Losses	tCO2e	57,612.50	47,933.60	61,295.62	48,184.67	53,500.00	44,512.00	47,612.50	39,613.60	54,025.0	44,948.8	46,631.52	38,885.04	Losses	0.03816	1222000000	1019000000	Kwh
Contractors Building Energy Use	Buildings - Electricity	tCO2e	-	-		-	-	19.5		2.1	187.0	187.0	18.63	15.62	Buildings - Electricity	0.46		33793.62	Kwh
	Buildings - Other fuels	tCO2e	-	-	-	-	-						4.71	0.05	Buildings - Other fuels	0.18		282.32	Kwh
	Buildings Natural Gas	tCO2e	-	-	-	-	-						-		Buildings Natural Gas				
	Total	tCO2e								**2.12**	**187.00**	**187.00**	**23.34**	**15.67**					
Contractors Operational Transport	Road Petrol	tCO2e											65.26	0.28	Road Petrol	0.31		911	Miles
	Road Diesel	tCO2e						452.1	700.8	1,484.8	3,121.0	3,121.0	-	295.34	Road Diesel	0.29		1006555.19	Miles
	Rail	tCO2e											-		Rail				
	Sea	tCO2e											-		Sea				
	Air	tCO2e											-	-	Air				
	Total	tCO2e						**452.10**	**700.77**	**1,484.77**			**65.26**	**295.62**					
Contractors Business Transport	Road	tCO2e						51.8		110.5	53.0	53.0	293.05	1.58	Road	0.29		5395	Miles
	Rail	tCO2e											-		Rail				
	Sea	tCO2e											-		Sea				
	Total	tCO2e						**51.80**		**110.54**	**53.00**	**53.00**	**293.05**	**1.58**					
Contractors Fuel Combustion	Diesel LPG	tCO2e						191.1	96.2	226.1	699.0	699.0	275.02	1.57	Diesel LPG	2.19		715.32	litres
	Contractor Energy Use (Oil)	tCO2e	-	-	-	-	-						-		Contractor Energy Use (Oil)				
	Fuels Other	tCO2e											-	78.09	Fuels Other	2.91		26847	litres
	Total	tCO2e						**191.10**	**96.24**	**226.13**	**699.00**	**699.00**	**275.02**	**79.66**					

Losses Snapshot Appendix 5 SPD & SPM 2016
E4 Losses

	Activity							Units and estimated unit costs					Volumes								Estimated total costs									Estimated Distribution Losses-Justified Costs									Estimated Distribution Losses benefits over 'Baseline Scenario'									RIIO-ED1 CBA Tool summary - estimated cumulative values for RIIO-ED1 and 45 years							
	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)	Cross-reference to relevant paragraph(s) of current Distribution Losses Strategy	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	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	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	Text	£k/unit	Text	£k/unit	£k/unit	#	↓	↓	↓	↓	↓	↓	↓	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m
SPD	Transformer	Undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)	Technical losses	Asset Replacement	Table - CV21	Yes	Page 20 Table 7.3 and Page 30 Table 7.4	Transformer Volumes	12.6	Do not undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)	12.6	12.6	30								0.38								0.38								5018								0.34	0.00	-0.34	0.00	0.13	0.33	-0.1	0.1
	Relevant Theft of Electricity	Theft in Conveyance Investigations	Non-technical losses	Operational activities to manage losses	Table - I5	Yes	Page 7 - Table 1.1	Number of cases investigated	0.0	Do not Investigate Theft in Conveyance and Relevant Theft of Electricity Cases	0.0	0.000	1								0.0								0.0								10								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
	Other (Revenue Protection Inspections)	Funding of Internal and External Revenue Protection Inspections	Non-technical losses	Operational activities to manage losses	Table - CV39	Yes	Page 46 - Section 8.1.2	Inspections	0.05	Do not fund internal and external revenue protection and inspection services	0.0	0.05	14155								0.64								0.64								13096								0.0	0.0	0.0	0.0	0.7	0.7	0.6	0.6
	Total																				**1.0**	-	-	-	-	-	-	-	**1.0**	-	-	-	-	-	-	-	**18,123.6**	-	-	-	-	-	-	-	**0.3**		**0.3**		**0.8**		**0.6**	
SPM	Transformer	Undertake early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)	Technical losses	Asset Replacement	Table - CV21	Yes	Page 29 Table 7.3 and Page 30 Table 7.4	Transformer Volumes	12.6	early replacement of Pre-1962 High Loss 6.6/11kV Transformer Ground Mounted (GM)	12.6	12.6	60.0								0.8								0.8								9531								0.7	0.0	-0.7	0.0	0.25	0.62	-0.2	0.09
	Relevant Theft of Electricity	Theft in Conveyance Investigations	Non-technical losses	Operational activities to manage losses	Table - I5	Yes	Page 7 - Table 1.1	Number of cases investigated	-	Do not Investigate Theft in Conveyance and Relevant Theft of Electricity Cases	-	-	-								-								0.00								28512								0.2	0.2	-0.2	-0.2	0.8	1.8	0.8	1.5
	Other (Revenue Protection Inspections)	Funding of Internal and External Revenue Protection Inspections	Non-technical losses	Operational activities to manage losses	Table - CV39	Yes	Page 46 - Section 8.1.2	Inspections	0.1	Do not fund internal and external revenue protection and inspection services	-	0.1	####								0.5								0.5								15060								0.0	0.0	0.0	0.0	0.8	0.8	0.7	0.7
	Total																				**1.3**	-	-	-	-	-	-	-	**1.3**	-	-	-	-	-	-	-	**53,108.9**	-	-	-	-	-	-	-	**0.9**		**0.9**		**1.8**		**1.3**	

Appendix 6 Smart Metering SPM & SPD 2016
First year of investment reporting year 2015/16

SPD

Costs	Cost		
		2016 RIIO-ED1 £m	RIIO-ED1 £m
Smart Meter Communication Licensee Costs (pass through)	-	0.6	**0.6**
Smart Meter Information Technology Costs (pass through)	-	0.9	**0.9**
Elective Communication Services (outside price control)	-	-	**-**
Smart Meter Communication Licensee Costs (outside price control)			**-**
Total	**-**	**1.5**	**1.5**

SPM

Costs	Cost		
Smart Meter Communication Licensee Costs (pass through)	-	0.4	**0.4**
Smart Meter Information Technology Costs (pass through)	-	0.8	**0.8**
Elective Communication Services (outside price control)	-	-	**-**
Smart Meter Communication Licensee Costs (outside price control)			**-**
Total	**-**	**1.2**	**1.2**

Appendix 7 Innovation SPD & SPM 2016

					Costs					MVA released			Estimated Gross Avoided Costs							
					2014	2015	RIIO-ED1 2016	DPCR5	Total RIIO-ED1	RIIO-ED1 2016	DPCR5	Total RIIO-ED1	2011	2012	DPCR5 2013	2014	2015	RIIO-ED1 2016	DPCR5	Total RIIO-ED1
	Voltage level of issue	**RIIO Output**	**Costs**	**Savings**	£m	£m	£m	£m	£m	MVA	MVA	MVA	£m	£m	£m	£m	£m	£m	£m	£m
SPD																				
Increase Network Capacity/Optimise Utilisation																				
Flexible Networks - Enhanced Secondary Substation Monitoring	LV		-£ 0.06	£ 0.88	**-£ 0.05**	**-£ 0.01**	-	**- 0.1**	**-**	**2.9**	**2.9**	**2.9**						**0.9**	**0.9**	**0.9**
Flexible Networks - Dynamic (Enhanced) Thermal Rating of Primary transformers	33kV/11kV		-£ 0.22	£ 0.28	**£ -**	**-£ 0.22**	-	**- 0.2**	**-**	**2.1**	**2.1**	**2.1**						**0.3**	**0.3**	**0.3**
Flexible Networks - Voltage Optimisation							-	**-**	**-**	-		**-**						-	**-**	**-**
SPT1001 IMPLEMENTATION OF REAL-TIME RATINGS	11/33kV							**-**	**-**			**-**							**-**	**-**
NIA SPEN 0003 Enhanced Real-Time Cable Temperature Monitoring	11/33kV							**-**	**-**			**-**							**-**	**-**
NIA ENWL 0003 Review of Engineering Recommendation P2/6	All							**-**	**-**			**-**							**-**	**-**
Total							**-**	**-**	**-**	**5.0**		**5.0**						**1.2**	**-**	**1.2**
Improve Asset Life Cycle Management																				
NIA NPG 0001 Vonaq Utility Pole Strength Measurement	All							**-**	**-**			**-**							**-**	**-**
Transformer Refurbishment	33kV & 132kV		-£ 0.05	£ 0.23			**-£ 0.05**	**-**	**- 0.0**			**-**						**0.2**	**-**	**0.2**
Total							**- 0.0**	**-**	**- 0.0**	**-**		**-**						**0.2**	**-**	**0.2**
Improve Network Performance																				
IFI 1304 Smart Meter Enablement	LV							**-**	**-**			**-**							**-**	**-**
IFI 1404 Urban NCP Enhancement Project	LV & 11kV							**-**	**-**			**-**							**-**	**-**
Total							**-**	**-**	**-**	**-**		**-**						**-**	**-**	**-**
Improve Vegetation Management																				
NIA SPEN 0002 Virtual World Asset Management	All							**-**	**-**			**-**							**-**	**-**
Total							**-**	**-**	**-**	**-**		**-**						**-**	**-**	**-**
Improve Safety																				
IFI 1007 Outram Fault Level Monitor	All							**-**	**-**			**-**							**-**	**-**
IFI 1414 PD - VMX	11kV							**-**	**-**			**-**							**-**	**-**
Smart Locks	All							**-**	**-**			**-**							**-**	**-**
Total							**-**	**-**	**-**	**-**		**-**						**-**	**-**	**-**
Improve Environmental Impact																				
NIA SPEN 0006 Mini-mole	LV & 11kV							**-**	**-**			**-**							**-**	**-**
NIA SPEN 0011 LV Elbow Joints	LV							**-**	**-**			**-**							**-**	**-**
Total							**-**	**-**	**-**	**-**		**-**						**-**	**-**	**-**
Improve Connection Performance																				
SPT2 004 ARC	Various	-	CV38	£ 17.96			**-**	**-**	**-**	**112.7**		**112.7**						**18.0**	**-**	**18.0**
Total							**-**	**-**	**-**	**112.7**		**112.7**						**18.0**	**-**	**18.0**
SPM																				
Increase Network Capacity/Optimise Utilisation																				
Flexible Networks - Enhanced Secondary Substation Monitoring	LV		£ -	£ 0.88	**£ -**	**£ -**	-	**£ -**	**£ -**	**2.93**		**2.93**						**£ 0.9**	**£ 0.9**	**£ 0.9**
Flexible Networks - Dynamic (Enhanced) Thermal Rating of Primary tra	33/11kV		-£ 0.22	£ 0.38	**0**	**-£ 0.22**	-	**-£ 0.2**	**£ -**	**2.00**		**2.00**						**£ 0.4**	**£ 0.4**	**£ 0.4**
Flexible Networks - Voltage Optimisation	11kV/LV		-£ 0.06	£ 0.05	**0**	**-£ 0.22**	-	**-£ 0.2**	**£ -**	**0.36**		**0.36**						**£ 0.1**	**£ -**	**£ 0.1**
SPT1001 IMPLEMENTATION OF REAL-TIME RATINGS								**£ -**	**£ -**			**0.00**							**£ -**	**£ -**
NIA SPEN 0003 Enhanced Real-Time Cable Temperature Monitoring								**£ -**	**£ -**			**0.00**							**£ -**	**£ -**
NIA ENWL 0003 Review of Engineering Recommendation P2/6								**£ -**	**£ -**			**0.00**							**£ -**	**£ -**
Total					£ -	-£ 0.43	**-**	**-£ 0.4**	**£ -**	**5.28**		**5.28**						**£ 1.3**	**£ -**	**£ 1.3**
Improve Asset Life Cycle Management																				
Transformer Refurbishment	132kV/33kV		-£ 0.27	£ 1.07			**-**	**£ -**	**£ -**			**-**						**£ 1.1**	**£ -**	**£ 1.1**
NIA NPG 0001 Vonaq Utility Pole Strength Measurement								**£ -**	**£ -**			**-**							**£ -**	**£ -**
Total					£ -	£ -	**-**	**£ -**	**£ -**	**-**		**-**						**£ 1.1**	**£ -**	**£ 1.1**
Improve Network Performance																				
IFI 1304 Smart Meter Enablement								**£ -**	**£ -**			**-**							**-**	**-**
IFI 1404 Urban NCP Enhancement Project								**£ -**	**£ -**			**-**							**-**	**-**
Total					£ -	£ -	**£ -**	**£ -**	**£ -**	**-**		**-**						**-**	**-**	**-**
Improve Vegetation Management																				
NIA SPEN 0002 Virtual World Asset Management								**£ -**	**£ -**			**-**							**-**	**-**
Total							**-**	**£ -**	**£ -**	**-**		**-**						**-**	**-**	**-**
Improve Safety																				
IFI 1007 Outram Fault Level Monitor								**£ -**	**£ -**			**-**							**-**	**-**
IFI 1414 PD - VMX								**£ -**	**£ -**			**-**							**-**	**-**
Smart Locks								**£ -**	**£ -**			**-**							**-**	**-**
Total							**-**	**£ -**	**£ -**	**-**		**-**						**-**	**-**	**-**
Improve Environmental Impact																				
NIA SPEN 0006 Mini-mole								**£ -**	**£ -**			**-**							**-**	**-**
NIA SPEN 0011 LV Elbow Joints								**£ -**	**£ -**			**-**							**-**	**-**
Total							**-**	**£ -**	**£ -**	**-**		**-**						**-**	**-**	**-**
Improve Connection Performance																				
No current work underway																				

0

Appendix 8 Low Carbon Technologies 2016 SPM & SPD

SPD

Estimated volumes of Low Carbon Technologies Installed

	Units	RIIO-ED1 2016	2017	2018	2019	2020	2021	2022	2023	Totals
		#	#	#	#	#	#	#	#	#
Secondary network										
Heat Pumps	Number	20.0								**20.0**
EV slow charge	Number	405.0								**405.0**
EV fast charge	Number									**-**
PVs (G83)	Number	5,497.0								**5,497.0**
Other DG (G83)	Number	4.0								**4.0**
DG (non G83)	Number									**-**
Total	Number	**5,926.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,926.0**
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								**145.0**
Total	Number	**145.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**145.0**

Estimated size of Low Carbon Technologies Installed (MW - megawatt definition. A unit of power: one million watts)

Secondary network										
Heat Pumps	MW	0.1								**0.1**
EV slow charge	MW	2.7								**2.7**
EV fast charge	MW									**-**
PVs (G83)	MW	18.3								**18.3**
Other DG (G83)	MW	0.0								**0.0**
DG (non G83)	MW									**-**
Total	MW	**21.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**21.1**
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								**124.7**
Total	MW	**124.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**124.7**

SPM

Estimated number of Low Carbon Technologies Installed

Secondary network										
Heat Pumps	Number	42.0								**42.0**
EV slow charge	Number	437.0								**437.0**
EV fast charge	Number									**-**
PVs (G83)	Number	7,966.0								**7,966.0**
Other DG (G83)	Number	1.0								**1.0**
DG (non G83)	Number									**-**
Total		**8,446.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8,446.0**
Primary network										
Heat Pumps	Number									**-**
EV slow charge	Number									**-**
EV fast charge	Number									**-**
PVs (G83)	Number									**-**
Other DG (G83)	Number									**-**
DG (non G83)	Number	120.0								**120.0**
Total		**120.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**120.0**

Estimated size of Low Carbon Technologies Installed

Secondary network										
Heat Pumps	MW	0.3								**0.3**
EV slow charge	MW	2.7								**2.7**
EV fast charge	MW									**-**
PVs (G83)	MW	25.0								**25.0**
Other DG (G83)	MW	0.0								**0.0**
DG (non G83)	MW									**-**
Total		**28.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**28.0**
Primary network										
Heat Pumps	MW									**-**
EV slow charge	MW									**-**
EV fast charge	MW									**-**
PVs (G83)	MW									**-**
Other DG (G83)	MW									**-**
DG (non G83)	MW	70.4								**70.4**
Total		**70.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**70.4**