Scottish and Southern Electricity Networks Environment Report

2015/16

Scottish & Southern Electricity Networks


CRESTO

Contents

1. Introduction

1.1. Executive Summary

One of our objectives for RIIO-ED1 is to reduce our impact on the environment and deliver the environmental expectations of our stakeholders. This was confirmed in stakeholder surveys when 88% rated lowering the environmental impact of your electricity supply by reducing reliance on fossil fuels as either 'very important' or 'important'.

Through our business activities we have managed to reduce our total business carbon footprint for 2015/16 to 60,588 tonnes of CO_2 – a reduction of 27% on the figure reported for 2014/15. This improvement is the result of reductions in emissions from fuel combustion and operational transport.

Our RIIO-ED1 commitments in this area were:

- Reduce the energy consumption in our buildings by 15%
- Reduce the average mileage of SSEN vehicles by 10%
- Reduce rate of leakage of installed SF_6 by 15%

All of these commitments are over the course of the RIIO-ED1 period, 2015–2023.

In terms of impact to visual amenities, we plan to replace 21 kilometres of fluid-filled cable in our SHEPD area and 55km in SEPD, during the RIIO-ED1 period in order to maintain a reliable network whilst protecting the environment and our customers.

In 2015/16, we have targeted our funding for undergrounding Areas of Outstanding Natural Beauty (AONB) and national parks on our High Voltage network by dismantling a total 1.2km of overhead line in the North Wessex AONB and Sunwood Downs AONB.

With respect to our Losses Strategy, we have also managed to achieve a reduction of 4% in distribution losses through improved business activities. We have commenced on the implementation of all the measures outlined in our Losses Strategy and these include:

- The installation of energy efficient transformers that deliver the enhanced losses performance
- Minimum sizing of cables and transformers to reduce losses
- Initiatives to reduce non-technical losses

We stated in our RIIO-ED1 Business Plan that our focus was on making innovation happen, delivering innovation and transferring it into Business as Usual (BaU). We are pleased to be able to say that we are achieving the key focus of our innovation strategy by successfully delivering real value to our customers and wider stakeholders.

We have continued to build on our broad portfolio of research and development projects developed via the Innovation Funding Incentive, Low Carbon Network Fund Tier 1 (replaced by the Network Innovation Competition (NIC)), Network Innovation Allowance and, more recently our Constraint Managed Zones (CMZ).

These achievements in the first year of RIIO-ED1 are getting us closer to achieving the targets we set ourselves in our business plan.

27%

reduction in our CO_2 footprint since our 2014/15 report.

This report and associated documents can be found at:

www.ssen.co.uk/Library/StakeholderEngagementPublications/

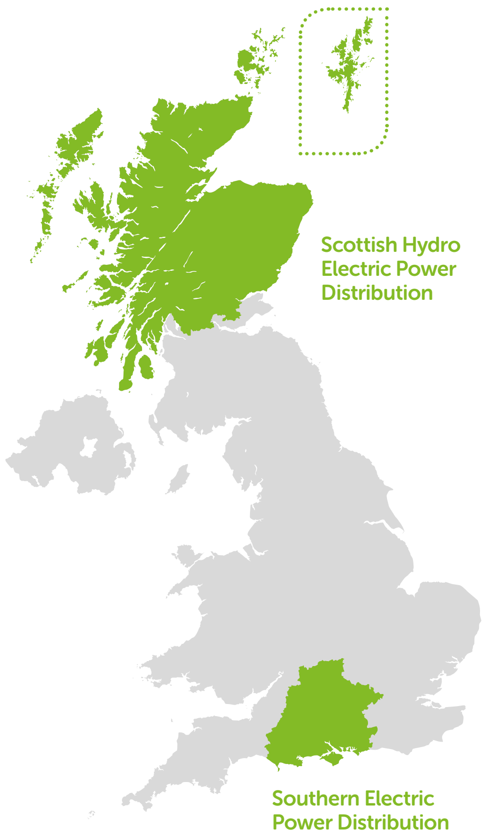
1.2. Our Business/Who We Are

Our business explained

We are Scottish and Southern Electricity Networks (SSEN), responsible for maintaining and operating the electricity distribution networks across central southern England and north of the central belt in Scotland and maintaining the electricity transmission network north of the central belt in Scotland.

Our Networks business consists of two electricity distribution businesses, Scottish Hydro Electric Power Distribution plc (SHEPD) and Southern Electric Power Distribution plc (SEPD), and one electricity transmission business, Scottish Hydro Electric Transmission plc (SHE Transmission).

Together these networks comprise 106,000 substations and 126,000km of overhead lines and underground cables across one third of the UK, delivering electricity to over 3.7 million homes and businesses.



Our network

1/3
Our two regions represent one third of the land mass of Great Britain

100
Over 100 subsea cables, powering island communities

550,000
Number of calls taken by local call centres in Perth and Portsmouth in 2015/16. Of these less than 1% were abandoned across our SEPD and SHEPD areas

4,000
Employees working from 85 depots and offices in the heart of the community

£1m
Awarded to local community projects through our Resilient Communities Fund

Our new brand

Scottish and Southern Electricity Networks is our new trading name that replaces our old brand, Scottish and Southern Energy Power Distribution (SSEPD).

While we are still proudly part of SSE plc, Scottish and Southern Electricity Networks is a rapidly changing business with a genuine commitment to being more customer focused. Engagement with our customers, stakeholders and feedback from our own research led us to look at how we could simplify our brand to provide a greater understanding of who we are, what we do and how we can be contacted.

In response, we launched Scottish and Southern Electricity Networks to make it easier to identify us and understand what we do. Our new brand aligns all of our Networks businesses under one clear and distinct unified identity.

Our brand values

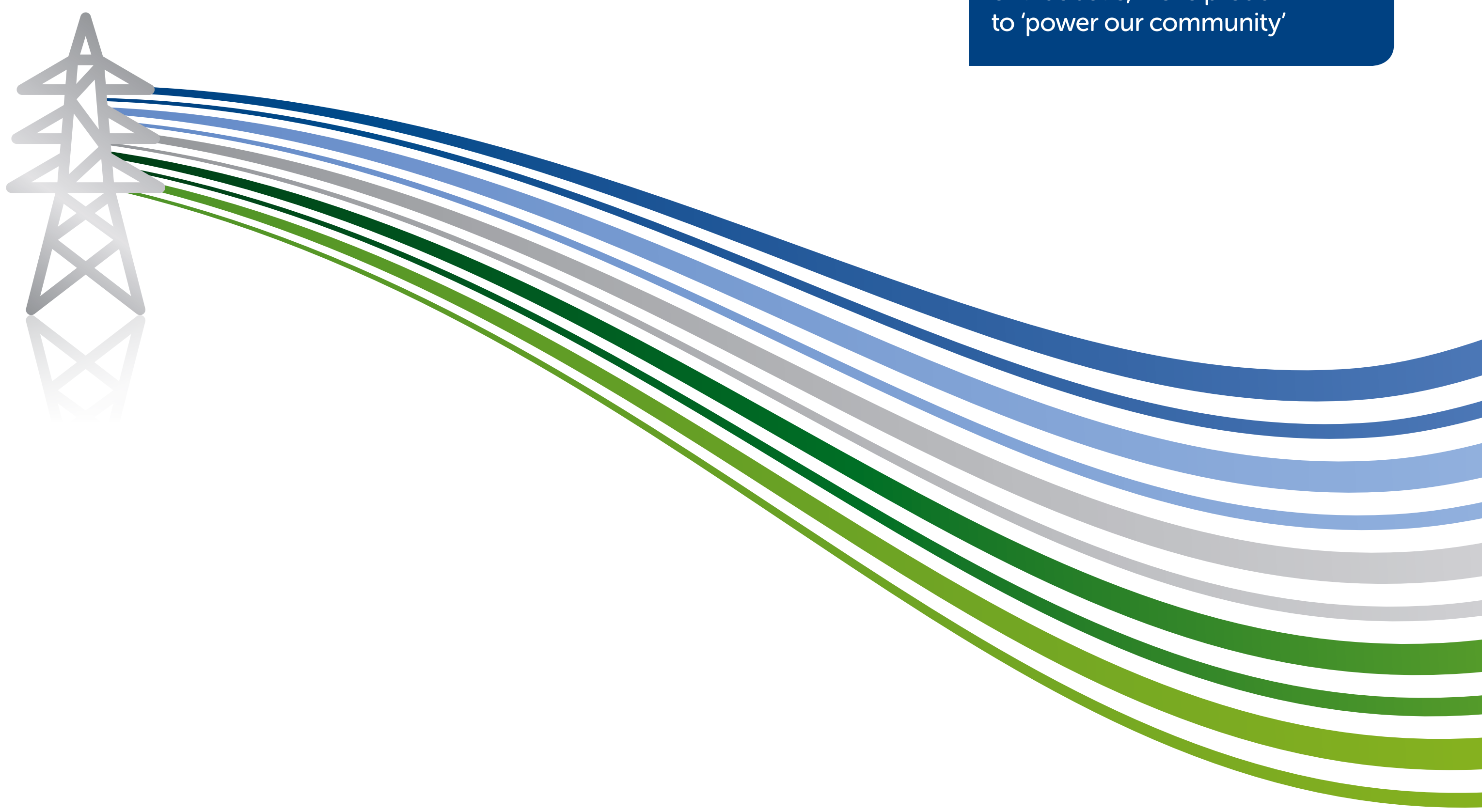
Reliable
People and communities can depend on us completely; we do what we say

Professional
We work hard, and our standards are second to none

Dedicated
We've shown time and again, we stop at nothing to get the job done safely and well

Open
We're honest, and always there when you need us

Passionate
We love what we do, we're enthusiastic, we're proud to 'power our community'



Scottish & Southern Electricity Networks | Powering our community

1.3. Purpose of the Report

The purpose of this Environmental Report is to provide stakeholders with a transparent and public account of SSEN's commitment to addressing environmental matters. This includes, but is not limited to, our role in the low carbon transition.
It is intended to provide a holistic overview and clear rationale for our actions and details of actual benefits to customers., and provide an important update on our continuing progress to meet our environmental targets, and show how stakeholders can shape this going forward in areas such as investment in Visual Amenity projects.

2. Managing Our Environmental Impact

2.1. Introduction

The purpose of this section is to provide a transparent account that our business activities have on the environment, our commitment to address these impacts and the innovation projects that have been initiated, which have already delivered or will deliver environmental benefits to stakeholders. This section highlights our carbon footprint, reports on greenhouse emission on the fuels we use in our buildings, for transportation, and for maintaining our assets and reports on our progress with delivering on our targets for visual amenity.

2.2. Visual Amenity

Our distribution networks consist of overhead lines, substations and, on a number of Scottish islands, small power stations that provide back-up generation. We recognise that this equipment can impact on visual amenity particularly, although not exclusively, in Areas of Natural Beauty (AONB), National Parks and National Scenic Areas (NSA). In particular, some can find overhead lines unsightly and consider the attractiveness of the landscape reduced by their presence. This might impact on individual wellbeing and also local economies if, for example, the main industry is tourism. As we always aim to provide a high level of customer service, this is important to us.

In the following section, we provide further information on the progress we have made in delivering our targets for RIIO-ED1 and forthcoming projects that we plan to deliver.

Both SHEPD and SEPD is given a defined funding for undergrounding of overhead lines in protected landscapes from Ofgem. This funding is influenced from the stakeholder engagement completed in this area. Stakeholders indicated a universal perception that undergrounding was "important" or "very important" for visual amenity and supported SSE's stakeholder led approach to address concerns in these areas.

Funding is specifically targeted at areas of outstanding natural beauty and National Parks, and is only applicable for distribution voltages of LV, 11kV, 33kV, 132kV.

Our stakeholders indicated that we should include factors that they consider important to them, such as the historic environment and that these were considered as part of the scheme selection process.

This is achieved by using a Visual Amenity Impact scoring model, developed in agreement with the AONB and National Park offices in our Region. Schemes are nominated to SEPD and SHEPD via these stakeholders, considered and prioritised to ensure consistency in assessment across all SEPD and SHEPD areas.

The focus is therefore on HV and EHV overhead lines that have a high visual impact on the landscape and which have a dominant impact for many viewers, targeting the top 1.5% of worst offending overhead lines in these designated areas.

Schemes are co-ordinated with other network investment and maintenance works where practicable to reduce the inconvenience impact on land owners and delivery costs.

We have a total 15,444 km of overhead lines within designated areas at the year end of 2015/16 in both DNO areas.

At the end of 2015/16, in the SEPD area our AONB programme spent approximately £0.25m. We laid 0.8km of HV Cable and dismantled 1.2 km of overhead line.

Breakdown by designated areas is shown in Table 1, Table 2 and Table 3.

At the end of 15/16, we laid 0.8km of HV Cable and dismantled

1.2km

of overhead line.

Breakdown by designated areas

Table 1 – Designated areas SEPD 2015/16

Scheme	Designated Area	OHL km Removed	Completion Date
Hungerford Thursley Common	North Wessex Downs AONB	0.4	2015/16
North Lodge to Sunwood Farm, Buriton, Petersfield	South Downs National Park	0.85	2015/16

Table 2 – SEPD Forthcoming Visual Amenity Projects

Scheme	Designated Area	OHL km Planned	Planned Completion Date
National Trust, Sherborne, Gloucestershire	Cotswolds AONB	1.4	2017/18
West Kennett, Gunsite Road and Silbury Hill	North Wessex Downs AONB	1.9	2018/19
Turville Village	Chilterns AONB	2.9	2016/17
Buckland Rings Iron Age Fort, Lymington	New Forest National Park	0.54	2016/17
Monkton Medieval Settlement, Chilgrove	South Downs National Park	1.75	2017/18
Tichborne, Alresford	South Downs National Park	4	2016/17
Ulwell Gap, Godlingston Hill, Purbeck	Dorset AONB	3.3	2017/18

Our network team in SHEPD conducted an extensive programme of stakeholder consultation in 2015, giving the public, local authorities and charities the opportunity to nominate overhead line sections which they would like to be considered for undergrounding.

Table 3 – SHEPD Forthcoming Visual Amenity Projects

Scheme	Designated Area	OHL km removed	Delivery date
Glen Tromie	Cairngorms National Park	8.0	2016/17
Callendar	Loch Lomond and The Trossachs National Park	2.0	2016/17
Balquidder	Loch Lomond and The Trossachs National Park	0.25	2017/18
Kingussie	Cairngorms National Park	6.0	2017/18
Blair Atholl	Cairngorms National Park	2.0	2017/18

For further details on Visual Amenity, please see worksheet E1 – Visual Amenity in Appendix 1.

2.3 Oil Leakage

Oil filled cables often suffer leaks due to age and wear. To mitigate the environmental impact and supply disruption when there is a leak, we employ a proactive leak location process. This process allows the circuit to remain in service while the leak location is being conducted by dosing the oil filled cable system with an inert fault detection fluid. This method of detection is capable of detecting more than one leak on the circuit at each operation. This process is built in to the routine maintenance of our asset. Depending on leak rate and volume, oil is pumped back in to the cable to re-pressurise and restore operation; and any leakage is cleaned up as required to minimise environmental impact.

In addition to our proactive oil leakage strategy, we also have a comprehensive contract and equipment available to ensure that we can provide a robust response to any oil leakage event.

We acknowledge that using oil as a cable insulator is an expired practice, and this has been superseded by solid cables. Besides operational maintenance, we plan to replace 21 kilometres of fluid-filled cable in our SHEPD area and 55km in SEPD, during the RIIO-ED1 period in order to maintain a reliable network whilst protecting the environment and our customers. We will report the reductions annually as the schemes get underway during RIIO-ED1.

For further details on Oil Leakage, please see worksheet E2 – Environmental Reporting in Appendix 1.

2.4. Carbon Impact and Climate Change

2.4.1. Business Carbon Footprint

This section details the total green house gas emissions produced by SHEPD and SEPD in the financial year 2015/16.

The purpose of this Business Carbon Footprint section is to provide a transparent account that our business activities have on the environment and our commitment to address these impacts. This report documents our carbon footprint and reports on greenhouse emission on the fuels we use in our buildings, for transportation, and for maintaining our assets.

In 2015/16, the combined total greenhouse gas emissions for SEPD and SHEPD were 1.13 $MtCO_2e$ for the 2 licence areas.

Of our carbon emissions, by far the largest contributor is electrical losses. This accounts for c.91% of SHEPD's and c.96% of SEPD's carbon emissions. The other activities that contribute from an SSEN perspective to our environmental footprint are sulphur hexafluoride (SF_6), and the emissions resulting from our vehicle fleet and buildings' energy usage.

How do we work to achieve our goal?

Our commitments by the end of the RIIO-ED1 period are:

- Reduce energy consumption in our buildings by 15%
- Reduce the average mileage of SSEN vehicles by 10%

One of the largest emission is from our vehicle fleet for the day to day operation of the business. Our fleet uses low emission cars and runs on diesel. This area of operational transport is one of the two areas we have achieved reductions due to our efforts and continued focus on reducing operational vehicle numbers.

We continue to look at the possibilities of increasing our use of biodiesel. Innovation in this area, for example hybrid and Electric Vehicles (EVs), holds a lot of promise and we continue to monitor this as the technology develops and becomes more aligned with the demands of our fleet.

Similarly, on emissions from our buildings, we are part of an SSE-company wide target to reduce CO_2 from energy consumption by 15%. The initiative, War on Watts, started in 2011/12, focuses on the behavioural side of energy use and creates an energy efficient culture. Our Facilities Management Office rolls out a series of Carbon Cutting Investment Programmes. We expect to see our office and depots upgraded with suitable energy saving features such as solar thermal systems, grey water accumulators, lighting controls, sub metering and energy display.

In DPCR5, as we revisited our processes and procedures, as part of a Data Assurance exercise, we found a number of areas where we could improve on, and in 2015/16 we adopted those changes. For example, instead of reporting carbon emission, we have moved on to reporting carbon equivalent emissions which include methane and nitrous oxide in the combustion of fuel.

The classification of carbon sources in the tables presented in this section follows the requirements of the industry regulator, Ofgem, for the purposes of reporting Business Carbon Footprint. We have been developing the capability to report our carbon footprint for several years, leading to more accurate identification of relevant equipment and their associated emissions. This piece of work satisfies the requirements of Business Carbon Footprint Rigs Standard Condition 46A.

Unless otherwise stated in this document, all conversion rates are extracted from specific annexes listed in the Defra/BEIS Greenhouse Gas (GHG) Conversion Factors for Company Reporting template. The data for each respective source is set out in Table 4.

Table 4 – Summary Carbon Footprint for SSEN's licensed areas

SHEPD Carbon Footprint

	2015/16 tonne CO_2e	2014/15 tonne CO_2e	% of change
Building Energy Usage	6,134	6,248	-1.82%
Operational Transport	8,228	8,858	-7.11%
Business Transport	698	664	5.07%
Fugitive Emissions	1,808	1,592	13.59%
Fuel Combustion	5,892	27,768	-79%
Total	**22,761**	**45,130**	**-50%**

SEPD Carbon Footprint

	2015/16 tonne CO_2e	2014/15 tonne CO_2e	% of change
Building Energy Usage	8,594	8,998	-4.49%
Operational Transport	16,822	17,383	-3%
Business Transport	1,332	1,249	6.68%
Fugitive Emissions	8,702	7,254	19.96%
Fuel Combustion	3,940	4,900	-20%
Total	**39,390**	**39,784**	**-1%**

Major factors contributing to year on year variations in our emissions are explained below:

- The largest contribution to the reduction on carbon footprint is related to fuel consumption, which is used in generation back-up in some remote areas of our network. One of the main reasons for this reduction showing is the comparatively large requirement in 2014/15 to run our Bowmore Power Station from June to December 2014 in the Western Isles in Scotland. This was caused by the failure of the Mainland–Jura submarine cable, which was subsequently replaced. This fuel requirement was not incurred in 2015/16.
- The number of unmetered assets, such as CCTV cameras and infra-red illumination we installed at substations has reduced. This has resulted in a decrease in building energy usage.
- SHEPD experienced three major weather events in 2015/16 affecting supply of power to remote islands. Due to weather conditions and last minute arrangements, engineers travelled by ferry to restore supply. As such, we are seeing activity in the km travelled by sea, albeit at reduced levels to 2014/15. This also contributed to an increase in Business Transport costs.

For further details on Business Carbon Footprint, please see worksheet E3 – BCF in the Appendix 1 to this report.

2.4.2. Sulphur Hexafluoride Emissions (SF_6 Emitted)

SF_6

Our RIIO-ED1 commitment for Sulphur Hexafluoride Emissions is to reduce the rate of leakage of installed SF_6 assets by 15% over the RIIO-ED1 period.

Emissions of SF_6 are calculated by combining the volume of SF_6 used in routine maintenance and the volume used during fault repair. These figures are extracted from our Asset Management System which is recorded in accordance with ENA Engineering Recommendation (ER) S38. In addition, natural leakage is calculated using the aforementioned ER and a model produced by the ENA. The appropriate conversion factor is used to transform this combined figure of SF_6 lost to tCO_2 (Tonnes of Carbon Dioxide).

We take any leakage of SF_6 extremely seriously and have detailed policies and procedures in place to manage our associated assets. This is an area where we are actively ensuring that our procurement policies encourage the purchase of alternatives to SF_6. These alternatives are now starting to appear on the market and will be migrated towards as assets are replaced and the technology matures. In addition, through our innovation programme we have developed SF_6 leakage locating systems and effective interventions to reduce SF_6 once a leak is found.

For further details on Business Carbon Footprint, please see worksheets E2 – Environmental Reporting and E3 – BCF in Appendix 1.

2.4.3. Distribution Losses

Overview

Distribution losses are an unavoidable consequence of transferring energy across the electricity network and they have a significant financial and environmental impact. These losses can either be technical (as electricity can turn to heat as it is transported) or non-technical (for instance, due to theft or measurement errors). Electricity losses have a significant financial and environmental impact upon consumers. The annual cost of distribution network losses is approximately £1bn per annum across GB.

Losses Strategy

Our Distribution Losses Strategy was updated in April 2016 and identifies our approach to ensuring that losses on our network are kept as low as reasonably practicable. Key measures identified include:

- Installing Primary and Grid transformers that outperform the EU Eco Directive;
- Increasing the minimum size of new secondary transformers;
- Prioritising early replacement of pre 1960 secondary transformers;
- Increasing the minimum cable size to the next size up for new cables; and
- Continue to develop new methods of managing Non-technical Losses.

Full details of our Losses Strategy can be found at:

www.ssepd.co.uk/LossesStrategy

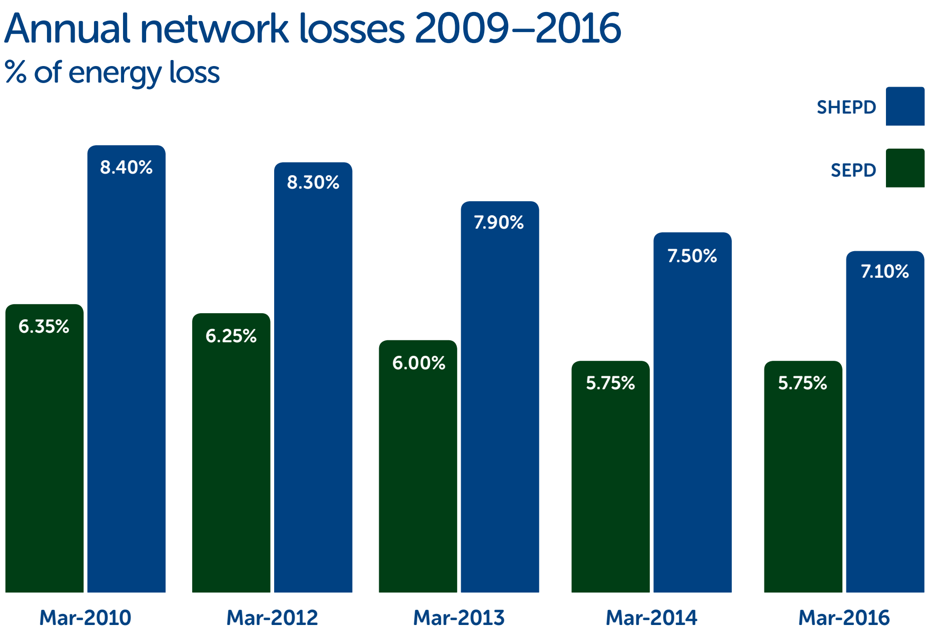
Losses Volume

The total amount of electrical losses on our network is calculated by subtracting the number of energy units known to be delivered to customers from the number of units that originally entered our network. There are a wide range of factors which influence Distribution Losses which in combination make losses notoriously difficult to measure accurately; for example, today's domestic metering does not record when energy is used in between each reading – this means it is not possible to completely align measurements of energy entering and leaving our network. However, current assessment of the losses on our network has been estimated as shown in Table 5. Figure 1 shows the percentage losses in the networks in relation to total electricity distributed.

Table 5 – Total losses in the network

Year 2015/16	Total Distribution Losses MWh	Equivalent tCO_2e
SHEPD	480,891	241,816.02
SEPD	1,640,018	824,683.14

Figure 1 – Percentage of energy losses 2009 - 2016



Losses Strategy in Action

SSEN has already commenced on the implementation of all of the measures outlined in our Losses Strategy, these include:

1 – Energy Efficient Transformers

We have commenced on the installation of plant and equipment that delivers enhanced losses performance and outperforms the EU Transformer Eco Directive Tier 1. Where relevant this has included prioritising the replacement of pre 1960 transformers.

2 – Minimum Sizing of Cables and Transformers

In general terms, larger diameter conductors result in lower losses. Therefore, we have put in place measures to increase the minimum size and rating of new cables and transformers. These measures relate to installation of equipment that affects both SSEN and external stakeholders such as Independent Connection Providers (ICPs). We have undertaken a detailed process of engagement with these key stakeholders to make them aware of the change, and have implemented the policy changes necessary to make these changes effective from 1 April 2016.

3 – Non-technical Losses

For the non-technical losses it was necessary to estimate the number of MWhs that will now be correctly metered and billed following resolution by our Revenue Protection Team. The Revenue Protection Team identified the number of properties/MPANS that have been rectified during the period. The number of MWhs was calculated using the average consumption per property type derived from the SHEPD or SEPD Common Distribution Charging Methodology as appropriate. We will continue to work with the Revenue Protection Team to further develop our approach to identifying and reducing Non-technical Losses.

Each of the initiatives described above has been selected based on obtaining a positive result when performing a Cost Benefit Analysis (CBA) that values the lost energy at £48.42 per MWh. We will update the Losses Strategy and associated CBAs on an annual basis to take account of any changes and to ensure that the anticipated benefits are realised. We will also assess the benefits from any new or innovative measures which become available since the previous update.

In addition to the Losses Strategy, SSEN also proposed a number of other loss reduction measures in our submission for Tranche 1 of the Losses Discretionary Reward. This sets out how we plan to transform our approach to managing losses b:

1 – Understanding Where to Intervene

- Building on our existing strategy by directly funding new pieces of analysis to better develop our understanding of losses and focus our actions;
- Improve preparation for the Smart Meter rollout by leveraging the learning and modelling techniques derived from our existing LCNF projects including SAVE and NTVV; and
- Initiating engagement with adjoining DNOs and upstream to ensure that networks operations are optimised across boundaries.

2 – Understanding How to Intervene

- Engaging with a wide range of key stakeholders including supply chain, other utilities and other energy market participants to raise awareness of losses and ensure a holistic approach to the management of losses; and
- Sponsoring the creation of a new award category at the Energy Innovation Centre Awards 2017 for the best new approach to the management and understanding of network losses.

3 – Intervening Effectively

- Investigating the creation of dedicated 'Losses Teams' to focus on the implementation of appropriate loss reduction actions on the network;
- Establishment of an SSEPD Losses Steering Group chaired by our Director of Engineering and Investment to focus and support our programme of work; and
- Leading the creation of a DNO Losses Forum to share best practice and develop a co-ordinated approach to the understanding and management of network losses.

We will continue to progress these initiatives through the remainder of the RIO-ED1 period.

Reporting Progress

The details of the tables can be found in Appendix 1. . This details the losses reduction from each of the initiatives outlined above. These can be found on worksheet E4 – Losses Snapshot. The Cost Benefit Analysis models used to derive the benefits of our losses strategy can be found on our website: https://www.ssepd.co.uk/Library/StakeholderEngagementPublications/

2.5. Other Environment-related Activities

Four innovation projects have been initiated, which have or will deliver environmental benefits, as detailed below:

Network Optimisation Project (NIA_SSEPD_0024)

The project aims to address the problem of undergrounding overhead lines in the trial site. In order to do so, the method will utilise an optimisation tool in order to produce optimal routes for undergrounding the overhead lines. The optimisation tool will optimise routes against a weighted balance of cost, time to construct, social acceptance and other parameters that will be defined during the course of the project. The optimisation tool will take into account data available to network operators (such as historic fault performance, construction costs, asset costs), consider network planning criteria and external constraints, process them through appropriate computing processes and produce a list of route options for undergrounding the overhead lines along with their anticipated performance against defined metrics. The outcome would provide the means to network operators to select the optimal option after aligning the produced route options with their strategic priorities. It is anticipated, that if the method is successful, it will increase the cost efficiency to network operators and the customers.

Applied Integrated Vegetation Management (IVM) (NIA_SSEPD_0025)

This project seeks to investigate potential improvements of efficiency, safety and environmental impact through the use of IVM. This is the practice of promoting desirable, stable, low-growing plant communities that will resist the invasion of tall-growing trees that are a major cause of supply interruptions, through the use of appropriate, environmentally sound, and cost effective control methods. These methods can include a combination of chemical, biological, cultural, mechanical and/or manual treatments and will possibly remove the requirement of the DNO to revisit a site and carry out costly and disruptive mulching. The purpose of this project is to investigate if using IVM can reduce the operational expenditure, number of re-visits, exposure to hazardous activities and impact on the environment compared to traditional techniques.

Low Cost LV Substation Monitoring (NIA_SSEPD_0027)

As more customers are take advantage of low carbon technologies, it has the potential to create load growth and unexpected power flows on the LV network. Accurate and detailed loading information from monitoring devices can be used to target and mitigate network alterations. However, due to the high costs involved in substation monitoring it hasn't been economically feasible to undertake this. We are investing in the development of new low cost substation monitoring equipment with a number of partners. This is being developed and trialled as part of an NIA project to test whether it can be installed and operated to provide valuable current and voltage information, while at the same time providing net financial benefits.

If it proves to be successful we will be able to roll it out as a BaU technology to help make intelligent investment decisions. These decisions will enable the implementation of other smart technologies, which in turn will support the growth of solar panels and Electric Vehicles at a much lower cost relative to conventional reinforcement

Underground Cable overlay Cost Reduction (NIA_SSEPD_0014)

Companies have developed innovative cable overlay processes which extract a previously installed cable and install a new cable at its position without having to open-cut a trench along the entire route of the initial cable. They aim to reduce the cable overlay cost to the DNOs and therefore the customers by reducing the excavation and reinstatement cost and retrieving value from the extracted cable (copper or aluminium). In addition, they aim to reduce the disturbance created from traditional cable overlay methods by reducing the length of open-cut trenches required in order to complete the cable overlay.

Flood mitigation

During the first year of RIIO, SEPD and SHEPD invested £0.9m in site surveys across all flood risk sites in order to prioritise investment across the remainder of the price control period. This was in addition to expenditure of over £1m on flood prevention measures at 11 sites across SEPD and SHEPD.

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

3.1. Introduction

The Great Britain (GB) network has a key role in facilitating the transition to a low carbon economy by providing the capacity to accommodate increasing electrical demand due to the electrification of heat or transport and the ongoing growth in volume of distributed generation. There is also a growing recognition that the network needs to be more flexible to respond to changes in demand and supply patterns. The information contained in the following sections of this report, provides an overview on our progress in using innovative solutions to provide a network which delivers the capacity and flexibility to meet the needs of our stakeholders. The report provides further details on the volumes of Low Carbon Technologies (LCTs) and Distributed Generation (DG) which are being connected to the network, along with an update on our preparations for the Smart Meter rollout.

We are focussed on a number of key challenges for the network that have been identified from both the work we are undertaking as part of our ongoing Innovation Portfolio and our Stakeholder Engagement work. Two key areas of focus are the provision of more options for flexible connections and preparations for the large scale adoption of EVs.

For plug in Electric Vehicles (EVs) we are working to:

- Understand the potential impact of EVs on different components of the network.
- Develop an understanding of the technical and commercial solutions to meet these network challenges.
- Engage with the EV community to ensure a mutual understanding of our requirements and needs.
- Put in place measures to help us to monitor the growth in EVs being connected to the network and in particular the impact of clustering.

Specifically on engagement, we have significantly increased our interaction with the EV sector to include manufactures, charging point suppliers, customer groups and relevant government agencies. This builds on the learning from our Low Carbon Network Fund (LCNF) Tier 2 Project – My Electric Avenue (http://myelectricavenue.info). We were one of the founder members of the EV Working Group – this is a cross sector engagement group including organisations such as OLEV, the AA, Citizens Advice Bureau, charging companies and vehicle manufacturers. The Group's purpose is to smooth the transition toward the mass adoption of EVs.

For flexible connections we have:

- Standardised the technical specification for our flexible Active Network Management (ANM) connections.
- Established and developed a specialised Active Solutions Team within our Business as Usual (BaU) function to provide customers with more flexible connection options and to continue to maintain and support these connections when they are complete.
- Continued to support and deliver innovative projects to develop further flexible arrangements. This includes the ACCESS project on Mull (www.accessproject.org.uk) where customers are using controllable demand to maximise the utilisation of distributed generation which would have been otherwise constrained.

We are also actively investigating other areas to assess the impacts of changing power flows on our network and actively preparing for a future transition to a Distribution System Operator's (DSO) role. Projects such as our Constraint Managed Zone (CMZ) are good examples of us looking beyond traditional boundaries to identify innovative ways of resolving network issues to benefit our customers.

For further details on the number of Low Carbon Technologies reported in 2015/16 please see worksheet E7 – LCTs in Appendix 1.

The Great Britain (GB) network has a key role in facilitating the transition to a low carbon economy

3.2. Progress on our innovation strategy

We originally published our Innovation Strategy along with our RIIO-ED1 business plan, this outlined our plans and proposal including our 'top 20' innovations. We have made progress on many of these initiatives since then. Further details can be found in our updated Innovation Strategy, the full document can be found at:

www.yourfutureenergynetwork.co.uk/wp-content/uploads/2016/04/Innovation-Stategy-update-ver-9.pdf

An updated list of our Top 20 innovations is shown in Table 6

Table 6 – Top 20 innovations

RIIO-ED1 Primary Output	Core Innovation for RIIO-ED1	2016/17 Update
Connections	Active network management – generator constraint management	Implemented into BaU
	Active network management – community demand management	Progressing as a live NIA project
	Demand-side management – thermal energy storage	In progress of being implemented into BaU in CMZ
	Dynamic circuit thermal rating	Fast following
	Fault current limiters	Fast following
	Local smart EV charging infrastructure	Progressing as a live NIA project
	LV solid-state voltage regulator and power conditioning	Trials progressing
	Static synchronous compensators (STATCOMs)	Implemented into BaU Progressing towards an NIA project
Customer Service	Advanced distribution automation – network reconfiguration	In process of being implemented into BaU
	Weather impact and response modelling tools	Implemented into BaU
Environment	Bidirectional hybrid generation plant	Implemented into BaU
	Wood pole alternative	Progressing as a live NIA project
Reliability	Automated demand response with commercial customers	In progress of being implemented into BaU in CMZ
	Energy efficiency approaches	Progressing in SAVE NIC project and in CMZ
	LV network modelling	Seeking BaU implementation
	LV network monitoring	Implemented in LV automation and losses activity and progressing as a live NIA project
Safety	Conductor sag/vibration monitoring	Progressing as a live NIA project
	Live line tree felling	Implemented into BaU
	Arc suppression coil and residual current compensation earthing	This project has been suspended
Social Obligations	Enhanced supply monitoring and support for vulnerable customers	Linked to roll out of smart metering

During 2015/16, SSEN had five large-scale innovation projects in its distribution businesses. These are detailed as follows:

Northern Isles New Energy Solutions (NINES)

Key activities
NINES aims to deliver a secure, affordable and reliable energy system for Shetland whilst increasing the use of renewable generation on the islands. NINES has implemented and trialled a range of technologies including:

Demand Side Management (DSM) using the next generation of storage and water heating. The aim is to deliver DSM into domestic homes, reducing peak electricity demand, thus enabling enhanced control of the current network and the ability to accommodate more renewable energy sources on to the grid.

A 1MW/3MWh lead acid battery which has been used to take or provide electricity according to generation and network characteristics.

An active Network Management System (ANM) to control the following technologies on the islands: lead acid battery, next generation of space and water heaters.

Expected outcomes
Assessment and deployment of innovative solutions to reduce peak demand and thereby reduce the required generation capacity and output on Shetland. This will ensure the best value solution in replacing Shetland's power station, reducing size, capital and operating cost.

Funding Stream
£18.59m project that assisted in the development of the first phase of the Integrated Plan and informs the New Energy Solution for Shetland process which aims to manage supply and demand on Shetland. £15.3m funded by electricity customers through adjustment to SSEN allowed revenue.

New Thames Valley Vision (NTVV) (SSET203)

Key activities
Monitoring, modelling and managing the low voltage network in the Bracknell area.

Analysis includes:
- network monitoring to measure the network's electrical characteristics in near real time with minimal disruption;
- end point monitoring to collect data to see what is happening at customer supply points to provide data for modelling how the network is running today and how the effect of low carbon technologies will impact on the LV network;
- adoption of agent-based modelling techniques to produce new forecasts of load flow and voltage profiles, integration of GIS, power flow analysis and SCADA software packages trialling the future of LV network management and design; and
- incorporation of automated demand response into existing commercial building management systems, deployment of electrical energy storage, thermal energy storage and power electronics technology on the LV network.

Expected outcomes
NTVV has adopted an approach addressing three key elements:

Understand: Through the planned monitoring activities and the related modelling work, NTVV intends to identify solutions that minimise the need for extensive monitoring on all parts of the network that would be costly and time consuming.

Anticipate: In order to maintain the existing levels of supply quality and plan new network developments, there is a need to understand how different consumers on different parts of the network will use electricity in the future. NTVV is utilising sophisticated mathematical techniques to develop these models.

Support: Once we have understood the issues and where they are occurring on the network, it will be vital to have the appropriate tools to manage them in the most cost effective way. NTVV will be trialling a number of technologies and solutions to determine the most efficient way to achieve this.

Funding Stream
LCNF Tier 2
£30m project
(£22.8m Tier 2 funding)

Start/end date
2012–2017

My Electric Avenue (SSET205)

Key activities
Trialling a monitoring and control technology to manage the charging of Electric Vehicles (EVs) connected to the LV network during periods of peak demand to reduce the risk of network overload. Customer acceptance to managed EV charging, along with driving and charging behaviour, recorded throughout, and assessment of customer and network impacts undertaken. Demonstration of a novel commercial arrangement through which a non-network company, EA Technology Ltd, can manage and deliver an innovation project on a DNO network and accelerate innovation deployment.

Expected outcomes
Control of EV charging proven to be successful, with high customer acceptance of the solution. Behavioural and technological analysis revealed expected network impact from clustered EV charging, with potential savings from deployment of the technology across GB estimated to be £2.2bn by 2047. Management and delivery of project by a third party also proved successful and should increase the number and range of projects successfully delivered on distribution networks.

Funding Stream
LCNF Tier 2
£9m project
(£4.1m Tier 2 funding)

Start/end date
2013–2015

Solent Achieving Value from Efficiency (SAVE) (SSET206)

Key activities
The trials will consist of evaluating four energy efficiency measures on participants in the Solent region. The measures use combinations of technology, commercial rewards and engagement campaigns informed by energy consumption and demographic data, and include: light emitting diode (LED) installation, data-informed engagement campaign, DNO price signals direct to customers, and data-informed engagement and community coaching. The methods have been chosen to allow an assessment of factors such as cost and effort required to implement.

Expected outcomes
To gain insight into the drivers of energy efficient behaviour for specific types of customers, to identify the most effective channels to engage with different types of customers, to gauge the effectiveness of different measures in eliciting energy efficient behaviour with customers and to determine the merits of DNOs interacting with customers on energy efficiency measures as opposed to suppliers or other parties.
This project will establish a tool to identify the energy efficiency measures which are most cost effective in terms of managing a particular network constraint.

Funding Stream
LCNF Tier 2
£10.3m project
(£8.3m Tier 2 funding)

Start/end date
2014–2019

Low Energy Automated Networks (LEAN) (SSET207/01)

Key activities
LEAN focusses on reducing transformer losses on primary substations. The key principal of the approach to be trialled is to switch off one of a number of transformers in a primary substation at times of low load, to avoid the fixed iron losses associated with that transformer.

A second method, Alternative Network Topology, will be deployed where appropriate to further reduce losses and maintain network supply integrity.

Expected outcomes
LEAN builds on learning captured from SSEN previous LCNF Tier 1 and IFI projects and seeks to demonstrate new methods that can be applied to existing assets to reduce losses in the shorter term.

Approximately 6% of electricity generated is lost each year in the GB distribution network, incurring costs in the region of £1bn to customers.

Funding Stream
LCNF Tier 2
£3.1m project

Start/end date
2014–2019

Current NIA (Network Innovation Allowance) Projects

For the year ending 31 March 2016, there were 27 projects funded under SSES and SSEH Network Innovation Allowance (NIA). Six of these projects had completed whilst 23 had been registered during the year. A number of these projects are still at an early stage and have yet to provide significant learning which can be shared hence their initial progress reports will be published in the future.

A crucial aspect of the ongoing SSEN NIA project portfolio is that each projects still maps onto at least one of the RIIO-ED1 primary outputs.

Table 7 below shows the NIA projects currently underway and the RIIO-ED1 primary output they relate to.

More details on the ongoing NIA projects can be found in the NIA annual report summary, which is located here:

www.ssepd.co.uk/InnovationLibrary/Distribution

Table 7 – SHEPD and SEPD NIA innovation projects

RIIO-ED1 Primary Output	Relevant NIA Projects	Description
Connections	**NIA_SSEPD_0019 Western Isles Resilient Zone Utilising Embedded Generation – Feasibility Study**	The aim of this project is to determine the potential to improve the resilience of supply to customers in the Western Isles, and to reduce the use of diesel generation. **Expected outcomes** – The delivery of a study which determines the viability of options to permit the operation of the network in an island mode. This will determine the potential to use the increasing volume of wind generation on the islands to reduce the running hours of the embedded diesel generation plant.
	NIA_SSEPD_006 Impact of Electrolysers on the Distribution Network	To design and test an operational system for the safe, efficient operation of an electrolyser connected to the distribution network and establish a commercial framework for carrying out trials. To allow us to assess impacts of a large scale electrolyser on the network and produce a technical design for the control system which will allow a full range of trials to be undertaken. **Expected outcomes –** Identification of the extent to which an electrolyser can be controlled to minimise its impact on the network and if it can be used as a tool to manage issues caused by other disruptive technologies.
	NIA_SSEPD_011 ACCESS – Local Constraint Management	The ACCESS project will look to manage the output from a 400kW hydro generator with approximately 600kW of new controllable demand being installed in up to 100 homes. **Expected outcomes –** The deployment of a successful trial that informs new technical and commercial standards. The ACCESS commercial model allows small-scale generation to connect to the network when capacity is at its limit. ACCESS is being delivered by Community Energy Scotland and the following project partners: Mull and Iona Community Trust, SSE Energy Supply, Element Energy, VCharge UK Ltd, SSE Home Services and SSEN.
	NIA_SSEPD_005 33kV parade Working	The innovative activity that this project will trial is the ability to carry out live line working on 33kV (EHV – Extra High Voltage) overhead lines. This would be an advancement on the current practice of 11kV (HV – High Voltage) Live Line Working. **Expected outcomes –** The success of this project will be defined by being able to demonstrate that 33kV hot glove work can be completed safely and with appropriate justification. This could allow maintenance work to be undertaken without the need for outages.
	NIA_SSEPD_012 Network Resilient Zone Utilising Embedded Generation – Feasibility Study	The project aims to determine the potential to improve the resilience of supply to remote communities by undertaking a feasibility study on the viability for the electricity supply to the community on the island of Gigha to be supported by the local embedded renewable generation. **Expected outcomes –** The delivery of a study which determines the viability of options to permit the operation of a remote network in island mode.
	NIA_SSEPD_0026 Management of Plug-in-Vehicle Uptake on Distribution Networks	The purpose of this project is to define an ENA Engineering Recommendation (or equivalent) that will allow the range of future chargers to interact with a common device located in the local distribution substation for the purpose of load management on the network. **Expected outcomes –** The success criteria is defined as industry accepted solution for managing PIV uptake on distribution networks that will avoid significant infrastructure costs or disruption. This would lead to industry accepted customer messaging strategy and recommendations for implementation.

Table 7 – SHEPD and SEPD NIA innovation projects

RIIO-ED1 Primary Output	Relevant NIA Projects	Description
Customer service	NIA_SSEPD_008 PARADE	This project aims to better understand what advanced Pole Mounted Reclosers (PMRs) can achieve when combined with distributed intelligence, to see whether customer outages can be reduced. **Expected outcomes –** To evaluate the year-round performance of this distribution automation technology, in terms of communications performance, behaviour during faults, and impact on CI/CMLs. Consider the suitability of the communications technology for any other applications of high data rate digital radio communications in the utility sector, at the frequencies allowed in the UK. Quantify the commercial benefits of Intelliteam technology for the distribution business and so provide the information needed to determine whether it is advantageous to deploy it elsewhere on the network.
	NIA_SSEPD_009 Automated Loop Restoration	This project will carry out a technical trial of the loop reconnection system developed by S&C Electric as this does not rely upon communications links for effective operation. **Expected outcomes –** Determine the impact on network performance delivered by the automated loop restoration methodology on the trial network sections.
	NIA_SSEPD_002 SASensor High-Medium Voltage (HMV) Primary Substation Provider	This project uses a digitised approach where a single processing unit protects the entire substation. It also gives remote access to fault information, which may assist in a reduction of customer minutes lost during power cuts, and provides information which can be used to determine whether maintenance of plant and equipment is required. **Expected outcomes –** Reduction in costs of installation due to reduced hardware and a reduction of costs during storms if details can be extracted remotely about the type of faults that have occurred.
	NIA_SSEPD_003 Network Damage Reporter	The aim of the project is to determine the viability of using a smartphone application to allow damage to be reported quickly by members of the public to a DNO service centre. **Expected outcomes –** Develop new procedures and processes to make use of the data submitted by users, such that the fault report submitted is integrated into the company fault management system. Develop a publicity strategy to publicise the availability of the app. Evaluate the benefit to the utility of fault reporting using smartphones.
	NIA_SSEPD_007 Field Team Support Tool	The project will use a standards based Common Information Model (CIM) to allow the different sources of data held within the company to be fed out to a tablet, and for data sent from the tablet to update the data sources. **Expected outcomes –** Evaluate the usability of the tablet. Show back end applications being updated from the tablet, and the new data passed back to the tablet and displayed. Demonstrate that the system can cope with the required level of traffic to and from the CIM. Demonstrate the security of the device, and the ability to delete the device from server control, and delete access to the application remotely.
	NIA_SSEPD_010 Mobile Generator Re-sync at 11kV and 33kV	A mobile, trailer mounted Circuit Breaker (CB) has been developed and trialled in SSEN under a previous IFI project which has successfully proven the concept, but the methodology needs further development to ensure that it is fit for purpose. This project will develop a technical methodology utilising the installation of a 33kV pole mounted CB using live line techniques which can be used at all distribution voltages from 11kV to 33kV on poles with Air Break Switches. **Expected outcomes –** Determine the technical and operational viability of the proposed methodology. Quantify the savings in CIs and CMLs which could be saved by the use of this technique. Determine the commercial viability of applying this methodology across the SSEN licence areas.
	NIA_SSEPD_0021 Thermal Imaging Observation Techniques for Underground Cable Networks (TOUCAN)	This project investigates a technical method using thermal imaging solutions as complementary tools in the context of locating underground cable faults in the power distribution network. **Expected outcomes –** The project will assess a range of complementary thermal imaging tools as to their ability to locate or assist in locating underground cable faults and in which conditions. Practical comparisons will be made between the performance of low cost devices with that of higher specification equipment. Substantiated recommendations will be made on whether or not there are benefits in equipping field operatives with thermal imaging cameras.
	NIA_SSEPD_0023 Fault Passage Indicators for SEF	A technical method is proposed and it involves carrying out tests on revised Fault Passage Indicators from Bowden Brothers which has been modified to detect Sensitive Earth Faults (SEF) down to 4A. The tests will be performed at the Power Networks Demonstration Centre (PNDC) in Cumbernauld to ensure that the revised device has significantly improved sensitivity over our current range of FPIs. **Expected outcomes –** This project will be successful if we are able to determine the ability of the revised FPI to reduce CMLs due to SEF faults.

Table 7 – SHEPD and SEPD NIA innovation projects.

RIIO-ED1 Primary Output	Relevant NIA Projects	Description
Environment	**NIA_SSEPD_0014 Underground Cable overlay Cost Reduction**	The project aims to investigate whether two identified cable overlay methods could reduce the cost and disturbance caused to the customers due to the cable overlay activity. **Expected outcomes –** The project aims to determine the effectiveness (positive or negative) of the innovative cable overlay methods in comparison to the traditional open-cut trench approach. The effectiveness will be measured through variation of the unit cost of cable overlay (quantitative information), variation of the disturbance caused due to the innovative cable overlay method (qualitative information) and variation in the environmental impact of the cable overlay process (qualitative and/or quantitative information).
	NIA_SSEPD_0016 Alternative Cable Installation Methods	The project aims to identify innovative cable installation methods that can reduce the cost of cable installation and increase the length of cables that can be installed without having joints. **Expected outcomes –** The project will be considered a success if it determines whether or not there are innovative methods for cable installation that have the potential to reduce costs and/or install long sections of cable without joints.
	NIA_SSEPD_0024 Network Optimisation Project	The project aims to address the problem of under-grounding overhead lines in the trial site. In order to do so, the method will utilise an optimisation tool in order to produce optimal routes for under-grounding the overhead lines. **Expected outcomes –** The project will be considered a success if it can determine whether the optimisation tool offered by the selected supplier can result in more cost effective options for the under-grounding of overhead lines, in comparison to traditional network planning approaches.
	NIA_SSEPD_0025 Applied Integrated Vegetation Management (IVM)	This project seeks to investigate potential improvements of efficiency, safety and environmental impact through the use of Integrated Vegetation Management (IVM). IVM is the practice of promoting desirable, low-growing plant species beneath overhead lines. Combined with occasional herbicide use, they are expected to suppress taller, woody species and so reduce the need for clearance work, reduce the frequency of re-visits, and replace chainsaw and mulcher techniques. IVM offers a safe, environmentally sound, and low cost approach to maintaining the necessary clearance distances. **Expected outcomes –** The success of the project will be defined by the following outcomes: identification of the extent to which IVM can control trees returning and how effective it is as a tool to maintain regulatory standards around power lines. The project will determine if IVM is a cost effective method in the UK.
	NIA_SSEPD_013 Network Resilient Zone Utilising Standby Generation – Feasibility Study	The proposal is to explore alternative ways of improving the resilience of supply to remote communities by undertaking a feasibility study on the viability for the village community at Arinagour on the Island of Coll to have a back-up source of supply in the form of a standby generator. **Expected outcomes –** The delivery of a study which determines the viability of options to improve network resilience to a remote village community by the provision of standby generation.
	NIA_SSEPD_0015 LV Connectivity Modelling	This project will develop a low voltage (LV) connectivity model using software to align meter supply points with local substations so that the links between substation feeders and user premises can be shown. **Expected outcomes –** The project aims to conclude whether the use of data analytics techniques with the available data are either able to make an accurate LV connectivity model, or not able to make an accurate LV connectivity model.
	NIA_SSEPD_001 DISCERN Knowledge Transfer	DISCERN focused on the need for enhanced intelligence on a distribution network and the replicability and scalability of solutions across different networks. In addition to direct learning from the solutions trialled at five Smart Grid demonstration sites across Europe, the diverse range of consortium partners enabled the creation of a suite of tools designed to support operators by informing their decisions on the development of networks that will provide high security of supply for the future. **Expected outcomes –** Studies and research directly relevant to SSEN, is made available for incorporation into both business and innovation strategic thinking. Knowledge relating to a range of Smart Grid sub-functionalities not yet being investigated within the business is made available from other FP7 DISCERN partners. Research and demonstration sites and simulations support decisions on how networks are built, managed and operated. Knowledge of such factors as systems architecture, use cases and Smart Grid Architecture Model (SGAM), semantic models and Common Information Model, is improved across operational and innovation areas of the business, as well as ICT, such that it is possible to take a view on the potential development, relevance and applicability of such approaches within the business from a BaU perspective. SSEN has successfully met all of its obligations as a project partner in the FP7 DISCERN project, and ensured that project outputs do not go against GB interests, specifically those forming recommendations to standards authorities.

Table 7 – SHEPD and SEPD NIA innovation projects

RIIO-ED1 Primary Output	Relevant NIA Projects	Description
Environment	NIA_SSEPD_0017 Overhead Line Vibration Monitoring Phase 2	This project will complete the development of a technical method that commenced in a previous Innovation Funding Incentive (IFI) project. In that project, wire mounted sensors incorporating electronics for detecting change in angle, wire sag and impact of a wire strike were developed. The IFI phase led to the production of prototype sensors which demonstrated proof of concept through successful vibration testing on overhead lines. **Expected outcomes –** The project will demonstrate that wire mounted sensors can sense wire strikes and wire sags, and have a mounted life of more than six months. It will also demonstrate that the information from the sensors can be used to discriminate between varying types of wire impacts, and reject false positives, e.g. heavy birds landing or colliding.
	NIA_SSEPD_0027 Low Cost LV Substation Monitoring	The project will develop and test a representative quantity of low cost substation monitoring devices from a number of different manufacturers. These will be deployed in a selection of secondary substations and their measurements integrated with a central data centre using GPRS communications. This will be in order to allow informed decisions to be made by network planners and other staff with respect to operational decisions, network planning and customer service. **Expected outcomes –** This project will be deemed successful if it can determine the technical and financial viability of low cost substation LV monitoring equipment in comparison with traditional higher cost equipment.
Safety	NIA_SSEPD_0020 Overhead Line Monitoring	Under IFI project 2014_08 Monitoring of Conductors and Poles, a prototype sensor system, comprising line mounted sensors, and a communications system was developed to operate on overhead lines up to 11kV. This project will take that work further to produce a production ready system. **Expected outcomes –** The project will be a success if it can demonstrate whether or not wire mounted sensors can be used to improve customer service by improving the management of contact with, and damage to, overhead lines and poles.
	NIA_SSEPD_0018 Remotely Operated Forestry Mulcher	This project seeks to investigate the potential improvement of efficiency and safety through the use of remotely operated vehicles to carry out tasks associated with forestry mulching. **Expected outcomes –** The project will evaluate Remotely Operated Mulching Methods in service, to determine if it is a substitute for hand clearance using chainsaws and a chipping machine if viable, it will substantially increase the productivity of the tree cutting teams in certain kinds of job.

3.3. Rolling out innovations into BaU

Prior to commencing any innovation project a robust CBA process is undertaken to ensure that the proposed initiative has a positive business case. This will involve making a number of assumptions in order to predict the future benefits. During the testing period these assumptions will be tested, in order to give better information on how the initiative will perform on our network. This will include an ongoing assessment on the potential benefits. At the end of the innovation project the business case will be thoroughly reviewed including a further robust CBA based on the learning gained through the innovation project. Only if this proves positive will we decide to progress with including the intervention in our BaU activities. In many cases further trials may be necessary to provide the level of confidence required to consider a transition to BaU. It should be noted that our experience has shown that the most successful BaU deployments have been derived from learning from across the SSEN innovation portfolio and the learning from other DNOs' projects.

In order to monitor the progress of innovation trials performed by other DNOs, various knowledge sharing workshops, conferences and strategic management meetings take place on a regular basis. This allows us to better understand how innovation is benefiting other DNOs and gain insight on effective deployment of the technology into BaU.

We also actively participate in a number of knowledge sharing initiatives to share our learning and to gain an insight into other activities. These include:

- The new Collaborative Energy Portfolio at the ENA which offers the benefits of collaboration with other DNOs on themed activities such as Future Networks.
- SSEN presently chairs the R&D working group at the ENA, which brings together GB DNOs as well as National Grid.
- SSEN chairs the ENA Active Network Management Group which is looking to develop a common set of standards and protocols to facilitate the wide spread adoption on ANM across GB.
- SSEN was among the founding members of the Energy Storage Operators Forum (ESOF) in 2012. ESOF facilitates knowledge exchange and horizon scanning between organisations developing energy storage capabilities, including all six GB DNOs, National Grid and the Energy Networks Association (ENA).

In addition, our proactive engagement with several academic initiatives enables us to extract focussed benefit from the wide spectrum of academic research and development of potential relevance to our network and customers including:

- The Power Networks Research Academy, which was established through a strategic partnership agreement between the Engineering and Physical Sciences Research Council (EPSRC), electricity transmission and distribution companies, related manufacturers and consultants. The Academy funds and supports PhD researchers in power industry-related projects.
- The recently created Centres of Doctoral Training in the University of Strathclyde, Imperial College, Manchester University, and Southampton University.
- SSEN is a founding funding member of the Power Networks Demonstration Centre, and we continue our active engagement with this facility which offers a range of benefits such as acting as smart grid technology accelerator and as a centre for collaborative work to further our insight into network challenges.

We are actively progressing the following solutions into Business as Usual (BaU).

We actively participate in a number of knowledge sharing initiatives to share our learning and to gain an insight into other activities.

Constraint Managed Zones (CMZ)

We have developed the CMZ based on learning from both our own and other DNOs' innovation portfolios. The CMZ is a new approach to managing constraints on the distribution network. With this approach we will procure a commercial service which will allow us to defer or avoid traditional network reinforcement. The CMZ project is being progressed as a Business as Usual (BaU) solution without the need for external funding.

CMZ have given us a simple commercial platform to allow the implementation of multiple smart interventions all of which have been tested as part of our, and others, innovation portfolios. We are currently undertaking a systematic analysis of our relevant ED1 reinforcement investments to allow us to recover the full value from CMZ in the remainder of the RIIO-ED1 period.

The key features of the CMZ:

- It utilises a market approach to procure constraint management services.
- It is technologically agnostic.
- It is open to a full range of market participants.
- It is a Totex solution with a fixed decision cycle and associated optionality value.
- It is replicable across a range of network scenarios.
- It is compatible with flexible connections and other smart interventions.

The site we have identified for the initial CMZ deployment, is a site where demand is forecast to overload the "firm" rating in the near future. By using a CMZ service to reduce demand in the event of an (N-1) scenario we can avoid or defer significant network investment as illustrated in Figure 2.

Figure 2 – Illustration of CMZ service configuration, for post-fault services

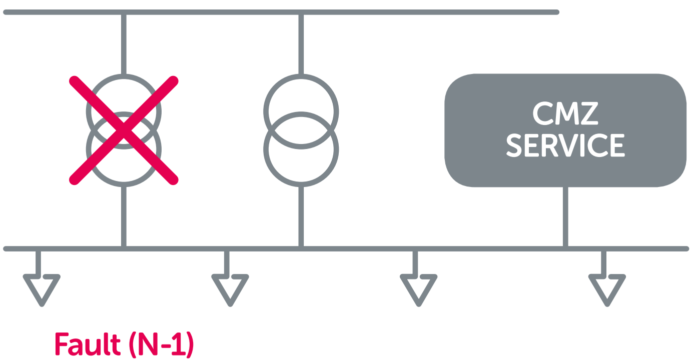
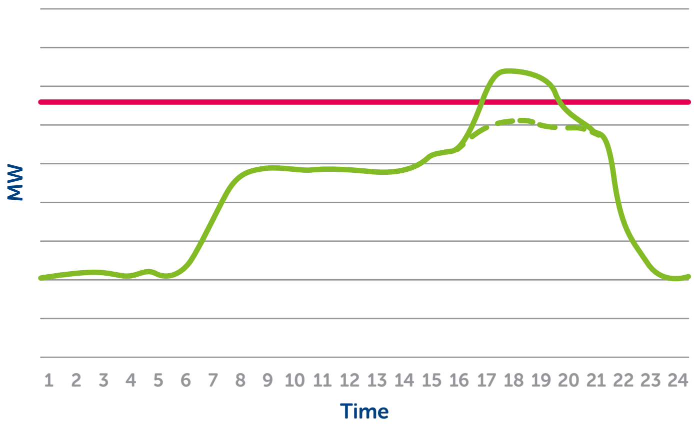


Figure 3 – Peak-lopping services re-shaping the load curve at the appropriate times



The Constraint Managed Zone (CMZ) is the natural culmination of a number of the innovation projects that we have delivered. Our projects of particular relevance are the Orkney Energy Storage Park LCNF Tier 1 project, the Orkney Active Network Management (ANM) IFI project, the Thames Valley Vision LCNF Tier 2 project and our DISCERN project which was part EU funded.

An additional value which comes from the CMZ is that it provides SSEN with a short term flexible option, allowing us the time to better understand how the use of the network will change with time.

The CMZ will have a fixed term contract, at the end of the contract SSEN will have a number of options:

- Conventional reinforcement if required.
- Do nothing – if forecast load growth does not materialise as anticipated.
- Extend CMZ contract.

This process ensures that we are constantly considering the most efficient and effective way of maintaining the integrity of the network.

LiDAR

Fixed wing aircraft will scan our overhead assets using a LiDAR scanner. The scanner will produce a 3D image of our network to a very high level of accuracy. This allows us to gain better data on the condition of our overhead line network – from this we can prioritise and target our approach to maintenance including tree cutting. This will result in significant efficiency improvements and also ensures that we can identify any potentially hazardous situations where safety distances to lines are being compromised. We are currently in the process of rolling out LiDAR within our business. Having reviewed the learning from other projects and other industry trials the business case for utilising LiDAR was clear, we made a decision to "fast follow" and deploy without utilising innovation funding.

In 2015 we undertook a small SSEN funded trial to validate our assumptions and subsequently commenced a procurement exercise. We discovered a very healthy market place for LiDAR services and associated analytics and are currently placing a contract to deploy LiDAR across our entire SEPD network and parts of our SHEPD network as a business as usual deployment. An example of LiDAR imagery is shown in Figure 4 below.

To support this roll out to BaU we have established the Innovation Deployment Team. This is to support the transition to BaU by utilising change management and project management skills to ensure a smooth implementation and rapid benefit realisation.

Key benefits from LiDAR include:

- Operational efficiency improvements.
- Resilience improvements by identifying areas for proactive tree cutting.
- Safety improvements.
- Improvements in Asset Data quality.

Figure 4 – Example of LiDAR imagery

Summary of SSEN Innovations that are now BaU

Active Network Management (ANM)

ANM has been implemented on the Isle of Wight (IoW) to help facilitate the connection of distributed generation. Prior to ANM the connection costs for new distributed generators was extremely high, due to large and expensive reinforcements being necessary. For example, the projected costs of reinforcement on the IoW were £2.3m and these high costs acted as a barrier to entry for generators wanting to connect to the network. Implementing ANM has enabled additional capacity to be utilised on the IoW network, with over 45MVA released without the need for this reinforcement. As a result generators are able to connect at a far lower cost and at much faster timescales than was previously possible on the constrained network.

Benefits
£2.3M of network reinforcement spend not required; 45MVA network capacity released

This project was made possible from learnings derived from our original SHEPD Orkney ANM project. Information on this project is available here:

www.ssepd.co.uk/OrkneySmartGrid

SEPD Bidoyng

Bidoyng is a smart fuse and fault location technology. Faults are often transient in nature, in that they occur briefly and do not cause any major damage to plant and equipment, meaning normal distribution operations can continue. However, they often cause fuses to blow, which means they need to be replaced before customers can have their power restored. Bidoyng smart fuses automatically switch fuses when one has blown meaning customers only experience a temporary loss of supply. It also means that SSEN do not incur any CI or CML fines as power can be restored within the three minute regulatory window. Kelvatec, the supplier of the Bidoyng technology, also provides a fault location service, which helps our field staff locate underground cable faults quicker than would otherwise be possible.

Benefits
There has been an estimated benefit of £1.6m on fault repair costs and over 54,180 Customer Interruptions and 9,796,449 Customer Minutes Lost prevented

The technology was implemented straight into BaU. More information can be found here:

www.smarternetworks.org/Project.aspx?ProjectID=384

SHEPD Live Line Tree Cutting

SHEPD Live Line Tree Cutting involves a specialised machine that is able to cut down trees adjacent to live overhead power lines. The machine is far more efficient than hand felling and also reduces the risk of injury to tree cutters as less hand felling is required. Before the live line tree harvester was utilised hand felling had to take place to overhead lines in a non-live environment requiring planned outages on the network and the need for mobile generators to provide temporary power to customers. These diesel generators are not only expensive to run but also release large quantities of CO_2. There is also a risk that the generator will trip causing a loss of power to potentially thousands of people. The live line harvester therefore offers significant improvement in safety and efficiency, while also reducing the environmental impact of tree cutting.

Benefits
There has been an estimated benefit of £1.5m on tree cutting expenditure and 36,182 Customer Interruptions and 5,472,654 Customer Minutes Lost prevented.

This project has led to 3,400 tCO_2e avoided due to the reduced requirement to run diesel generation. The original project was done as an IFI project. More information can be found here:

www.smarternetworks.org/Project.aspx?ProjectID=545

SHEPD Bi Directional Hybrid Generator

The hybrid generator contains a battery which allows it to switch between battery and diesel generation modes. Running the generator on battery mode produce less noise, making it advantageous when in use around populated areas and at night time. On top of this the generators require less diesel to be used which saves fuel costs and reduces its environmental impact.

Benefits
We estimate that approximately 11.2 tCO_2e have been avoided as a result of this project.

The original project was done as an IFI project. More information can be found here:

www.smarternetworks.org/Project.aspx?ProjectID=1537

The Cost Benefit Analysis models – can be found on our website:

https://www.ssepd.co.uk/LibraryStakeholderEngagementPublications/

It should be noted that the projects below had previously been identified as being suitable for BaU deployment and have since been stopped/suspended:

- Pole pinning: This was stopped because the pole pinning machine turned out to be viable in very specific situations i.e. where low levels of pole degradation are present. Where pole degradation was high the pole pinning machine would cause the pole to disintegrate and need to be replaced. Therefore, it was not possible to achieve the predicted economies of scale anticipated in the original business case and so the initiative was withdrawn.
- Bi-Directional Hybrid Generator: The current hybrid generators are in the process of being sold after reaching the end of their useful life. Whilst the underlying concept is still sound the original units did not deliver the anticipated benefits. However, the learning from the project will help us to better define our requirements and we are currently investigating new hybrid generators that will meet our needs.

- Arc suppression coil and residual current compensation earthing: This project has been temporarily suspended as it is unable to produce viable financial benefits to both the DNO and customers. We are using the learning to investigating a more commercially viable option.

3.4 Smart Meters

Throughout 2015/2016 Scottish and Southern Electricity Networks progressed with the development of its Information Technology (IT) and communications infrastructure in preparation for the roll out of smart meters. Due to the level of complexity associated with the governance, security and IT requirements for connection to the Data Communication Company's (DCC) systems, SSEN created an internal programme to develop the necessary business processes and build new IT infrastructure to enable connection to the DCC and comply with the relevant code.

In our RIIO-ED1 business plan in March 2014 we identified that we would go live and connect to the DCC's systems in September 2015. There have been a number of changes to the GB Smart Meter Implementation Programme (SMIP) which have had a knock-on impact for delivery of a number of functionalities. We now expect that this will happen in early 2017.

It is anticipated that around 3.5 million smart meters will be connected to our networks and whilst is it expected that DNOs will have the means to communicate and gather information from the majority of smart meters we also believe that there will be a sizeable proportion of smart meters that we will not be able to communicate with or receive alerts from. Further information is provided in the following sections.

Meter Types and Volumes of Meters Installed

Specifications for two versions of Smart Meters have been developed by the SMIP; these are defined as SMETS1 and SMETS2 meters.

- SMETS1 meters provide a significant amount of smart functionality but currently they are not able to connect to the DCC's central communications and data infrastructure. Whilst there are future plans to connect these meters to the DCC there is no clarity regarding how and when they will be connected and what functionality from these meters will be made available to DNOs via the DCC's systems.
- SMETS2 meters provide additional functionality from that defined in SMETS1; they will be connected to parties including DNOs via the DCC's communications and data infrastructure. These meters will enable SSEN to gain access to the full range of alerts and service requests as defined by the SMIP.

Information relating to the volumes of smart meters installed during 2015/2016 is provided in Table 8.

Table 8 – Volume of smart meters installed during 2015/16

	SMETS1			SMETS2		
Licence Area	**Installed in 2015/2016**	**Total Installed**	**% Penetration (year end)**	**Installed in 2015/2016**	**Total Installed**	**% Penetration (year end)**
SHEPD	13,122	22,800	3.1%	0	0	0
SEPD	89,104	131,200	4.4%	0	0	0

It should be noted that due to the level of uncertainty associated with the connection of SMETS1 meters to DCC systems it is currently difficult to assess the impact that significant volumes of SMETS1 meter installations will have on our ability to deliver DNO smart meter related customer benefits.

Development of Information Technology and Communications Infrastructure

SSEN is developing systems to enable data from smart meters to be made available via connection to the DCC's infrastructure. In accordance with our business plan we are working towards connecting our IT infrastructure with the DCC and developing our own systems to manage and monitor alerts sent by smart meters directly into our existing outage management system (SIMS). Significant effort has gone into ensuring that the design of our systems and infrastructure remains compliant with the SEC which is a mandated requirement for all parties who interface with the DCC.

Our expenditure associated with the development of our IT and communications systems and payments made to the DCC during 2015/2016 are detailed in worksheet E5, they are also summarised in Table 9.

Table 9 – IT expenditure for Smart Meters

Licence Area	SM IT Costs (£k)	SM Communication Licence (DCC) Costs (£k)	Elective Communication (DCC) Costs (£k)
SHEPD	1,550	231	0
SEPD	6,220	830	0

Delivering Value from Smart Metering Data

In our business plan we explained how having access to data from smart meters will provide opportunities for us to deliver benefits to our customers. We split the benefits into a number of categories and provided an estimate of the potential benefit that could be delivered for both the RIIO-ED1 and ED2 periods.

The benefits that are delivered by us having access to data from smart metering can be split into the following categories:

1. Avoided losses to network operators
2. Reduction in CML
3. Reduction in operational costs to fix faults
4. Reduction in calls to faults and emergencies lines
5. Better informed investment decisions for electricity network enforcement
6. Avoided cost of investigation of customer complaints about voltage quality of supply
7. Network capacity investment savings from electricity demand shift

In the design of our systems we considered the need to have access to data that will enable us to use the information to provide benefit to both customers and the wider Scottish and Southern Electricity Networks business. In the development of our smart metering business processes and systems consideration has been made to ensure that maximum benefit can be delivered from how we use data from smart meters. Our efforts throughout 2015/2016 are detailed in Table 10:

Table 10 – Progress on delivery of benefits from Smart Metering throughout 2015/2016

Category of Benefit	Work Undertaken
Avoided losses to network operators	• Detailed design and development of our Networks DCC Access Gateway (NDAG) to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Work on being able to access consumption data.
Reduction in CML	• Detailed design and development of our NDAG to ensure that power outage and power restore alerts are available for use in appropriate areas of the business. • Detailed design and development of our outage management system (SIMS) to receive power outage and power restore alerts from smart meters. • Engagement with the DCC regarding the future operation of power outage and power restore alerts.

Reduction in operational costs to fix faults	• Detailed design and development of our NDAG to ensure that:
	  • we are able to check the energisation status of individual customers via their smart meter
	  • power outage and power restore alerts are available for use in appropriate areas of the business
	• Detailed design and development of our outage management system (SIMS) to:
	  • enable the initiation of supply energisation status checks from relevant locations
	  • receive power outage and power restore alerts from smart meters
	• Engagement with the DCC regarding the future operation of power outage and power restore alerts.

Reduction in calls to faults and emergencies lines	• Detailed design and development of our NDAG to ensure that power outage and power restore alerts are available for use in appropriate areas of the business. • Detailed design and development of our outage management system (SIMS) to receive power outage and power restore alerts from smart meters. • Engagement with the DCC regarding the future operation of power outage and power restore alert.
Better informed investment decisions for electricity network enforcement	• Detailed design and development of our NDAG to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Work on being able to access consumption data.

Avoided cost of investigation of customer complaints about voltage quality of supply	• Detailed design and development of our NDAG to ensure that voltage related alerts are available for use in appropriate areas of the business.
	• Detailed design and development of our outage management system (SIMS) to:
	  • receive voltage related alerts from smart meters
	  • enable users to request further information from smart meters regarding recorded voltage measurements

Network capacity investment savings from electricity demand shift	• Developing a means to influence suppliers regarding how customer load is controlled.

Table 11 – Smart meter actions proposed for 2016/17

Category of Benefit	Work to be Undertaken during 2016/2017
Avoided losses to network operators	• Build, test and commission the NDAG to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Development of our smart meter data privacy framework. • Detailed design and development of a new data repository which is required to manage and store consumption data from smart meters.
Reduction in CML	• Build, test and commission the NDAG to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Build, test and commission changes to our outage management system (SIMS) to receive power outage and power restore alerts from smart meters. • Business engagement, communication and training for identified user groups. • Continued engagement with the DCC regarding the future operation of power outage and power restore alerts through the early life study.

Reduction in operational costs to fix faults	• Build, test and commission the NDAG to ensure that:
	  ◦ we are able to check the energisation status of individual customers via their smart meter
	  ◦ power outage and power restore alerts are available for use in appropriate areas of the business
	• Build, test and commission changes to our outage management system (SIMS) to:
	  ◦ enable the initiation of supply energisation status checks from relevant locations
	  ◦ receive power outage and power restore alerts from smart meters
	• Business engagement, communication and training for identified user groups.
	• Continued engagement with the DCC regarding the future operation of power outage and power restore alerts through the early life study.

Reduction in calls to faults and emergencies lines	• Build, test and commission the NDAG to ensure that power outage and power restore alerts are available for use in appropriate areas of the business. • Build, test and commission changes to our outage management system (SIMS) to receive power outage and power restore alerts from smart meters • Business engagement, communication and training for identified user groups. • Continued engagement with the DCC regarding the future operation of power outage and power restore alerts through the early life study.
Better informed investment decisions for electricity network enforcement	• Build, test and commission the NDAG to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Development of our smart meter data privacy framework. • Detailed design and development of a new data repository which is required to mange and store consumption data from smart meters.

Avoided cost of investigation of customer complaints about voltage quality of supply	• Build, test and commission the NDAG to ensure that voltage related alerts are available for use in appropriate areas of the business.
	• Build, test and commission changes to our outage management system (SIMS) to:
	  ◦ receive voltage related alerts from smart meters
	  ◦ enable users to request further information from smart meters regarding recorded voltage measurements

Network capacity investment savings from electricity demand shift	• Continue to work with suppliers in order to better understand how recent DCUSA changes can be implemented in order to mange network loading minimise future network investment.

Looking Forward to 2016/2017

Details of the actions we propose to take during 2016/2017 in relation to each of the benefit categories identified in worksheet E5 are detailed in Table 11.

In order to enable delivery of the smart meter related benefits we have identified we will continue to:

- Develop our smart meter data privacy framework

- Collaborate with the DCC in commencing the power outage/restore early life study (if DCC systems go live in this period)

- Continue to support the ongoing DCUSA work associated with the management of RTS meters and SMETS2

4. Conclusion

SSEN continuously review our environmental commitments and look for opportunities to reduce our impact on the environment and deliver the environmental expectations of our stakeholders efficiently.

The progress reported for the first year of RIIO-ED1 provides a clear message to our stakeholders that we are committed to deliver the benefits set out in our business plan. We have made progress in the first year of the RIIO-ED1 price control and will continue to look to the future and pursue not only those solutions that provide a short term return but also which will deliver enduring benefits.

Appendix 1 – Regulatory Reporting Tables

E 1 – Visual Amenity
SEPD
2016

Volumes/ Additions (DPCR5: 2011–2015; RIIO-ED1: 2016; Total: DPCR5, RIIO-ED1)

			2011 #	2012 #	2013 #	2014 #	2015 #	2016 #	DPCR5 #	RIIO-ED1 #
Volume - Visual Amenity Inside Designated Areas										
OHL Inside Designated Areas at End of Reporting Year (km)	LV	km	3,285.50	3,299.70	3,360.80	3,360.20	3,364.40	3,364.40	**16,671**	**3,364**
OHL Inside Designated Areas at End of Reporting Year (km)	HV	km	6,122.80	6,594.00	6,131.50	6,115.40	6,094.90	6,094.10	**31,059**	**6,094**
OHL Inside Designated Areas at End of Reporting Year (km)	EHV	km	1,152.00	1,147.70	1,037.70	1,037.90	1,037.50	1,037.10	**5,413**	**1,037**
OHL Inside Designated Areas at End of Reporting Year (km)	132kV	km	639.50	639.50	470.30	470.30	469.50	469.50	**2,689**	**470**
Total OHL Inside Designated Areas at End of Reporting Year (km)		km	11,199.8	11,680.9	11,000.3	10,983.8	10,966.3	10,965.1	**55,831**	**10,965**
OHL (km) Removed During Year	LV	km	-	-	0.88	-	-	-	**1**	**-**
OHL (km) Removed During Year	HV	km	-	-	2.18	7.32	5.10	0.80	**15**	**1**
OHL (km) Removed During Year	EHV	km	-	-	-	-	1.95	0.40	**2**	**0**
OHL (km) Removed During Year	132kV	km	-	-	-	-	-	-	**-**	**-**
Total OHL (km) Removed During Year		km	-	-	3.06	7.32	7.05	1.20	**17**	**1**
UG Cables Installed During Year (km)	LV	km	-	-	0.88	-	0.13	-	**1**	**-**
UG Cables Installed During Year (km)	HV	km	-	-	2.40	8.16	5.65	0.80	**16**	**1**
UG Cables Installed During Year (km)	EHV	km	-	-	-	-	3.35	-	**3**	**-**
UG Cables Installed During Year (km)	132kV	km	-	-	-	-	-	-	**-**	**-**
Total UG Cables Installed During Year (km)		km	-	-	3.28	8.16	9.13	0.80	**21**	**1**
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 (DPCR5: 2011–2015; RIIO-ED1: 2016–2023; Total: DPCR5, RIIO-ED1)

			2011 £m	2012 £m	2013 £m	2014 £m	2015 £m	2016 £m	2017 £m	2018 £m	2019 £m	2020 £m	2021 £m	2022 £m	2023 £m	DPCR5 £m	RIIO-ED1 £m
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

		OHL Inside Designated Areas at End of Reporting Year (km)					Visual Amenity Inside Designated Areas: OHL (km) Removed During Year				
		LV	HV	33kV & 66kV	132kV	**Total**	LV	HV	33kV & 66kV	132kV	**Total**
Enter 1st Designated Area name here >>	DA1	-	-	-	-	-	-	0	-	-	0.40
Enter 2nd Designated Area name here >>	DA2	-	-	-	-	-	-	1	-	-	0.80
		-	-	-	-	-	-	1.20	-	-	1.20

		Visual Amenity Inside Designated Areas: UG Cables Installed During Year (km)					Visual Amenity Inside Designated Areas: Visual Amenity Expenditure (£m) on Visual Amenity Inside Designated Areas by voltage				
		LV	HV	33kV & 66kV	132kV	**Total**	LV	HV	33kV & 66kV	132kV	**Total**
Enter 1st Designated Area name here >>	DA1	-	-	-	-	-	-	-	-	-	-
Enter 2nd Designated Area name here >>	DA2	-	1	-	-	0.80	-	-	-	-	-
		-	0.80	-	-	0.80	-	-	-	-	-

		Visual Amenity Outside Designated Areas: OHL (km) Removed During Year					Visual Amenity Outside Designated Areas: UG Cables Installed During Year (km)				
		LV	HV	33kV & 66kV	132kV	**Total**	LV	HV	33kV & 66kV	132kV	**Total**
Enter 1st Designated Area name here >>	DA1	-	-	-	-	-	-	-	-	-	-
Enter 2nd Designated Area name here >>	DA2	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-

Appendix 1 – Regulatory Reporting Tables

E2 – Environmental Reporting
SEPD
2016

Costs

	Unit	DPCR5 2011 £m	DPCR5 2012 £m	DPCR5 2013 £m	DPCR5 2014 £m	DPCR5 2015 £m	RIIO-ED1 2016 £m	Total DPCR5 £m	Total RIIO-ED1 £m
Environmental costs and volumes									
Undergrounding for Visual Amenity	km removed	-	-	-	-	-	-	**-**	**-**
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	**-**	**-**
Oil Pollution Mitigation Scheme - Cables	#	-					-		**-**
Oil Pollution Mitigation Scheme - Operational Sites	#	-							
Oil Pollution Mitigation Scheme - Non Operational Sites	#			-	-	-	-		**-**
SF6 Emitted Mitigation Schemes	#	-	-	-		-	-		**-**
Noise Pollution	# Interventions	-					-		**-**
Contaminated Land Clean Up	#								
Environmental Civil Sanction	#	-	-	-	-	-	-	**-**	**-**
Total									

Volumes/ Additions

	Unit	DPCR5 2011 #	DPCR5 2012 #	DPCR5 2013 #	DPCR5 2014 #	DPCR5 2015 #	RIIO-ED1 2016 #	Total DPCR5 #	Total RIIO-ED1 #
Environmental costs and volumes									
Undergrounding for Visual Amenity	km removed	-	-	-	-	-	-	**-**	**-**
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	**-**	**-**
Oil Pollution Mitigation Scheme - Cables	#	-	4.00	19.00	8.00	3.00	-	**34**	**-**
Oil Pollution Mitigation Scheme - Operational Sites	#	-	24.00	142.00	21.00	357.00	13.00	**544**	**13**
Oil Pollution Mitigation Scheme - Non Operational Sites	#	2.00	-	-	-	-	-	**2**	**-**
SF6 Emitted Mitigation Schemes	#	-	-	-	1.00	-	-	**1**	**-**
Noise Pollution	# Interventions	2.00	1.00	-	2.00	1.00	-	**6**	**-**
Contaminated Land Clean Up	#	2.00	37.00	79.00	36.00	53.00	20.00	**207**	**20**
Environmental Civil Sanction	#	-	-	-	-	-	-	**-**	**-**
Total									
Fluid-Filled Cables									
Fluid-Filled Cables in service	Circuit km	947.00	938.58	938.58	923.57	921.87	921.52		
Oil in Service in Cables	Fluid ltrs	591,617.00	524,315.93	520,538.39	513,316.18	513,316.18	578,699.08		
Fluid Used to Top Up Cables	Fluid ltrs	29,905.00	23,487.00	20,562.00	17,184.00	18,804.00	14,851.00	**109,942**	**14,851**
Fluid Used to Top Up Cables as a percentage of volume in serv	%	5%	4%	4%	3%	4%	3%		
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs							**-**	**-**
SF6									
SF6 Bank	kg	17,731.09	18,278.57	20,277.51	22,983.68	21,967.99	25,702.00		
SF6 Emitted	kg	249.52	267.40	323.02	311.06	303.53	382.00	**1,455**	**382**
SF6 Emitted as a percentage of SF6 Bank	%	1%	1%	2%	1%	1%	1%		
Noise Pollution									
Total complaints received	#	-	-	-	-	-	-	**-**	**-**

Appendix 1 – Regulatory Reporting Tables

E3 – BCF
SEPD
2016

Volumes/ Additions	Units	DPCR5 2011 #	DPCR5 2012 #	DPCR5 2013 #	DPCR5 2014 #	DPCR5 2015 #	RIIO-ED1 2016 #	Total DPCR5 #	Total RIIO-ED1 #
Total BCF (excl. losses)	tCO2e	**31,446.99**	**33,111.98**	**36,564.97**	**40,368.28**	**39,784.22**	**38,687.36**	**181,276.44**	**38,687.36**
TOTAL BCF (incl. losses)	tCO2e	**1,069,541.27**	**1,036,855.18**	**1,030,521.83**	**963,840.66**	**940,005.38**	**870,555.90**	**5,040,764.32**	**870,555.90**
DNO Emissions:									
Buildings Energy Usage									
Buildings - Electricity	tCO2e	2,271.38	2,088.08	1,911.50	1,290.73	1,311.85	1,329.87	**8,873.54**	**1,329.87**
Buildings - Other Fuels	tCO2e	180.81	131.55	140.68	162.31	149.66	78.83	**765.02**	**78.83**
Substation Electricity	tCO2e	7,329.31	7,414.86	7,279.11	7,426.56	7,536.76	7,185.40	**36,986.60**	**7,185.40**
	tCO2e	-	-	-	-	-	-	**-**	**-**
	tCO2e	-	-	-	-	-	-	**-**	**-**
Total		**9,781.51**	**9,634.50**	**9,331.28**	**8,879.59**	**8,998.28**	**8,594.10**	**46,625.15**	**8,594.10**
Operational Transport									
Road	tCO2e	11,951.95	13,752.64	14,829.23	16,843.93	17,336.95	9,323.65	**74,714.69**	**9,323.65**
Rail	tCO2e	-	-	-	-	-	-	**-**	**-**
Sea	tCO2e	-	-	-	-	-	-	**-**	**-**
Air	tCO2e	41.81	69.61	34.99	185.83	46.16	43.90	**378.40**	**43.90**
	tCO2e	-	-	-	-	-	-	**-**	**-**
	tCO2e	-	-	-	-	-	-	**-**	**-**
Total	tCO2e	**11,993.76**	**13,822.25**	**14,864.22**	**17,029.76**	**17,383.11**	**9,367.55**	**75,093.10**	**9,367.55**
Business Transport									
Road	tCO2e	1,242.86	1,234.73	1,241.66	1,232.74	1,188.23	1,216.01	**6,140.22**	**1,216.01**
Rail	tCO2e	8.08	4.89	5.18	5.53	3.16	10.22	**26.84**	**10.22**
Sea	tCO2e	-	-	-	-	-	-	**-**	**-**
Air	tCO2e	32.66	23.48	38.56	43.81	57.51	105.86	**196.01**	**105.86**
	tCO2e	-	-	-	-	-	-	**-**	**-**
	tCO2e	-	-	-	-	-	-	**-**	**-**
Total	tCO2e	**1,283.59**	**1,263.10**	**1,285.39**	**1,282.08**	**1,248.90**	**1,332.09**	**6,363.07**	**1,332.09**
Fugitive Emissions									
SF6	tCO2e	5,963.55	6,390.88	7,720.18	7,434.38	7,254.36	8,008.27	**34,763.35**	**8,008.27**
Gases Other	tCO2e	-	-	-	-	-	-	**-**	**-**
	tCO2e	-	-	-	-	-	-	**-**	**-**
	tCO2e	-	-	-	-	-	-	**-**	**-**
Total	tCO2e	**5,963.55**	**6,390.88**	**7,720.18**	**7,434.38**	**7,254.36**	**8,008.27**	**34,763.35**	**8,008.27**
Fuel Combustion									
Diesel	tCO2e	542.74	625.74	554.07	630.26	568.05	536.78	**2,920.86**	**536.78**
Gas Natural	tCO2e	-	-	-	-	-	-	**-**	**-**
Fuels Other	tCO2e	1,881.84	1,375.52	2,809.83	5,112.20	4,331.52	3,403.38	**15,510.91**	**3,403.38**
	tCO2e	-	-	-	-	-	-	**-**	**-**
	tCO2e	-	-	-	-	-	-	**-**	**-**
Total	tCO2e	**2,424.58**	**2,001.25**	**3,363.90**	**5,742.46**	**4,899.57**	**3,940.16**	**18,431.77**	**3,940.16**
Losses									
Losses	tCO2e	1,038,094.28	1,003,743.21	993,956.86	923,472.38	900,221.15	831,868.53	**4,859,487.88**	**831,868.53**
Contractor emissions:									
Operational Transport									
Road	tCO2e						7,445.19	**-**	**7,445.19**
Rail	tCO2e						-	**-**	**-**
Sea	tCO2e						-	**-**	**-**
Air	tCO2e						-	**-**	**-**
	tCO2e						-	**-**	**-**
	tCO2e						-	**-**	**-**
Total	tCO2e						**7,445.19**	**-**	**7,445.19**

Conversion factors

	Units	RIIO-ED1 2016 #
Buildings energy usage		
Buildings - Electricity	Scalar	0.46
Buildings - Other fuels	Scalar	0.18
Substation Electricity	Scalar	0.46
	Scalar	-
	Scalar	-
Total		
Operational Transport		
Road	Scalar	2.58
Rail	Scalar	-
Sea	Scalar	-
Air	Scalar	2.26
	Scalar	-
	Scalar	-
Total	Scalar	
Business Transport		
Road	Scalar	0.29
Rail	Scalar	0.05
Sea	Scalar	-
Air	Scalar	0.17
	Scalar	-
	Scalar	-
Total	Scalar	
Fugitive Emissions		
SF6	Scalar	22,800.00
Gases Other	Scalar	-
	Scalar	-
	Scalar	-
Total	Scalar	
Fuel Combustion		
Diesel	Scalar	2.58
Gas Natural	Scalar	-
Fuels Other	Scalar	2.91
	Scalar	-
	Scalar	-
Total	Scalar	
Losses		
Losses	Scalar	0.46
Operational Transport		
Road	Scalar	1.00
Rail	Scalar	-
Sea	Scalar	-
Air	Scalar	-
	Scalar	-
	Scalar	-
Total	Scalar	

Volume

		Units	RIIO-ED1 2016 #	Total RIIO-ED1 #
Buildings Energy Usage				
	Buildings - Electricity	kWh	2,877.32	**2,877.32**
	Buildings - Other fuels	kWh	427.39	**427.39**
	Substation Electricity	kWh	15,546.42	**15,546.42**
		-	-	**-**
		-	-	**-**
	Total			
Operational Transport				
	Road	Litres	3,608.36	**3,608.36**
	Rail	-	-	**-**
	Sea	-	-	**-**
	Air	km	19.43	**19.43**
		-	-	**-**
		-	-	**-**
	Total			
Business Transport				
	Road	Miles	4,135.94	**4,135.94**
	Rail	km	226.92	**226.92**
	Sea	km	-	**-**
	Air	km	609.08	**609.08**
		-	-	**-**
		-	-	**-**
	Total			
Fugitive Emissions				
	SF6	Tonnes	0.35	**0.35**
	Gases Other	-	-	**-**
		-	-	**-**
		-	-	**-**
	Total			
Fuel Combustion				
	Diesel	Litres	207.74	**207.74**
	Gas Natural	-	-	**-**
	Fuels Other	Litres	1,170.01	**1,170.01**
		-	-	**-**
		-	-	**-**
	Total			
Losses				
	Losses	kWh	1,799,841.05	**1,799,841.05**
Operational Transport				
	Road	km	7,445.19	**7,445.19**
	Rail	-	-	**-**
	Sea	-	-	**-**
	Air	-	-	**-**
		-	-	**-**
		-	-	**-**
	Total			

Appendix 1 – Regulatory Reporting Tables

E4 – Losses Snapshot
SEPD
2016

Activity							Units and estimated unit costs					Volumes	Estimated total costs	Estimated Distribution Losses-Justified Costs	Estimated Distribution Losses benefits over 'Baseline Scenario'	Distribution Losses-Justified Costs over 'Baseline Scenario'		Avoided DNO costs over 'Baseline Scenario'		Distribution Losses benefits over 'Baseline Scenario'		Cumulative discounted net benefits	
Category	Programme/project title	Type of Distribution Losses managed by the activity *(Select from list)*	Primary driver of activity *(Select from list)*	Please indicate where else in the RIGs the activity has been reported	Activity identified in DNO's final RIIO-ED1 Business Plan? *(Yes/No)*	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	2015/16	2015/16	2015/16	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	MWh	£m	£m	£m	£m	£m	£m	£m	£m
Cable	33kV Transformer (GM)	Technical losses	Asset Replacement	CV7 - Asset Replacement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 33kV		Install transformers that meet the Eco Directive		119.0	7		0.8	-1225.0	0.8	N/A	-0.8	N/A	9800.0	55125.0	0.0	1.0
Cable	33kV Transformer (GM)	Technical losses	General Reinforcement	CV1 - Primary Reinforcement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 33kV		Install transformers that meet the Eco Directive		119.0	1		0.1	-175.0	0.1	N/A	-0.1	N/A	1575.0	7875.0	0.0	0.1
Cable	33kV Transformer (GM)	Technical losses	Other	Connections (V3 Connections & V4 Other Cost Movements)	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 33kV		Install transformers that meet the Eco Directive		119.0	3		0.4	-525.0	0.4	N/A	-0.4	N/A	4200.0	23625.0	0.0	0.4
Cable	66kV Transformer	Technical losses	Asset Replacement	CV7 - Asset Replacement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 66kV		Install transformers that meet the Eco Directive		213.2	1		0.2	-263.0	0.2	N/A	-0.2	N/A	2104.0	11835.0	0.0	0.2
Cable	66kV Transformer	Technical losses	General Reinforcement	CV1 - Primary Reinforcement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 66kV		Install transformers that meet the Eco Directive		213.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	66kV Transformer	Technical losses	Other	Connections (V3 Connections & V4 Other Cost Movements)	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 66kV		Install transformers that meet the Eco Directive		213.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	132kV Transformer	Technical losses	Asset Replacement	CV7 - Asset Replacement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 132kV		Install transformers that meet the Eco Directive		371.8	2		0.7	-526.0	0.7	N/A	-0.7	N/A	4208.0	23670.0	-0.2	0.0
Transformer	132kV Transformer	Technical losses	General Reinforcement	CV1 - Primary Reinforcement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 132kV		Install transformers that meet the Eco Directive		371.8	1		0.4	-263.0	0.4	N/A	-0.4	N/A	2104.0	263.0	-0.1	0.0
Transformer	132kV Transformer	Technical losses	Other	Connections (V3 Connections & V4 Other Cost Movements)	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 132kV		Install transformers that meet the Eco Directive		371.8	4		1.5	-1052.0	1.5	N/A	-1.5	N/A	8416.0	47340.0	-0.4	0.0
Transformer	LV Transformers - GMT	Technical losses	Asset Replacement	CV7 - Asset Replacement	Yes	Page 19 para 2	Prioritisation of pre 1960 transformers for replacement		Do not prioritise the asset replacement programme		-	3	0.0	0.0	-28.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	DUOS recovery SEPD - domestic	Non-technical losses	Other	-	Yes	Page 24 para 2	MPAN rectification	-	N/A	#VALUE!	N/A	1892	0.0	0.0	-7832.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Relevant Theft of Electricity	DUOS recovery SEPD - non domestic	Non-technical losses	Other	-	Yes	Page 24 para 2	MPAN rectification	-	N/A	#VALUE!	N/A	597	0.0	0.0	-9002.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (please specify)	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (please specify)	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (please specify)																							
Other (please specify)																							
Other (please specify)																							
Total														4.1	- 20,893.1	4.1		- 4.1		32,407.0		- 0.8	

Appendix 1 – Regulatory Reporting Tables

E5 – Smart Metering
SEPD
2016

	DPCR5					RIIO-ED1	Total	
	2011	2012	2013	2014	2015	2016	DPCR5	RIIO-ED1
	£m	£m	£m	£m	£m	£m	£m	£m
Costs	**Cost**							
Smart Meter Communication Licensee Costs (pass through)	-	-	-	-	-		-	
Smart Meter Information Technology Costs (pass through)	-	-	-	-	-		-	
Elective Communication Services (outside price control)	-	-	-	-	-	-	-	-
Smart Meter Communication Licensee Costs (outside price control)							-	-
Total	**-**	**-**	**-**	**-**	**-**		**-**	
Estimated Benefits	**Estimated benefits**							
Avoided losses to network operators	-	-	-	-	-	-	-	-
Reduction in CML	-	-	-	-	-	-	-	-
Reduction in operational costs to fix faults	-	-	-	-	-	-	-	-
Reduction in calls to faults and emergencies lines	-	-	-	-	-	-	-	-
Better informed investment decisions for electricity network enforcement	-	-	-	-	-	-	-	-
Avoided cost of investigation of customer complaints about voltage quality of supply	-	-	-	-	-	-	-	-
Network capacity investment savings from electricity demand shift	-	-	-	-	-	-	-	-
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Appendix 1 – Regulatory Reporting Tables

E6 – Innovative Solutions
SEPD
2016

Solution type	Unit	Voltage level of issue	RIIO Output	Worksheet (costs)	Worksheet (savings)	Costs RIIO-ED1 2016 £m	Costs DPCR5 £m	Costs Total RIIO-ED1 £m	MVA released RIIO-ED1 2016 MVA	MVA released DPCR5 MVA	MVA released Total RIIO-ED1 MVA
Increase Network Capacity/Optimise Utilisation											
Active Network Management	deployments	132kV	Connections	V4 Other Asset Movements (Consequential, DG, ICP)	V4 Other Asset Movements (Consequential, DG, ICP)				45.0	**45.0**	**45.0**
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments					-	-	-	-	-	-
Add description of innovative solution	deployments						-	-		-	-
Total							-		**45.0**	-	**45.0**
Improve Asset Life Cycle Management											
Pole Pinning SSES	deployments	HV	Customer Satisfaction	Refurbishment	Refurbishment		-			-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments						-	-		-	-
Total							-		-	-	-
Improve Network Performance											
Bidoyng	deployments	LV	reliability and availability	CV26 Faults	CV26 Faults		-			-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments					-	-	-		-	-
Add description of innovative solution	deployments						-	-		-	-
Total							-		-	-	-

Solution type	Estimated Gross Avoided Costs RIIO-ED1 2016 £m	2017 £m	2018 £m	2019 £m	2020 £m	2021 £m	2022 £m	2023 £m	DPCR5 £m	Total RIIO-ED1 £m	Estimated CI Impact RIIO-ED1 2016 CI	DPCR5 CI	Total RIIO-ED1 CI	Estimated CML Impact RIIO-ED1 2016 mins	DPCR5 mins	Total RIIO-ED1 mins
Increase Network Capacity/Optimise Utilisation																
Active Network Management	- 2.3	0.1	- 37.9	0.1	3.4	0.1	0.1	38.1	-	**1.7**		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Total	**- 2.3**	**0.1**	**- 37.9**	**0.1**	**3.4**	**0.1**	**0.1**	**38.1**	-	**1.7**	-	-	-	-	-	-
Improve Asset Life Cycle Management																
Pole Pinning SSES	0.0								-	**0.0**		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Total	**0.0**	-	-	-	-	-	-	-	-	**0.0**	-	-	-	-	-	-
Improve Network Performance																
Bidoyng	- 1.6								-	**- 1.6**	- 54,179.7	**- 54,179.7**	**- 54,179.7**	- 9,796,449.2	-	**- 9,796,449.2**
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Add description of innovative solution									-	-		-	-		-	-
Total	**- 1.6**	-	-	-	-	-	-	-	-	**- 1.6**	**- 54,179.7**	-	**- 54,179.7**	**- 9,796,449.2**	-	**- 9,796,449.2**

Appendix 1 – Regulatory Reporting Tables

E7 – LCTs
SEPD
2016

		Estimated Volumes/ Additions							
		DPCR5					RIIO-ED1	Total	
		2011	2012	2013	2014	2015	2016	DPCR5	RIIO-ED1
	Units	#	#	#	#	#	#	#	#
Estimated volumes of LCTs Installed									
Secondary network									
Heat Pumps	Number						-		**-**
EV slow charge	Number						120.0		**120.0**
EV fast charge	Number						340.0		**340.0**
PVs (G83)	Number						11,239.0		**11,239.0**
Other DG (G83)	Number						1.0		**1.0**
DG (non G83)	Number						109.0		**109.0**
Total							**11,809.0**		**11,809.0**
Primary network									
Heat Pumps	Number						-		**-**
EV slow charge	Number						-		**-**
EV fast charge	Number						-		**-**
PVs (G83)	Number						-		**-**
Other DG (G83)	Number						-		**-**
DG (non G83)	Number						45.0		**45.0**
Total							**45.0**		**45.0**
Estimated size of LCTs Installed									
Secondary network									
Heat Pumps							-		**-**
EV slow charge	MW						0.4		**0.4**
EV fast charge	MW						2.4		**2.4**
PVs (G83)	MW						37.0		**37.0**
Other DG (G83)	MW						0.0		**0.0**
DG (non G83)	MW						43.9		**43.9**
Total							**83.8**		**83.8**
Primary network									
Heat Pumps	MW						-		**-**
EV slow charge	MW						-		**-**
EV fast charge	MW						-		**-**
PVs (G83)	MW						-		**-**
Other DG (G83)	MW						-		**-**
DG (non G83)	MW						580.2		**580.2**
Total							**580.2**		**580.2**

Appendix 1 – Regulatory Reporting Tables

E 1 – Visual Amenity
SHEPD
2016

Volumes/ Additions

			DPCR5 2011 #	DPCR5 2012 #	DPCR5 2013 #	DPCR5 2014 #	DPCR5 2015 #	RIIO-ED1 2016 #	Total DPCR5 #	Total RIIO-ED1 #
Volume - Visual Amenity Inside Designated Areas										
OHL Inside Designated Areas at End of Reporting Year (km)	LV	km	588.91	620.99	554.00	550.90	545.70	545.70	**2,861**	**546**
OHL Inside Designated Areas at End of Reporting Year (km)	HV	km	3,163.00	3,166.97	3,107.50	3,105.10	3,110.60	3,110.60	**15,653**	**3,111**
OHL Inside Designated Areas at End of Reporting Year (km)	EHV	km	874.60	889.60	811.60	821.90	823.00	823.00	**4,221**	**823**
OHL Inside Designated Areas at End of Reporting Year (km)	132kV	km	-	-	-	-	-	-	**-**	**-**
Total OHL Inside Designated Areas at End of Reporting Year (km)		km	4,626.5	4,677.6	4,473.1	4,477.9	4,479.3	4,479.3	**22,734**	**4,479**
OHL (km) Removed During Year	LV	km	-	-	-	-	-	-	**-**	**-**
OHL (km) Removed During Year	HV	km	-	-	-	-	1.90	-	**2**	**-**
OHL (km) Removed During Year	EHV	km	-	-	-	-	5.80	-	**6**	**-**
OHL (km) Removed During Year	132kV	km	-	-	-	-	-	-	**-**	**-**
Total OHL (km) Removed During Year		km	-	-	-	-	7.70	-	**8**	**-**
UG Cables Installed During Year (km)	LV	km	-	-	-	-	-	-	**-**	**-**
UG Cables Installed During Year (km)	HV	km	-	-	-	-	1.90	-	**2**	**-**
UG Cables Installed During Year (km)	EHV	km	-	-	-	-	5.76	-	**6**	**-**
UG Cables Installed During Year (km)	132kV	km	-	-	-	-	-	-	**-**	**-**
Total UG Cables Installed During Year (km)		km	-	-	-	-	7.66	-	**8**	**-**
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

			DPCR5 2011 £m	DPCR5 2012 £m	DPCR5 2013 £m	DPCR5 2014 £m	DPCR5 2015 £m	RIIO-ED1 2016 £m	Total DPCR5 £m	Total RIIO-ED1 £m
Costs										
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			-					-		-

Appendix 1 – Regulatory Reporting Tables

E2 – Environmental Reporting
SHEPD
2016

Costs

	Unit	DPCR5 2011 £m	DPCR5 2012 £m	DPCR5 2013 £m	DPCR5 2014 £m	DPCR5 2015 £m	RIIO-ED1 2016 £m	Total DPCR5 £m	Total RIIO-ED1 £m
Environmental costs and volumes									
Undergrounding for Visual Amenity	km removed	-	-	-	-	-	-	**-**	**-**
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	**-**	**-**
Oil Pollution Mitigation Scheme - Cables	#	-	-			-	-		**-**
Oil Pollution Mitigation Scheme - Operational Sites	#								
Oil Pollution Mitigation Scheme - Non Operational Sites	#	-		-	-	-	-		**-**
SF6 Emitted Mitigation Schemes	#	-	-	-	-	-	-	**-**	**-**
Noise Pollution	# Interventions	-		-			-		**-**
Contaminated Land Clean Up	#						-		**-**
Environmental Civil Sanction	#	-	-	-	-	-		**-**	
Total									

Volumes/ Additions

	Unit	DPCR5 2011 #	DPCR5 2012 #	DPCR5 2013 #	DPCR5 2014 #	DPCR5 2015 #	RIIO-ED1 2016 #	Total DPCR5 #	Total RIIO-ED1 #
Environmental costs and volumes									
Undergrounding for Visual Amenity	km removed	-	-	-	-	-	-	**-**	**-**
Non-Undergrounding Visual Amenity Schemes	# interventions	-	-	-	-	-	-	**-**	**-**
Oil Pollution Mitigation Scheme - Cables	#	-	-	-	1.00	-	-	**1**	**-**
Oil Pollution Mitigation Scheme - Operational Sites	#	8.00	8.00	5.00	2.00	1.00	4.00	**24**	**4**
Oil Pollution Mitigation Scheme - Non Operational Sites	#	-	3.00	-	-	-	-	**3**	**-**
SF6 Emitted Mitigation Schemes	#	-	-	-	-	-	-	**-**	**-**
Noise Pollution	# Interventions	-	1.00	-	1.00	1.00	-	**3**	**-**
Contaminated Land Clean Up	#	2.00	-	2.00	3.00	11.00	-	**18**	**-**
Environmental Civil Sanction	#	-	-	-	-	-	2.00	**-**	**2**
Total									
Fluid-Filled Cables									
Fluid-Filled Cables in service	Circuit km	80.00	80.00	80.00	79.40	79.25	80.00		
Oil in Service in Cables	Fluid ltrs	38,480.00	38,480.00	38,480.00	38,189.00	38,116.85	38,480.00		
Fluid Used to Top Up Cables	Fluid ltrs	-	364.00	2,117.00	1,077.00	1,623.00	410.00	**5,181**	**410**
Fluid Used to Top Up Cables as a percentage of volume in s	%	0%	1%	6%	3%	4%	1%		
Fluid Recovered from Fluid-Filled Cables	Fluid ltrs							**-**	**-**
SF6									
SF6 Bank	kg	3,863.82	4,094.09	4,429.99	4,887.28	5,231.98	5,510.84		
SF6 Emitted	kg	41.64	43.44	46.00	57.77	66.62	79.00	**255**	**79**
SF6 Emitted as a percentage of SF6 Bank	%	1%	1%	1%	1%	1%	1%		
Noise Pollution									
Total complaints received	#	-	-	-	-	-	-	**-**	**-**

Appendix 1 – Regulatory Reporting Tables

E3 – BCF SHEPD 2016

	Units	Volumes/ Additions DPCR5 2011 #	2012 #	2013 #	2014 #	2015 #	RIIO-ED1 2016 #	Total DPCR5 #	Total RIIO-ED1 #
Total BCF (excl. losses)	tCO2e	**54,205.96**	**47,256.41**	**55,114.25**	**49,096.51**	**68,233.07**	**22,326.48**	**273,906.20**	**22,326.48**
TOTAL BCF (incl. losses)	tCO2e	**1,092,300.24**	**1,050,999.62**	**1,049,071.11**	**972,568.89**	**968,454.23**	**269,268.25**	**5,133,394.08**	**269,268.25**
DNO Emissions:									
Buildings Energy Usage									
Buildings - Electricity	tCO2e	2,271.38	2,088.08	1,911.50	1,290.73	1,311.85	974.81	**8,873.54**	**974.81**
Buildings - Other Fuels	tCO2e	180.81	131.55	140.68	162.31	149.66	33.41	**765.02**	**33.41**
Substation Electricity	tCO2e	7,329.31	7,414.86	7,279.11	7,426.56	7,536.76	5,125.76	**36,986.60**	**5,125.76**
	tCO2e	-	-	-	-	-	-	-	-
	tCO2e	-	-	-	-	-	-	-	-
Total		**9,781.51**	**9,634.50**	**9,331.28**	**8,879.59**	**8,998.28**	**6,133.98**	**46,625.15**	**6,133.98**
Operational Transport									
Road	tCO2e	11,951.95	13,752.64	14,829.23	16,843.93	17,336.95	5,089.60	**74,714.69**	**5,089.60**
Rail	tCO2e	-	-	-	-	-	-	-	-
Sea	tCO2e	-	-	-	-	-	-	-	-
Air	tCO2e	41.81	69.61	34.99	185.83	46.16	134.80	**378.40**	**134.80**
	tCO2e	-	-	-	-	-	-	-	-
	tCO2e	-	-	-	-	-	-	-	-
Total	tCO2e	**11,993.76**	**13,822.25**	**14,864.22**	**17,029.76**	**17,383.11**	**5,224.40**	**75,093.10**	**5,224.40**
Business Transport									
Road	tCO2e	1,242.86	1,234.73	1,241.66	1,232.74	1,188.23	578.14	**6,140.22**	**578.14**
Rail	tCO2e	8.08	4.89	5.18	5.53	3.16	9.18	**26.84**	**9.18**
Sea	tCO2e	-	-	-	-	-	0.33	**-**	**0.33**
Air	tCO2e	32.66	23.48	38.56	43.81	57.51	101.49	**196.01**	**101.49**
	tCO2e	-	-	-	-	-	-	-	-
	tCO2e	-	-	-	-	-	-	-	-
Total	tCO2e	**1,283.59**	**1,263.10**	**1,285.39**	**1,282.08**	**1,248.90**	**689.14**	**6,363.07**	**689.14**
Fugitive Emissions									
SF6	tCO2e	1,283.59	1,263.10	1,285.39	1,282.08	1,248.90	1,384.91	**6,363.07**	**1,384.91**
Gases Other	tCO2e	5,963.55	6,390.88	7,720.18	7,434.38	7,254.36	-	**34,763.35**	**-**
	tCO2e	-	-	-	-	-	-	-	-
	tCO2e	-	-	-	-	-	-	-	-
Total	tCO2e	**7,247.14**	**7,653.97**	**9,005.57**	**8,716.46**	**8,503.26**	**1,384.91**	**41,126.42**	**1,384.91**
Fuel Combustion									
Diesel	tCO2e	22,018.12	13,507.07	17,817.96	8,076.41	27,768.00	5,854.92	**89,187.56**	**5,854.92**
Gas Natural	tCO2e	-	-	-	-	-	-	-	-
Fuels Other	tCO2e	1,881.84	1,375.52	2,809.83	5,112.20	4,331.52	37.42	**15,510.91**	**37.42**
	tCO2e	-	-	-	-	-	-	-	-
	tCO2e	-	-	-	-	-	-	-	-
Total	tCO2e	**23,899.96**	**14,882.59**	**20,627.78**	**13,188.61**	**32,099.53**	**5,892.34**	**104,698.47**	**5,892.34**
Losses									
Losses	tCO2e	1,038,094.28	1,003,743.21	993,956.86	923,472.38	900,221.15	246,941.78	**4,859,487.88**	**246,941.78**
Contractor emissions:									
Operational Transport									
Road	tCO2e						3,001.71	**-**	**3,001.71**
Rail	tCO2e						-	-	-
Sea	tCO2e						-	-	-
Air	tCO2e						-	-	-
	tCO2e						-	-	-
	tCO2e						-	-	-
Total	tCO2e						**3,001.71**	**-**	**3,001.71**

Conversion factors

	Units	RIIO-ED1 2016 #
Buildings energy usage		
Buildings - Electricity	Scalar	0.46
Buildings - Other fuels	Scalar	0.18
Substation Electricity	Scalar	0.46
	Scalar	-
	Scalar	-
Total		
Operational Transport		
Road	Scalar	2.58
Rail	Scalar	-
Sea	Scalar	-
Air	Scalar	2.26
	Scalar	-
	Scalar	-
Total	Scalar	
Business Transport		
Road	Scalar	0.29
Rail	Scalar	0.05
Sea	Scalar	0.13
Air	Scalar	0.16
	Scalar	-
	Scalar	-
Total	Scalar	
Fugitive Emissions		
SF6	Scalar	22,800.00
Gases Other	Scalar	-
	Scalar	-
	Scalar	-
Total	Scalar	
Fuel Combustion		
Diesel	Scalar	2.58
Gas Natural	Scalar	-
Fuels Other	Scalar	2.91
	Scalar	-
	Scalar	-
Total	Scalar	
Losses		
Losses	Scalar	0.46
Operational Transport		
Road	Scalar	1.00
Rail	Scalar	-
Sea	Scalar	-
Air	Scalar	-
	Scalar	-
	Scalar	-
Total	Scalar	

Volume

		Units	RIIO-ED1 2016 #	Total RIIO-ED1 #
Buildings Energy Usage				
	Buildings - Electricity	kWh	2,109.11	**2,109.11**
	Buildings - Other fuels	kWh	181.12	**181.12**
	Substation Electricity	kWh	11,090.16	**11,090.16**
		-	-	-
		-	-	-
	Total			
Operational Transport				
	Road	Litres	1,972.72	**1,972.72**
	Rail	-	-	-
	Sea	-	-	-
	Air	km	59.65	**59.65**
		-	-	-
		-	-	-
	Total			
Business Transport				
	Road	Miles	1,993.58	**1,993.58**
	Rail	km	203.76	**203.76**
	Sea	km	2.46	**2.46**
	Air	km	644.10	**644.10**
		-	-	-
		-	-	-
	Total			
Fugitive Emissions				
	SF6	Tonnes	0.06	**0.06**
	Gases Other	-	-	-
		-	-	-
		-	-	-
	Total			
Fuel Combustion				
	Diesel	Litres	2,265.92	**2,265.92**
	Gas Natural	-	-	-
	Fuels Other	Litres	12.86	**12.86**
		-	-	-
		-	-	-
	Total			
Losses				
	Losses	kWh	534,286.28	**534,286.28**
Operational Transport				
	Road	km	3,001.71	**3,001.71**
	Rail	-	-	-
	Sea	-	-	-
	Air	-	-	-
		-	-	-
		-	-	-
	Total			

Appendix 1 – Regulatory Reporting Tables

E4 – Losses Snapshot
SHEPD
2016

Activity							Units and estimated unit costs					Volumes	Estimated total costs	Estimated Distribution Losses-Justified Costs	Estimated Distribution Losses benefits over 'Baseline Scenario'	Distribution Losses-Justified Costs over 'Baseline Scenario'		Avoided DNO costs over 'Baseline Scenario'		Distribution Losses benefits over 'Baseline Scenario'		Cumulative discounted net benefits	
Category	**Programme/project title**	**Type of Distribution Losses managed by the activity *(Select from list)***	**Primary driver of activity *(Select from list)***	**Please indicate where else in the RIGs the activity has been reported**	**Activity identified in DNO's final RIIO-ED1 Business Plan? *(Yes/No)***	**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**	**2015/16**	**2015/16**	**2015/16**	**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**	**MWh**	**£m**	**£m**	**£m**	**£m**	**£m**	**£m**	**£m**	**£m**
Cable	33kV Transformer (GM)	Technical losses	Asset Replacement	CV7 - Asset Replacement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 33kV		Install transformers that meet the Eco Directive		173.2	8		1.4	-1048.0	1.4	N/A	-1.4	N/A	8384.0	47160.0	-0.4	0.1
Cable	33kV Transformer (GM)	Technical losses	General Reinforcement	CV1 - Primary Reinforcement	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 33kV		Install transformers that meet the Eco Directive		173.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cable	33kV Transformer (GM)	Technical losses	Other	Connections (V3 Connections & V4 Other Cost Movements)	Yes	Page 18 para 2	Installing transformers that outperform the Eco Directive 33kV		Install transformers that meet the Eco Directive		173.2	38		6.6	-4978.0	6.6	N/A	-6.6	N/A	39842.0	258856.0	-2.1	0.7
Cable	LV Transformers - GMT	Technical losses	Asset Replacement	CV7 - Asset Replacement	Yes	Page 19 para 2	Prioritisation of pre 1960 transformers for replacement		Do not prioritise the asset replacement programme		-	2	0.0	0.0	-19.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cable	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Innovative Solution	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smart Meters	DUOS recovery SHEPD - domestic	Non-technical losses	Other	-	Yes	Page 24 para 2	MPAN rectification	-	N/A	N/A	N/A	1023	0.0	0.0	-4409.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Smart Meters	DUOS recovery SHEPD - non domestic	Non-technical losses	Other	-	Yes	Page 24 para 2	MPAN rectification	-	N/A	N/A	N/A	250	0.0	0.0	-3990.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Smart Meters	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Relevant Theft of Electricity	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (please specify)	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (please specify)	-	-	-	-	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (please specify)																							
Other (please specify)																							
Other (please specify)																							
Total													**24.2**	**8.0**	**- 14,444.1**	**8.0**		**- 8.0**		**48,226.0**		**- 2.6**	

Appendix 1 – Regulatory Reporting Tables

E5 – Smart Metering
SHEPD
2016

	DPCR5 2011 £m	DPCR5 2012 £m	DPCR5 2013 £m	DPCR5 2014 £m	DPCR5 2015 £m	RIIO-ED1 2016 £m	Total DPCR5 £m	Total RIIO-ED1 £m
Costs	**Cost**							
Smart Meter Communication Licensee Costs (pass through)	-	-	-	-	-		-	
Smart Meter Information Technology Costs (pass through)	-	-	-	-	-		-	
Elective Communication Services (outside price control)	-	-	-	-	-	-	-	-
Smart Meter Communication Licensee Costs (outside price control)							-	-
Total	-	-	-	-	-		-	
Estimated Benefits	**Estimated benefits**							
Avoided losses to network operators	-	-	-	-	-	-	-	-
Reduction in CML	-	-	-	-	-	-	-	-
Reduction in operational costs to fix faults	-	-	-	-	-	-	-	-
Reduction in calls to faults and emergencies lines	-	-	-	-	-	-	-	-
Better informed investment decisions for electricity network enforcement	-	-	-	-	-	-	-	-
Avoided cost of investigation of customer complaints about voltage quality of supply	-	-	-	-	-	-	-	-
Network capacity investment savings from electricity demand shift	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-

Appendix 1 – Regulatory Reporting Tables

E6 – Innovative Solutions
SHEPD
2016

Solution type	Unit	Voltage level of issue	RIIO Output	Worksheet (costs)	Worksheet (savings)	Costs RIIO-ED1 2016	Costs DPCR5	Costs Total RIIO-ED1	Estimated Gross Avoided Costs RIIO-ED1 2016	2017	2018	2019	2020	2021	2022	2023	DPCR5	Total RIIO-ED1
						£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m
Improve Asset Life Cycle Management																		
Pole Pinning SSEH	deployments	HV	Customer Satisfaction	Refurbishment	Refurbishment		-		0.0								-	0.0
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments						-	-									-	-
Total							-		**0.0**	-	-	-	-	-	-	-	-	**0.0**
Improve Vegetation Management																		
Live Line Tree Cutting	deployments	HV	reliability and availability	Tree cutting	Tree Cutting				- 1.5								- 1.5	- 1.5
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Total							-		**- 1.5**	-	-	-	-	-	-	-	-	**- 1.5**
Improve Environmental Impact																		
Bi Directional Hybrid Generator	deployments	LV	Environment	CV26 Faults	CV26 Faults		-		- 0.0								-	- 0.0
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Add description of innovative solution	deployments					-	-	-									-	-
Total							-		**- 0.0**	-	-	-	-	-	-	-	-	**- 0.0**

Solution type	Estimated CI Impact RIIO-ED1 2016	DPCR5	Total RIIO-ED1	Estimated CML Impact RIIO-ED1 2016	DPCR5	Total RIIO-ED1	Other Estimated GHG Emissions RIIO-ED1 2016	DPCR5	Total RIIO-ED1
	CI	CI	CI	mins	mins	mins	tCO2e		
Improve Asset Life Cycle Management									
Pole Pinning SSEH		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Total	-	-	-	-	-	-	-	-	-
Improve Vegetation Management									
Live Line Tree Cutting	- 36,182.0	- 36,182.0	- 36,182.0	- 5,472,653.5	- 5,472,653.5	- 5,472,653.5	- 3,400.0	-3,400.0	- 3,400.0
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Total	**- 36,182.0**	-	**- 36,182.0**	**- 5,472,653.5**	-	**- 5,472,653.5**	**-3,400.0**	-	**- 3,400.0**
Improve Environmental Impact									
Bi Directional Hybrid Generator		-	-		-	-	- 11.2	-	- 11.2
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Add description of innovative solution		-	-		-	-		-	-
Total	-	-	-	-	-	-	**- 11.2**	-	**- 11.2**

Appendix 1 – Regulatory Reporting Tables

E7 – LCTs
SHEPD
2016

	Units	2011 #	2012 #	2013 #	2014 #	2015 #	2016 #	DPCR5 #	RIIO-ED1 #
		Estimated Volumes/ Additions							
		DPCR5					RIIO-ED1	Total	
Estimated volumes of LCTs Installed									
Secondary network									
Heat Pumps	Number						-		**-**
EV slow charge	Number						2.0		**2.0**
EV fast charge	Number						54.0		**54.0**
PVs (G83)	Number						2,924.0		**2,924.0**
Other DG (G83)	Number						187.0		**187.0**
DG (non G83)	Number						272.0		**272.0**
Total							**3,439.0**		**3,439.0**
Primary network									
Heat Pumps	Number						-		**-**
EV slow charge	Number						-		**-**
EV fast charge	Number						-		**-**
PVs (G83)	Number						-		**-**
Other DG (G83)	Number						-		**-**
DG (non G83)	Number						31.0		**31.0**
Total							**31.0**		**31.0**
Estimated size of LCTs Installed									
Secondary network									
Heat Pumps							-		**-**
EV slow charge	MW						0.0		**0.0**
EV fast charge	MW						0.4		**0.4**
PVs (G83)	MW						10.0		**10.0**
Other DG (G83)	MW						0.5		**0.5**
DG (non G83)	MW						83.1		**83.1**
Total							**94.0**		**94.0**
Primary network									
Heat Pumps	MW						-		**-**
EV slow charge	MW						-		**-**
EV fast charge	MW						-		**-**
PVs (G83)	MW						-		**-**
Other DG (G83)	MW						-		**-**
DG (non G83)	MW						140.5		**140.5**
Total							**140.5**		**140.5**

Appendix 2 – Relevant terms

Business Carbon Footprint (BCF)
A measure of the total Greenhouse Gas Emissions (in tonnes of CO2 equivalent) resulting from operations on which the DNO has full authority to introduce and implement its operating policy and contractors emissions.

Designated Area
Areas in which Visual Amenity Projects may be undertaken, according to the relevant definitions in CRC 3J (Allowed expenditure on Visual Amenity Projects).

Distributed Generation (DG)
Plant or equipment for the production of electricity that is directly connected to the Distribution Network.

Distribution Losses
Units lost while being transported through the licensee's Distribution System, either as electricity turns to heat as it is transported through the network or non-technical losses, such as theft or measurement errors.

Distribution Losses Strategy
Has the meaning given in Standard Condition 49 (Electricity Distribution Losses Management Obligation and Distribution Losses Strategy) of the electricity distribution licence.

Environment Report
Has the meaning given to it in Standard Condition 47 of the electricity distribution licence.

Fluid Filled Cables
Pressurised fluid-filled underground cables, high voltage cables in which the insulting medium is liquid oil as opposed to a solid insulator such as oil impregnated paper or PVC.

Fluid Recovered
Fluid associated with pressurised fluid-filled underground cables that has leaked from a cable and is subsequently recovered and includes:

- fluid captured in a container whilst jointing works are being undertaken
- spoil removed from site because it has become saturated with fluid during a cable leak

In order to avoid double counting, the volume of fluid used to top up a cable in order to prevent pressure reaching the Pressure emergency (Pe) level prior to jointing or repair should be excluded.

Used to Top Up Cables
Fluid pumped into pressurised fluid-filled underground cables and includes fluid used to:

- bring a circuit back up to pressure from a lower pressure level
- sustain a circuit fluid pressure from reaching Pressure emergency level prior to jointing or repair of a leak

Greenhouse Gas Emission
The release of greenhouse gases into the atmosphere, including carbon emissions. Within the BCF, greenhouse gas emissions, e.g. SF_6 , are calculated as equivalent carbon dioxide emissions.

Innovative Solution
A Working Group will determine the definitions of Innovative Solutions. Until such time as the Working Group can provide definitions, only solutions that meet one of the following criteria can be defined as Innovative Solutions:

- Has been trialled by any DNO as part of an LCNF, NIC, NIA, or IFI innovation project during DPCR5 or RIIO-ED1.
- Was considered a smart solution as part of the RIIO-ED1 smart solutions assessment.

- Involves the application of technology, systems or processes not in widespread use at the beginning of RIIO-ED1 to provide long term direct benefits to distribution network customers through:
  - Improving the utilisation or provision of network capacity for demand or generation (including demand side solutions),
  - Improving the management of asset condition to reduce lifetime costs,
  - Increasing the DNO's ability to manage network performance, safety or security, or
  - Improving the level of service provided to network customers.

Direct benefits can include improvements in economic performance, environmental benefits, safety, quality of service, reliability, and/or resilience.

Innovation Strategy
Has the meaning given in SLC 48 (The Innovation Strategy) of the electricity distribution licence. This condition requires the licensee to have in place and maintain an Innovation Strategy for the purpose of demonstrating the role of innovation within the Electricity Distribution Group of which it is a part.

Low Carbon Technologies (LCTs)
LCTs is the collective term for technologies that are being introduced to the market with the aim of reducing carbon emissions through the more efficient use of energy, the storage of energy in a flexible way or a move from another energy vector such as oil to electricity.

Examples include:
- Heat Pumps
- Electric vehicles
- Domestic Batteries
- Demand Side Response

Noise Pollution
The activity of investigating reports of noise pollution, and consequential remedial works (if necessary). In this context, noise pollution is defined as levels of noise associated with the normal operational characteristics of electrical distribution assets that may be deemed to be a nuisance and subject to Part III of the Environmental Protection Act 1990 (EPA).

Non-Technical Losses
Electricity units lost for non-physical reasons, including theft and measurement inaccuracy.

Oil Leakage
The discharging of insulating oil into the environment as a result of DNO's equipment and activities.
actual activity volumes.

Network Innovation Allowance (NIA)
A set allowance per network licensee
- To fund smaller technical, commercial, or operational projects directly related to the licensees network that have the potential to deliver financial benefits, and / or
- to fund the preparation of submissions to the Network Innovation Competition (NIC)

Appendix 2 – Relevant terms

Regulatory Instructions and Guidance (RIGs)
The term RIGs refers to a collection of documents issued by Ofgem to the DNOs to enable them to complete the reporting requirements associated with the RIIO-ED1 price control arrangements. It includes excel reporting packs, instructions and guidance, commentaries and the glossary.

RIIO-ED1 Business Plan
For SHEPD and SEPD, the document submitted to the Authority and published by the licensee in March 2014 in response to the document entitled "Assessment of RIIO-ED1 business plans and fast-tracking" published on 22 November 2013. This business plan covered the period 1 April 2015 to 31 March 2023.

RIIO-ED1 CBA Tool
The CBA tool DNOs used when completing their RIIO-ED1 Business Plans.

SF_6
The chemical symbol for sulphur hexafluoride, a gas that is used as both an insulating and arc extinction medium in electrical plant. The reporting requirement is in respect of fugitive BCF emissions attributed to SF_6 lost from electrical plant.

SF_6 Bank
The total mass (in kg) of sulphur hexafluoride held by the DNO for both assets installed on the network and those held in inventory. Each DNO's SF_6 bank should be calculated according to the methods set out in ENA Engineering Recommendation S38.

SF_6 Emitted
The total mass (in kg) of sulphur hexafluoride emitted during asset installation (only if gassed by the DNO), service life and decommissioning. Service life emissions include those due to leakage (measured through top-ups); those measured during service activity requiring gassing and degassing; and those due to equipment failure resulting in the loss of all gas contained by the asset. The SF_6 emitted value should account for gas recovered.

Each DNO's SF_6 emitted should be calculated according to the methods set out in ENA Engineering Recommendation S38. DNOs should not assume a percentage leakage rate to determine any element of SF_6 emitted and if a DNO does not have measured records of SF_6 emitted, this should be highlighted in the accompanying commentary.

Smart Meters
An Energy Meter that can both send and receive information using an External Electronic Communications Network.

$tC0_2e$
Carbon dioxide (CO_2) equivalent, measured in tonnes. This is a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide (CO_2) as the reference.

Technical Losses
Electricity units lost owing to the physical properties of the network. This also includes the way the network is configured and operated.

Visual Amenity Inside Designated Areas

Activity undertaken as part of a Visual Amenity Project funded under the Visual Amenity Allowance funding mechanism described in CRC 3J (Allowed expenditure on Visual Amenity Projects) of the electricity distribution licence which relates to overhead distribution assets located within a Designated Area.

Visual Amenity Outside Designated Areas

Activity undertaken as part of a Visual Amenity Project funded under the Visual Amenity Allowance funding mechanism described in CRC 3J (Allowed expenditure on Visual Amenity Projects) of the electricity distribution licence which relates to overhead distribution assets which form part of an overhead line which spans the boundary of a Designated Area and is located outside the boundaries of the DNO's Designated Area, for which up to 10% of the Visual Amenity Allowance funding mechanism described in CRC 3J (Allowed expenditure on Visual Amenity Projects) of the electricity distribution licence may be used.

Contacting us

For any queries or to request further information, please contact us on:

futurenetworks@sse.com
www.ssen.co.uk

0345 300 2315

This report and associated documents can be found at:

www.ssen.co.uk/LibraryStakeholderEngagementPublications/