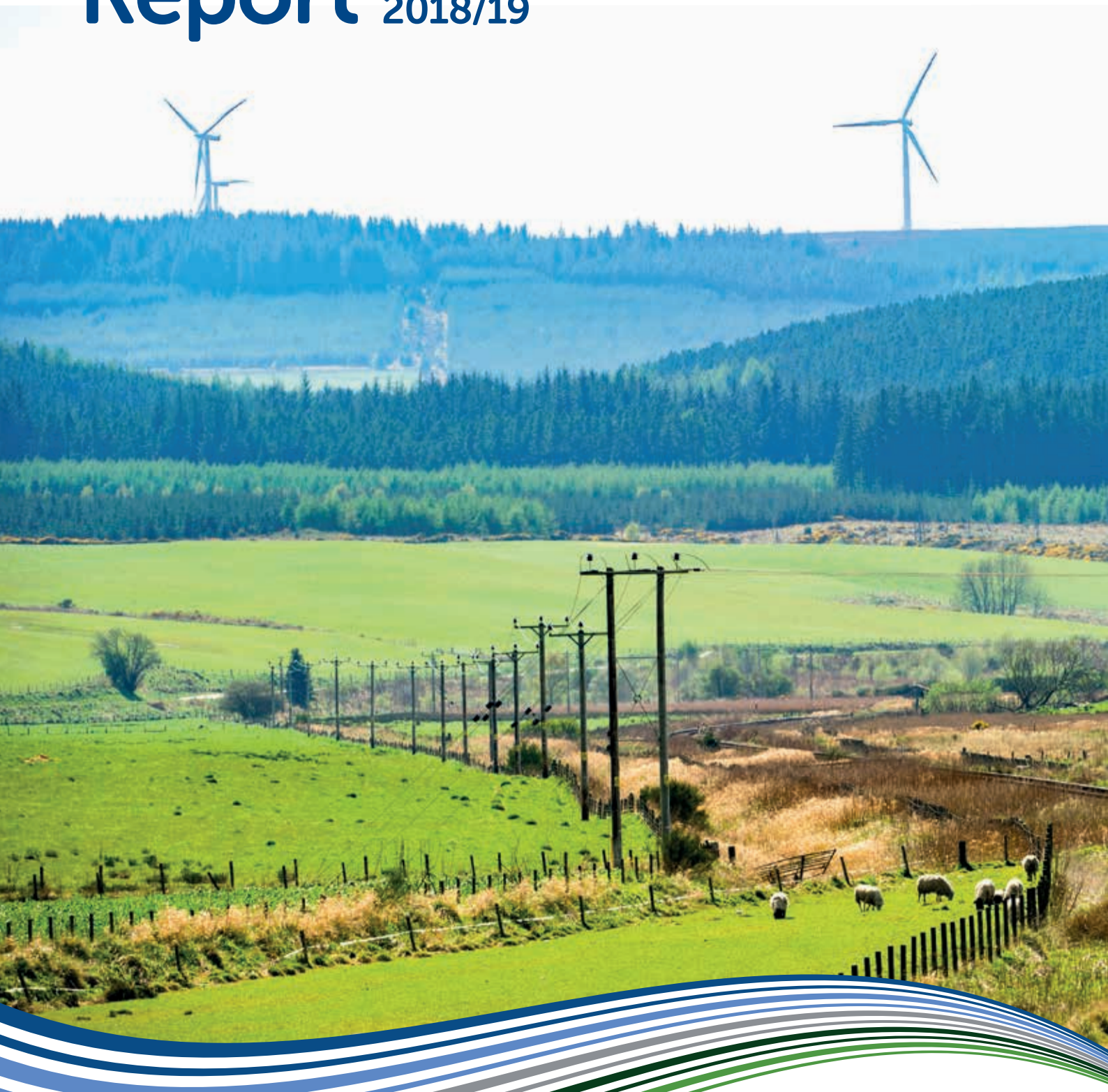
Environmental Report 2018/19



Scottish & Southern Electricity Networks

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1. Introduction

1.1. Executive Summary

The aim of this report is to inform stakeholders and members of the public on how we (Scottish Hydro Electric Power Distribution plc and Southern Electric Power Distribution plc) are performing against our RIIO-ED1 environmental commitments and to provide details of the additional environmental work that we are involved in. The second part of this report provides an overview of our latest innovation projects that are paving the way towards an ever-smarter grid, which will be crucial to facilitating the energy system transition.

Business Carbon Footprint
Through our business activities we have managed to reduce our total business carbon footprint for 2018/19 to 56,658 tonnes of CO_2 excluding network losses, a reduction of just under 13% of the 2012/13 baseline figure. This improvement is mainly due to the result of reductions in emissions from building energy use and operational transport. Our emission reduction has been so significant that we have nearly surpassed our RIIO-ED1 Business Carbon Footprint (BCF) target of 15%. Our RIIO-ED1 commitments in this area are to:

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

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

Oil Leakage from Fluid Filled Cables
Oil leakage from fluid filled cables is known to cause negative environmental impacts. As a result, we made a commitment to replace 21km of fluid-filled cable in our SHEPD network and 55km in our SEPD network over the RIIO-ED1 period. In 2018/19 we removed a total of 8.93km of oil filled cable across both our networks. We are not currently meeting our RIIO-ED1 target but are continuing with our strategy of cable tagging and replacement, together with good asset management practices. We have recently updated our strategy to support and focus the improvements needed.

Areas of Natural Beauty
Overhead lines especially those at higher voltage running through areas of outstanding natural beauty (AONB) are considered unsightly by many. We targeted our funding for AONB and national parks on our High Voltage network and have so far dismantled a total 13.02km of overhead line over RIIO-ED1. We committed to underground up to 90km of overhead line in designated areas, so far, we have ongoing projects to underground 63.66km of cable. The details of the projects we have planned, and their completion dates are in section 2.2 below. We continue to engage our stakeholders to identify additional projects that can be undertaken.

Losses
With respect to our losses strategy, we have achieved a significant losses reduction since 2009 and aim to maintain our focus to continue these reductions further in upcoming years. We have commenced the implementation of all the measures outlined in our Losses Strategy and these include:

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

Innovation
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 novel technologies into BaU. This creates monetary savings for our customers as well as trialling a host of new technologies aimed at delivering future benefits for our customers, the environment and society.

Distribution System Operator
One of the biggest challenges affecting us is the transition from Distribution Network Operator (DNO) to Distribution System Operator (DSO). This transition along with the development of new technologies and smart meter implementation will allow for greater network flexibility and pave the way towards a smarter network.

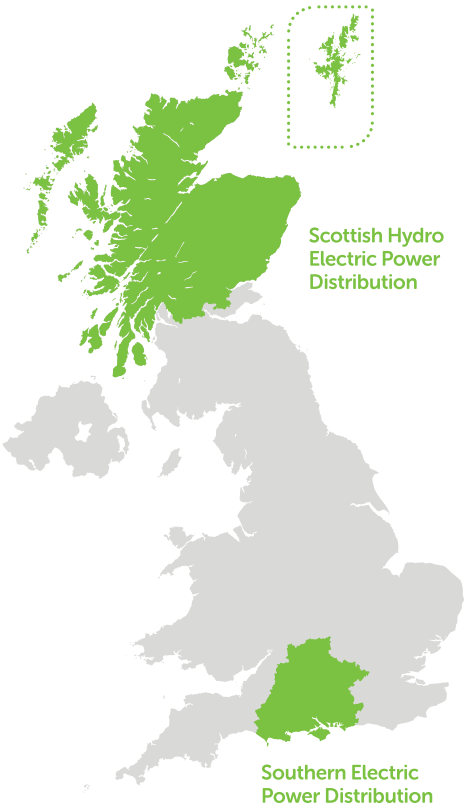
1.2. Our Business/Who We Are

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). This report relates only to the activities carried out by SHEPD and SEPD.

Our story in numbers (approximate)



700,000

Over 700,000 vulnerable customers identified through our Priority Services Register

£2.13m

Over £2.13m contributed to local community projects through our Resilient Communities Fund

130,000km

130,000km of overhead lines and underground cables

100+

Over 100+ subsea cables, powering island communities

Over 3.8m customers served by our networks

3.1m in southern England

778,300 in the north of Scotland

4,000+ SSEN employees working in engineering and customer service teams

84 depots located in the heart of the communities we serve

4 major office hubs at Reading, Portsmouth, Perth and Inverness

720,000 calls received from our customers last year

Our distribution networks cover some of the most scenic terrain within the UK, including the Cairngorms National Park and Isle of Skye. It is also one of the most challenging areas to reliably deliver electricity due to the vast distances that must be covered to supply remote rural and island locations.

We therefore have a duty to not only efficiently supply electricity to our customers but to also maintain and protect the environment we operate in. This includes:

- Deliberate environmental planning during the design and construction phases of projects.
- Reducing the amount of overhead line in designated areas e.g. areas of outstanding natural beauty and special scientific interest.
- Reducing the amount of oil leakage caused by our assets.
- Reducing our business carbon footprint.
- Keeping losses as low as reasonably practicable.
- Continuously innovating to reduce our environmental impact.

1.3. Purpose of the Report

The purpose of this Environmental Report is to provide stakeholders with a transparent and public account of our commitment to addressing environmental matters in RIIO-ED1. 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. It provides an important update on our continuing progress to meet our environmental targets and demonstrates how stakeholders shape this going forward e.g. in areas such as investment in visual amenity projects.

Our RIIO-ED1 environmental commitments are summarised below:

Visual Amenity

- Underground up to 90km of OHL in AONB, National Parks & National Scenic Areas (NSA).

Oil & Fluid Filled Cables

- Replace 76km of fluid filled cable.
- Reduce oil leakage by 15%.

Business Carbon Footprint

- Reduce the energy consumption in our buildings by 15%.
- Reduce the average mileage of SSEN cars by 10%.
- Reduce rate of leakage of installed SF6 by 15%.

Electrical Losses

- Continue replacing current equipment with lower loss equipment.
- Continue implementing a range of technologies designed to reduce losses.
- Better understand the energy use of our customers and work with customer to reduce their overall energy use.
- Use new sources of data to create better models that allow us to analyse and track losses, and target loss reduction.
- Work with Electricity Supply Licensees to detect and prevent fraudulent energy use (theft).
- Fully utilise the data we control to address omissions, under reporting and abuses.

Security of Supply

- We will continue to operate standby generating stations to provide security of supply to remote Scottish islands.

We are committed to reducing our impact on the environment and we aim to manage our activities according with the following high level principles:

- **Promote our core value of sustainability:** We aim to achieve our sustainability targets that are set across the entire SSE umbrella company. More information can be found in our annual sustainability report **(https://sse.com/investors/reportsandresults/media/lnrexivh/sse-sustainability-report-2019-final-spreads.pdf)**.
- **Seek and then act on the views of our customers:** Our customers' views on the environment and the actions they expect us to take to manage our impact on the environment change by location and through time. Our approach is to work with our customers to understand their concerns and take actions where we can.
- **Act in an environmentally conscious way:** We find innovative solutions to our problems and embed good environmental practice.
- **Look after our assets:** We ensure that they are maintained, refurbished and replaced as required, which has also allowed us to reduce our environmental impact.

2. Managing Our Environmental Impact

2.1. Introduction

This section details the activities we are engaging in to meet our environmental commitments.

Visual Amenity: Undergrounding overhead lines in designated areas including Areas of Outstanding Natural Beauty (AONB), National Parks, National Scenic Areas (NSA) and Special Scientific Interest (SSI) Areas. The removal of overhead lines returns the locations to a more natural state and is supported by our stakeholders.

Oil Leakage: Many of our assets contain oil, essential for insulation and providing electrical safety. However, oil leakage from these assets can cause environmental harm. As a result, we are tactically reducing oil leakage by replacing specific high-risk cables.

Business Carbon Footprint: SSEN operates over a wide geographical area and employs thousands of people. We are committed to reducing our footprint by reducing emissions associated with vehicles, reducing energy usage in our buildings, minimising the amount of SF6 that leaks from our assets and keeping electrical losses as low as reasonably practicable.

Other Environmental Activities: SSEN engages in a host of environmental activities. The implementation of innovations with environmental benefits, flood protection, contaminated land clean-up, community fund raising and employee awareness are just some of the projects we are involved in to help maintain and protect our environment.

2.2. Visual Amenity

At the start of RIIO-ED1 we committed to undergrounding up to 90km of overhead line in designated scenic areas in Great Britain across both our distribution networks. These will be initiated by interest from our stakeholders and we are actively seeking their input. We recognise that our overhead lines can have an adverse impact on visual amenity especially in sensitive environments such as AONB, National Parks and NSA. Some people can find overhead lines unsightly and consider the attractiveness of the landscape reduced by their presence. This might impact on individual wellbeing and local economies if, for example, the primary local industry is tourism. The communities we serve are key stakeholders for our business and therefore, this is an important issue for us.

Both SHEPD and SEPD are allowed specific funding by Ofgem for undergrounding of overhead lines in protected landscapes in RIIO-ED1. The allocation of funding is influenced by stakeholder engagement completed in local areas. Stakeholders have indicated that undergrounding of existing overhead lines was "important" or "very important" from a visual amenity perspective and supported SSEN's stakeholder led approach to address concerns in these areas.

Funding is specifically targeted at AONB, National Parks and NSA, and applicable for distribution voltages up to 132kV.

Our stakeholders indicated that we should include factors that they considered 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 by these stakeholders, and then considered and prioritised to ensure consistency in assessment across all SEPD and SHEPD areas and delivery of maximum value for money.

The focus has primarily been on High Voltage (HV) and Extra High Voltage (EHV) overhead lines that have a high visual impact on the landscape and have a dominant impact for many viewers. We have therefore targeted our efforts on the worst affected areas identified using the scoring mechanism. Schemes are co-ordinated with other network investment and maintenance works where practicable to minimise disruption for stakeholders and reduce delivery costs.

We have a total of 15,487 km of overhead lines within designated areas at the year end of 2018/19 across both of our DNO areas. Over RIIO-ED1, we have spent £2.32m in locations chosen by our Stakeholders and improved our visual amenity by reducing the amount of overhead line in these designated areas by 13.02km. Details of the schemes are provided in the Tables overleaf.

Table 2.2a – Undergrounding schemes completed in Designated SEPD areas up to end 2018/19

Scheme	Designated Area	OHL km Removed	Completion Date
Hungerford	North Wessex Downs AONB	1.4	2015/16
North Lodge to Sunwood Farm, Buriton, Petersfield	South Downs National Park	0.8	2015/16
Thursley Common	Surrey Hills AONB	0.3	2015/16
Tichborne, Alresford	Southdowns National Park	3.5	2016/17
Turville Village	Chilterns AONB	2.5	2016/17

Table 2.2b – SEPD Undergrounding schemes in progress

Scheme	Designated Area	OHL km Planned	Progress	Planned Completion Date
PS002754 – Sherborne	Cotswolds AONB	1.31	Refinement	20/21
PS002755 – West Kennett	North Wessex Downs AONB	1.10	Refinement	20/21
PS002791 – Monkton Chilgrove	South Downs National Park	1.01	Execution	19/20
PS002787 – Godlingston Hill	Dorset AONB	3.68	Refinement	21/22
PS004445 – Woodyates PMT	Cranbourne Chase	1.60	Execution	19/20
PS001397 – Plush	Dorset AONB	0.08	Refinement	19/20
PS004105 – Bignor Park	South Downs National Park	1.39	Execution	19/20
PS003427 – Winterbourne Near Newbury	North Wessex Downs AONB	1.60	Execution	19/20
PS004454 – Valley of Stones Nature Reserve	Dorset AONB	3.22	Refinement	20/21
PS003052 – South Burley	New Forest National Park	6.60	Refinement	20/21
PS003064 – Rivar Hill, Shalbourne	North Wessex Downs AONB	0.42	Refinement	19/20
PS003210 – Turville Village, LV	Chilterns AONB	0.12	Refinement	19/20
PS003636 – Itchen Abbs	South Downs National Park	0.18	Execution	19/20

PS003743 – Franklin Farm	South Downs National Park	1.08	Refinement	20/21
PS003301 – Vineyard Hole	South Downs National Park	1.32	Execution	19/20
PS004207 – Worth Matravers	Dorset AONB	0.11	Refinement	20/21
PS004269 – Church Road	South Downs AONB	0.92	Refinement	19/20
PS004373 – Clayhanger	Dorset AONB	1.90	Refinement	20/21
PS004391 – Cheselbourne Village	Dorset AONB	1.81	Refinement	21/22
PS004474 – North Cerney	Cotswold AONB	0.33	Refinement	21/22
PS004473 – Kingwood Common	Chilterns AONB	0.87	Refinement	21/22
PS004543 – Eastbury	North Wessex Downs	5.03	Opportunity Assessment	21/22

In the SHEPD area we conducted an extensive program of stakeholder consultation, giving the public, local authorities and charities the opportunity to nominate overhead line sections which they would like to be considered for undergrounding. Several of these schemes are design works which have been progressed in preparation for construction.

Table 2.2c – Undergrounding schemes completed in Designated SHEPD areas up to end 2018/19

Scheme	Designated Area	OHL km Planned	Completion Date
Callander	Loch Lomond and the Trossachs National Park	1.92	2017/18
Loch Tummel	Loch Tummel National Scenic Area	0.27	2018/19
Blairauchdar (Blair Atholl)	Cairngorms National Park	2.33	2018/19

Table 2.2d – SHEPD Undergrounding of schemes in progress

Scheme	Designated Area	OHL km Planned	Progress	Completion Date
PH002018 – Glen Tromie	Cairngorms National Park	7.96	Execution	20/21
PH002259 – Kingussie	Cairngorms National Park	7.00	Refinement	19/20
PH002337 – Strathyre	Cairngorms National Park	2..40	Execution	19/20

For further details on Visual Amenity, please see worksheet E1 – Visual Amenity linked to the Appendix of this report.

As presented in Tables 2.2b and 2.2c, there are 20 visual amenity schemes in progress in SEPD and SHEPD licence areas. We have undergrounded 13.02km so far and have another 50.64km of undergrounding planned. We will continue to engage with our stakeholders to ensure that ongoing and forthcoming projects achieve the best outcomes for landscape, biodiversity and communities.

2.3. Oil Leakage

We have a responsibility to have regard for the environment in the communities in which we operate. An important element of this is that we must ensure that any oil contained in our assets does not cause damage to the surrounding area.

Oil is widely used as an insulating material or cooling medium across a wide variety of electrical equipment including fluid-filled cables (FFC) and some types of electrical switchgear and transformers. We have robust processes in place to maintain and operate these assets such that we ensure that any potential leakage is minimised. If there are any incidents, then we are committed to a fast response and to addressing and resolving any issues to ensure that there is no adverse environmental impact.

However, oil filled cables can leak due to age, wear or third-party damage. If untreated a leak will not only cause potential environmental damage but may result in equipment failure and disruption for our customers.

To mitigate the environmental impact and any associated supply disruption, we employ a proactive leak location process. This process allows the circuit to remain in service while the leak is being located by dosing the 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.

Once identified repairs will be done as well as any necessary remedial works. This process is built in to the routine maintenance process of our FFC assets.

In addition to our proactive oil leakage strategy, we also have a comprehensive range of specialist equipment to ensure that we can provide a robust response to any oil leakage event. We have also established service agreements with specialist contractors for support in the event of an incident.

2.3.1. Oil Leakage performance in RIIO-ED1

In our RIIO-ED1 business plan, we made a commitment to replace 21 kilometres of fluid-filled cable in our SHEPD area and 55km in SEPD.

Since the start of RIIO-ED1 SEPD has tagged (See glossary for definition) 28 fluid filled circuits to improve accuracy of leak location and expedite repairs. Where condition assessments have indicated cable sections to be close to end of life, projects have been initiated to consider replacing these assets with modern cable types which do not contain oil.

Figure 2.3a shows that the total km of oil filled cable on our network has decreased over the RIIO-ED1 period.

Since this commitment was made, the oil leakage rate has decreased and stabilised across our fleet of cables, which makes selection of the cables to be replaced to achieve maximum customer and environmental benefit more challenging. Figure 2.3a shows that the total km of oil filled cable on our network has decreased over the RIIO-ED1 period.

The significant drop in oil filled cable between 2015/16 and 2016/17 was mainly due to data cleansing, whereas the 11km drop between 2016/17 and 2018/19 was due to removal of oil filled cable. We will continue to monitor the performance of our cables and will update our plans if the situation changes.

The total amount of oil filled cables in service has dropped over RIIO-ED1, as shown in figure 2.3a. However, there has been a rise in the amount of fluid used to top up cables. This is due to large leakage events in both our SEPD and SHEPD networks in both 2016/17 and 2017/18. There has been a slight reduction in the volume of oil in cables and fluid used to top up cables in the 2018/19 reporting year.

We have not achieved our proposed ED1 position at present. With this in mind, we continue our strategy of tagging and replacement, together with good asset management practices. In 2018/19 we tagged cables with PFT oil to ensure we can correctly and efficiently locate any leaks. This tagging process is a BAU activity and SSEN were the first UK DNO to trial the technique. and establish it as business as usual. We have recently updated our strategy to support and focus the improvements needed. Now we are capturing better quality data, we plan to review targets going forward from 2019/20, to ensure the correct strategy is delivered.

2.3.2. SSEN Fluid Filled Cable industry engagement

We are also continuing to engage with other industry stakeholders to share best practices to reduce oil leakage. This involvement includes meetings with other DNOs to share best practices from BaU and ongoing innovative projects, as well as attending bi-annual meeting with the Environment Agency and Scottish Environmental Protection Agency (SEPA) to review performance. We will continue this work for the remainder of ED1.

Figure 2.3a – Change in total length of oil filled cable over RIIO-ED1 period

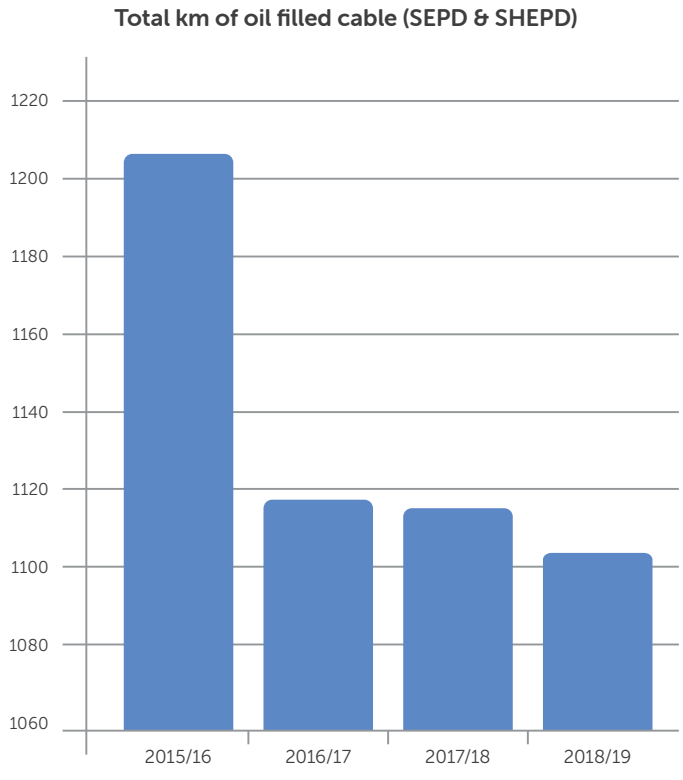
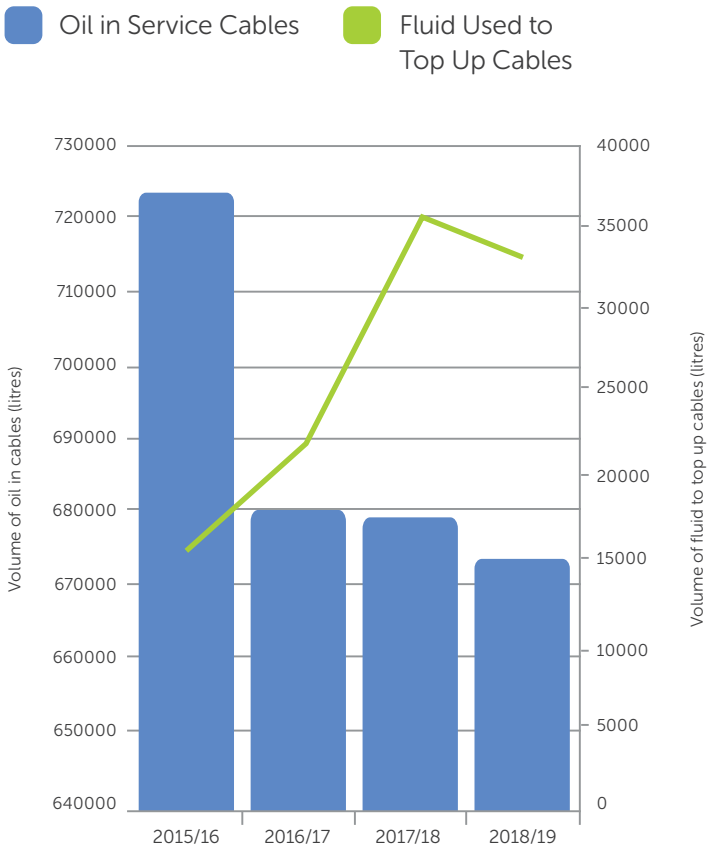


Figure 2.3b – Oil in service cables vs fluid used to top up cables over RIIO-ED1



2.3.3. Oil Mitigation Schemes

SSEN reports the number of oil mitigation schemes affecting cables and substation plant such as transformers and circuit breakers and the costs associated with these to Ofgem on an annual basis as part of the E2 – Environmental Reporting requirement linked to this report in the Appendix.

Over the RIIO-ED1 period SEPD has spent £2.87 million on 77 oil mitigation schemes, while SHEPD has spent £7.8k on 5 schemes.

2.4. Carbon Impact and Climate Change

2.4.1. Business Carbon Footprint (BCF)

This section details the total Green House Gas emissions produced by SHEPD and SEPD from 2012/13 to 2018/19. The BCF is published as part of our company reporting obligations and reported annually to Ofgem as part of our distribution licence requirements. More details can be found in table E3 attached as an appendix to this report.

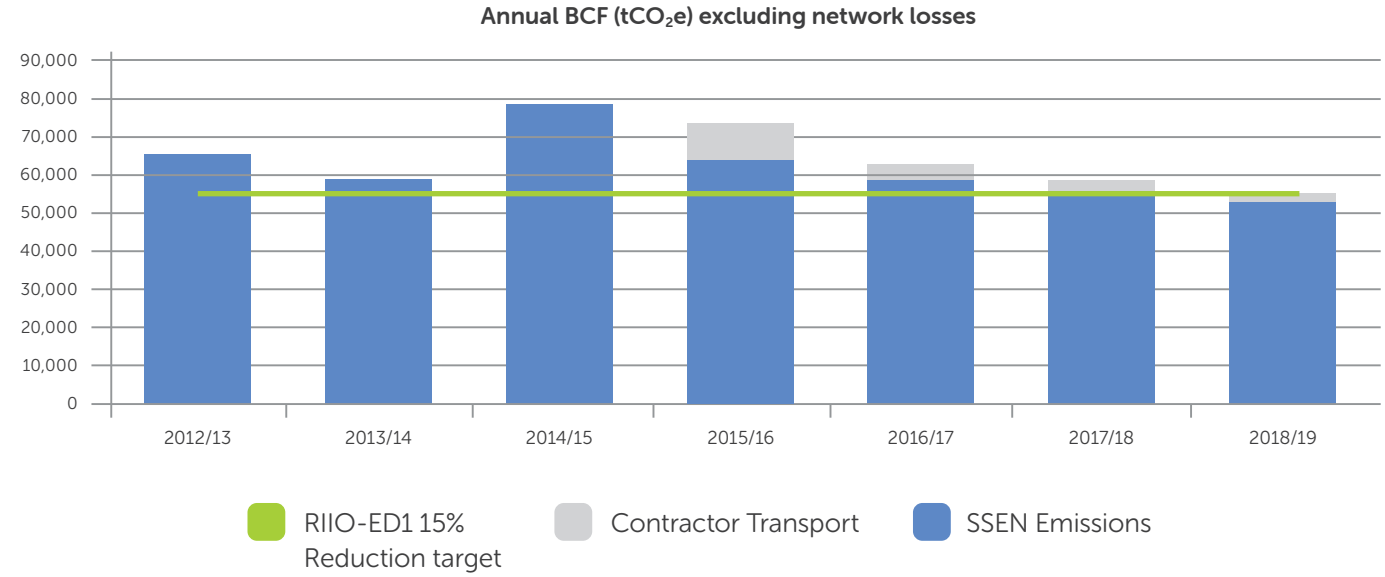
The BCF is an account of the impact that our operational activities have on the environment. We collate the data from across our business using the methodology described within international business carbon footprint standards, the Greenhouse Gas (GHG) reporting protocol and ISO14064-1. We convert our data to equivalent tonnes of carbon dioxide (tCO_2e) using conversion factors as provided by the Department for Environment, Food & Rural Affairs (DEFRA) for annual reporting to Ofgem.

The purpose of this Business Carbon Footprint section is to provide a transparent account of the impact that our business activities have on the environment and our commitment to address these impacts. This report documents our energy usage from offices, substations, transport emissions (both operational and business), fuel combustion and the release of greenhouse gases such as SF_6. The reported data for operational transport (road) and fuel combustion also takes account of a number of our larger contractor emissions as required in Ofgem's regulatory reporting packs.

In 2018/19, the combined total greenhouse gas emissions for SEPD and SHEPD were $0.65MtCO_2e$ (including losses) for the 2 licence areas. Of our carbon emissions, by far the largest contributor is electrical losses. This accounts for circa 84% of SHEPD's and circa 94% 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.

Our RIIO-ED1 commitment was to reduce the Business Carbon Footprint of our business activities by 15% during the RIIO-ED1 period relative to 2012/13,

Figure 2.4a – Annual BCF excluding losses



As shown in Fig 2.4a above, our BCF (excluding losses) has lowered every year since 2014/15. So far we have reduced our BCF by almost 13% against target. If these trends continue, we expect to meet our BCF target by the end of RIIO-ED1.

Figure 2.4b – Annual BCF including losses

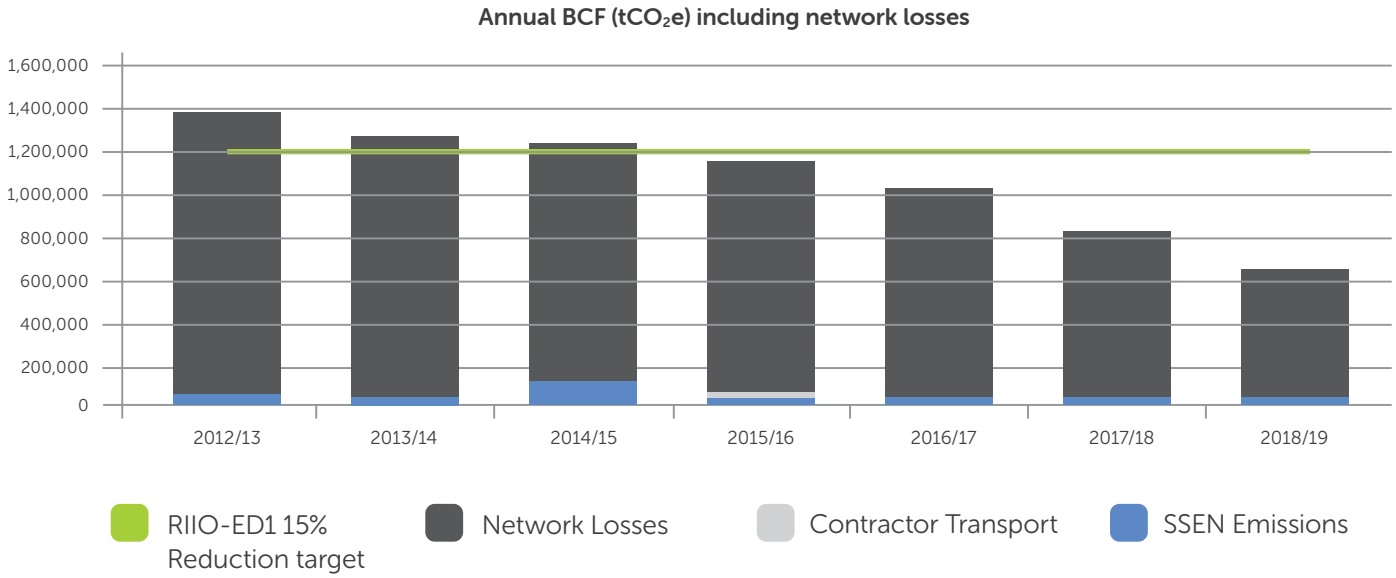


Fig 2.4b shows the contribution that our network losses makes to our overall BCF in relation to our operational emissions and contractor emissions.

Progress to achieve our RIIO-ED1 BCF target (including losses) was reached in 2015/16 due to significant efficiencies made in operational transport as explained under figure 2.4d below and due to a reduction in fuel combustion.

Losses tCO_2e has dropped significantly since 2016/17, due to more pro-active measures taken to reduce losses e.g. increasing minimum cable size and reducing energy theft. However, there was also a change in the losses calculation methodology, which contributes to this reduction in losses.

2.4.1.1. RIIO-ED1 Commitments

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

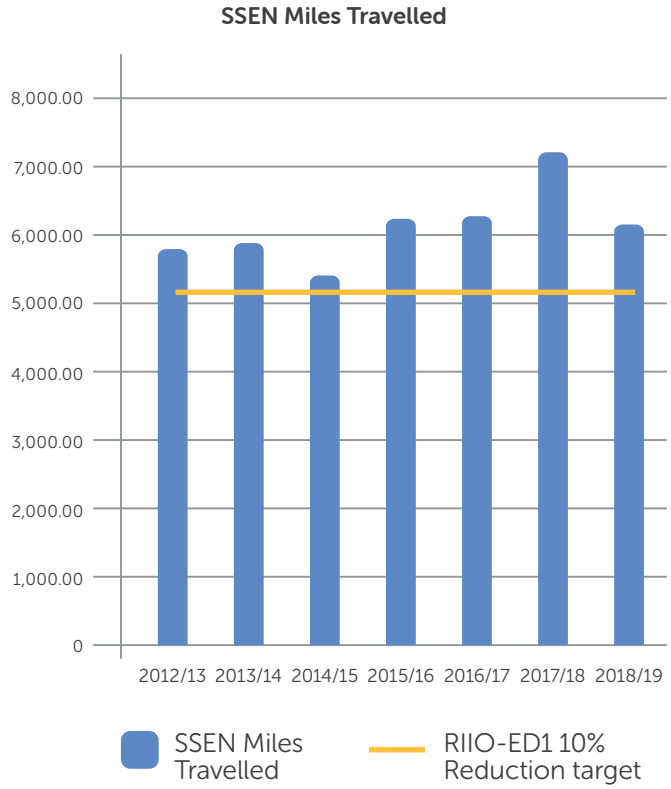
- Reduce the annual mileage of SSEN vehicles by 10%, and
- Reduce Energy consumption in our buildings by 15% against 2012/13 performance

2.4.1.2. Reducing the mileage of SSEN vehicles

One of the largest emissions is from our vehicle fleet for business transport. Our fleet uses low emission cars and runs on diesel; however, our continuing focus is on reducing vehicle numbers and hence the mileage from business road transport.

Our commitment is to reduce the average mileage of SSEN vehicles by 10% during the RIIO-ED1 period. Figure 2.4c shows our progress at meeting this target.

Figure 2.4c – Annual vehicle mileage



As shown in Figure 2.4c above, our Annual vehicle mileage has varied since 2012/13 and remained over our 10% reduction target. However, annual emissions associated with vehicle mileage have dropped significantly as shown in figure 2.4d.

Figure 2.4d – Annual vehicle emissions

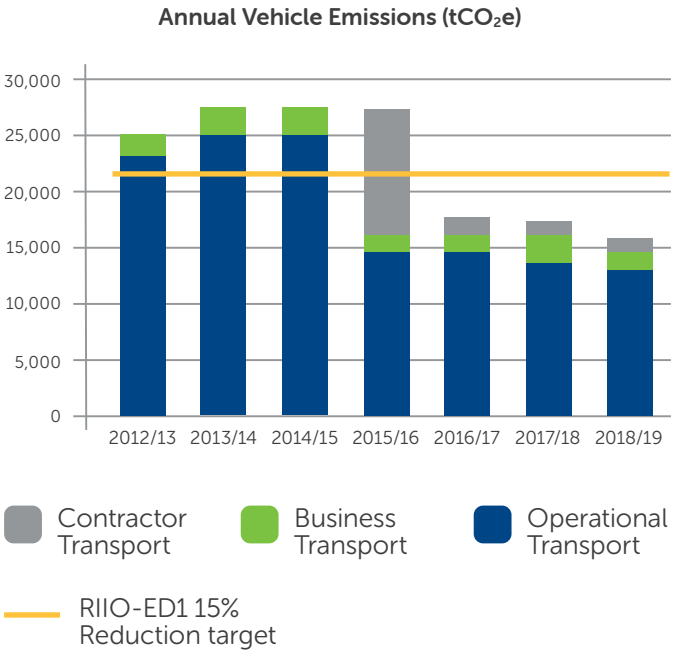


Figure 2.4d is a graph of emissions from business and operational transport, which shows that we're moving in the right direction in terms of reducing our CO_2 emissions from transport. Our commitment to reduce the mileage of our operational fleet was intended to reduce our annual transport emissions, we are not currently meeting our target of reducing average annual vehicle mileage by 10%, however CO_2 emissions from transport in 2018/19 shows a significant reduction relative to 2012/13. This reduction is because of our increased use of diesel and hybrid power vehicles and the significant efficiencies we have made in operational transport by contractors.

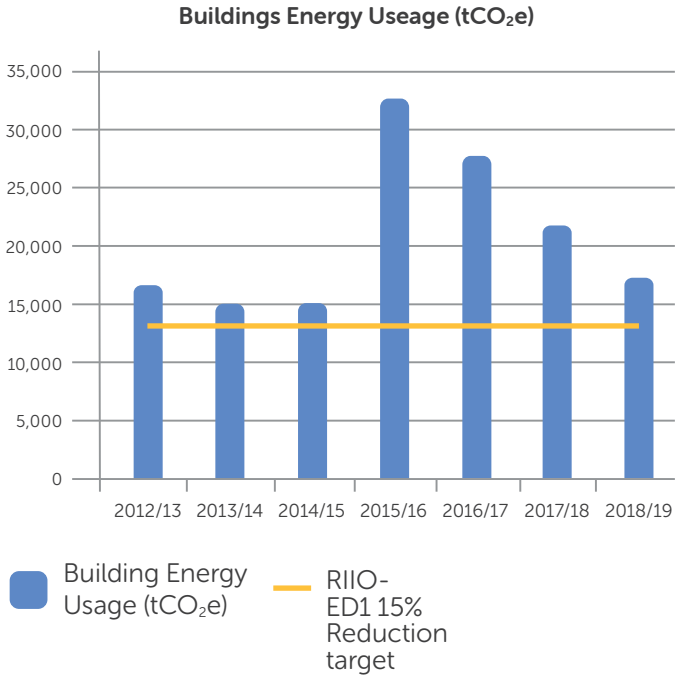
As shown in Fig 2.4d, the tCO_2e related to operational transport by contractors in 2018/19 shows a downward trend from 2015/16. This is because there has been a shift away from using 'external' contractors in 2016/17, with a number of the core areas being brought into the Networks business. This has led to an overall reduction in fuel consumption in this area, thus reducing CO_2e output. It should be noted here that contractor emissions were recorded as part of operational transport prior to 2015/16. After this point they were recorded separately as shown in the graph.

2.4.1.3. Reducing energy consumption in our buildings

Over the last six years, the SSE Group's non-operational building carbon footprint has experienced a carbon reduction of 38%. It is important to note here that SSEN makes up one part of the wider SSE Group, which also includes Retail, Wholesale businesses and other energy services businesses. By sharing building space with other SSE businesses, we can keep costs down and reduce energy consumption. To date, the investment made has been successful in returning financial and carbon emissions savings and enhancing SSE's reputation in meeting our commitment to minimising environmental impact. Our target is to achieve a reduction of 15% from a 2012/13 baseline.

As shown in figure 2.4e, our Annual building energy usage remained relatively constant from 2012/13 to 2014/15, before dramatically rising in 2015/16. This large increase was due to an improved calculation methodology that showed a more realistic view of energy use. However, since 2015/16 building energy use has fallen each year. This graph displays building energy use associated with SSEN rather than the entire SSE Group as shown in table 2.4a.

Figure 2.4e – Annual building energy usage.



Since the start of RIIO-ED1 (2015/16) we have reduced our Building Energy Usage by 46%. We will recalculate the 2012/13 target figure according to our new methodology to establish our performance against the original target.

One of the core reasons for the large reduction in building energy use has been a move to 'Agile Working', which allows employees more flexibility in terms of working times and locations. We have also moved one of our major office hubs in Reading to a new and significantly more energy efficient building.

Table 2.4a – SSE Group's Energy Efficiency Performance 2011 to 2018

Year	Investment (per annum)	Reported Annual Carbon Reductions	Energy Saving (annually recurring)	Annual CRC Tax Savings (annually recurring)	Total Saving (annually recurring)
2012/13	£1,170,000	12,469	£39,740	£149,628	£189,368
2013/14	£2,399,000	7,819	£164,492	£93,828	£258,320
2014/15	£2,360,000	35,020	£632,540	£420,240	£1,052,780
2015/16	£3,083,000	6,170	£1,134,412	£104,273	£1,238,685
2016/17	£1,568,000	2,203	£229,786	£35,468	£265,254
2017/18	£2,237,910	2,314	£107,733	£38,412	£146,145
2018/19	£429,244	3,765	£207,228	£64,758	£271,986
Totals	£13,247,154	65,995.00	£2,200,970	£803,437	£3,004,407

During 2018/19 investments over £400k designated as energy efficiency improvement work were delivered across the non-operational buildings estate.

An indicative target of 5% CO_2 reduction per three-year period (up until 2030), is challenging, but remains achievable and is now the non-operational building visionary key performance indicator from this financial year onwards.

Co-ordination with the property asset database and any rationalisation plans for the estate will provide opportunities for the efficient and effective upgrade or replacement required in compliance and condition-based investments.

To increase the awareness regarding the importance of resource efficiency and to improve engagement, an Energy Champion network is a key part of the Property communications strategy. Over the last 12-month period, 67 Energy Champions have been recruited across multiple SSE sites, who have the remit of promoting all energy related behavioural change initiatives that are rolled out across SSE. Our behavioural change initiatives are branded internally as the "Better Off" campaign.

Through actively engaging with these colleagues, it has been possible to roll-out a number of key behavioural changes in a consistent manner. This approach has also facilitated a heightened awareness of SSE's energy efficiency aspirations.

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

2.4.2. Sulphur Hexafluoride (SF_6) Emissions

SF_6 is an extremely effective electrical insulator that is used in our circuit breakers, switchgear and other electrical equipment. It has significant advantages over alternative materials. It is non-flammable, a critical safety requirement in the high-voltage applications and because of its excellent insulating properties it takes up less volume than alternatives such as oil. However, it is also a very potent greenhouse gas, one kg of SF_6 is equivalent to approximately 22,800kg of carbon dioxide.

The total capacity of SF_6 used in assets on our network is slightly less than 30,000kg across our two licence areas as presented in Table 2.4f below:

Figure 2.4f – Installed SF_6 capacity per Licensee

Licensee	Installed Capacity (kg)
SHEPD	5,433
SEPD	22,704
TOTAL	28,137

Emissions of SF_6 are calculated by combining the volume of SF_6 used in routine maintenance and the volume used during fault repair.

During routine substation inspections, all SF_6 switchgear, plant and equipment are inspected and all gauges checked to ensure that SF_6 pressure is in the normal operating range. Low SF_6 gas levels are reported to the Network Management Centre, which will ensure prompt attention.

We take any leakage of SF_6 extremely seriously and have detailed policies and procedures in place to manage our relevant assets. We monitor plant leakage rates on a quarterly basis to quickly identify plant items that are becoming problematic and decide on an appropriate course of action for intervention to halt any leakage.

Topping up of SF_6 network assets is done in accordance with the BS EN 60376 standard. The quantity of SF_6 topped up is recorded in our asset management system upon the completion of the top-up work. There are detailed policies and procedures in place to manage the process.

We are actively following the progress made on more efficient, safer, insulation materials to replace SF_6 through National Grid's NIA project, as well as looking at techniques to reduce leakage from existing plant. Link to National Grid SF_6 project:

http://www.smarternetworks.org/project/nia_nget0163

This is an area where we are actively ensuring that our procurement policies encourage the purchase of alternatives to SF_6. Depending on plant type, condition etc. this will be either a refurbishment or replacement solution.

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, which is now being used by our operational staff. Link to our SF6 leakage location project:

http://www.smarternetworks.org/project/2013_13

Figure 2.4g – Actual loss of SF_6 to bank

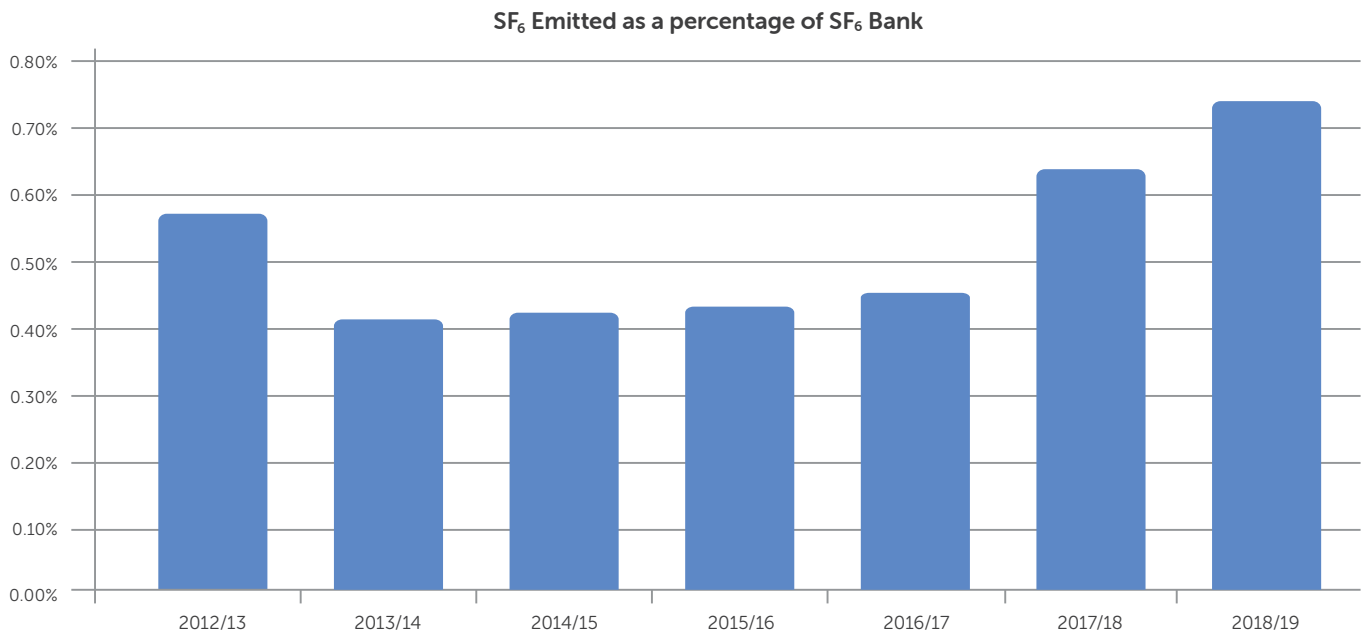
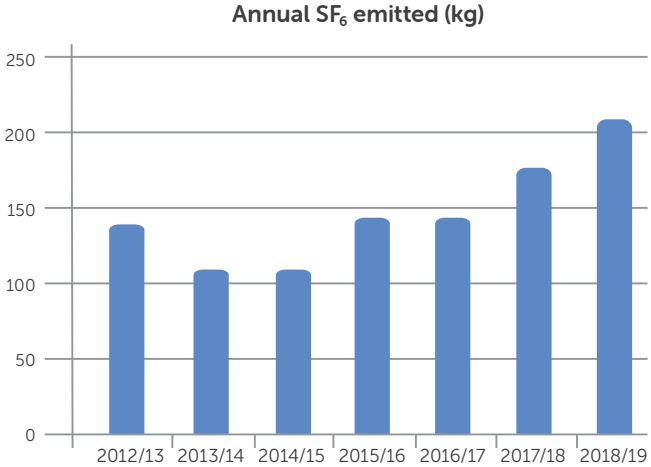


Figure 2.4g shows that our actual emissions of SF_6 as a percentage of total banked SF6 (refers to the total amount of SF_6 stored in plant) was 0.57% in 2013.

SF_6 emissions were higher than target in 2018/19, but the actual volume in kg of SF_6 topped up decreased. Our strategy in this area continues to focus on a risk-based approach to investment and our decisions have been informed by intervention evidence from our inspection regime; this has favoured repair over replacement to date. We have recently updated our strategy and documents to support improvements needed.

Figure 2.4h – Annual SF_6 emissions



Our continued focus on field data capture means that we will continue to target the correct intervention as needed. We will ensure our strategy takes account of all relevant factors and ensure the most economic and efficient solution is implemented for customers, while continuing to meet safety and environmental standards.

As shown in figure 2.4h, our SF_6 emissions decreased between 2012/13 and 2013/14 and then gradually started to increase up to 2016/17. In 2017/18 and 2018/19 there was a significant increase in emissions due to the higher leakage rates associated with the ageing population of assets, which will be replaced in future years.

For further details on Business Carbon Footprint, please see worksheets E2 – Environmental Reporting and E3 – BCF linked to the Appendix of this report.

2.4.3. Distribution Losses

This section details electrical losses figures, their impact and what we are doing to keep them as low as reasonably practicable.

2.4.3.1. Overview

Distribution losses are an unavoidable consequence of transferring energy across the electricity network, where they have a significant financial and environmental impact. Losses can either be technical (electricity can turn to heat as it is transported) or non-technical (for instance, due to theft or measurement errors).

2.4.3.2. Losses Strategy

Our Distribution Losses Strategy was updated in April 2018 and identifies our approach to ensuring that losses on our network are kept as low as reasonably practicable. Key measures identified include:

- Installing Primary & Grid transformers that outperform the EU Eco Directive.
- Increasing the minimum size of new secondary transformers.
- Increasing the minimum cable size to the next size up for specific cables.
- Continuing to develop new methods of managing Non-Technical Losses.

Full details of our Losses Strategy can be found at:
www.ssen.co.uk/lossesstrategy/

2.4.3.3. Losses Volume

The total amount of electrical losses in 18/19 was 2.2 GWh and 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. Current assessment of the losses on our network has been estimated as shown in table 2.4i. Figure 2.4j shows the percentage losses in the networks in relation to total electricity distributed.

Table 2.4i – Total losses in the network

Year 2018/19	Total Distribution Losses MWh	Equivalent tCO_2e
SHEPD	529,020	148,126
SEPD	1,625,300	455,084

Figure 2.4j – Percentage of energy losses 2013–2019

From the graph above, there appears to have been a significant reduction in SEPD losses in January 2018. However, this is due to a change in the calculation methodology (now more accurate).

2.4.3.4. Losses Strategy in Action

To help ensure we meet our commitment to reduce losses we are implementing a number of targeted measures outlined in our Losses Strategy, these include:

1 Energy Efficient Transformers

We have commenced the installation of plant and equipment that delivers enhanced losses performance and outperforms the EU Transformer Eco Directive[2] Tier 1.

2 Minimum Sizing of Cables and Transformers

In general terms, increasing the diameter of conductors lowers losses. Therefore, we have put in place measures to increase the minimum size and rating of new cables and transformers. These upgrades are made as part of our asset replacement scheme once the original asset has reached the end of its life. CBAs are undertaken to ensure these changes are cost effective. These measures relate to installation of equipment that affects both SSEN and external stakeholders such as Independent Connection Providers (ICPs). We undertook a detailed process of engagement with these key stakeholders to make them aware of the change and implemented the policy changes necessary from 1st April 2016.

3 Non-Technical Losses

Our Revenue Protection team continues to focus on developing 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). 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.

2.4.3.5. Losses Reporting Progress

For further details on losses, please see worksheet **E4 – Losses Snapshot linked to the Appendix of this report.**

The tables opposite show a snap shot of our losses reduction activities over RIIO-ED1. These benefits have been achieved through our programme of installing lower loss equipment as well as reducing energy theft as described above

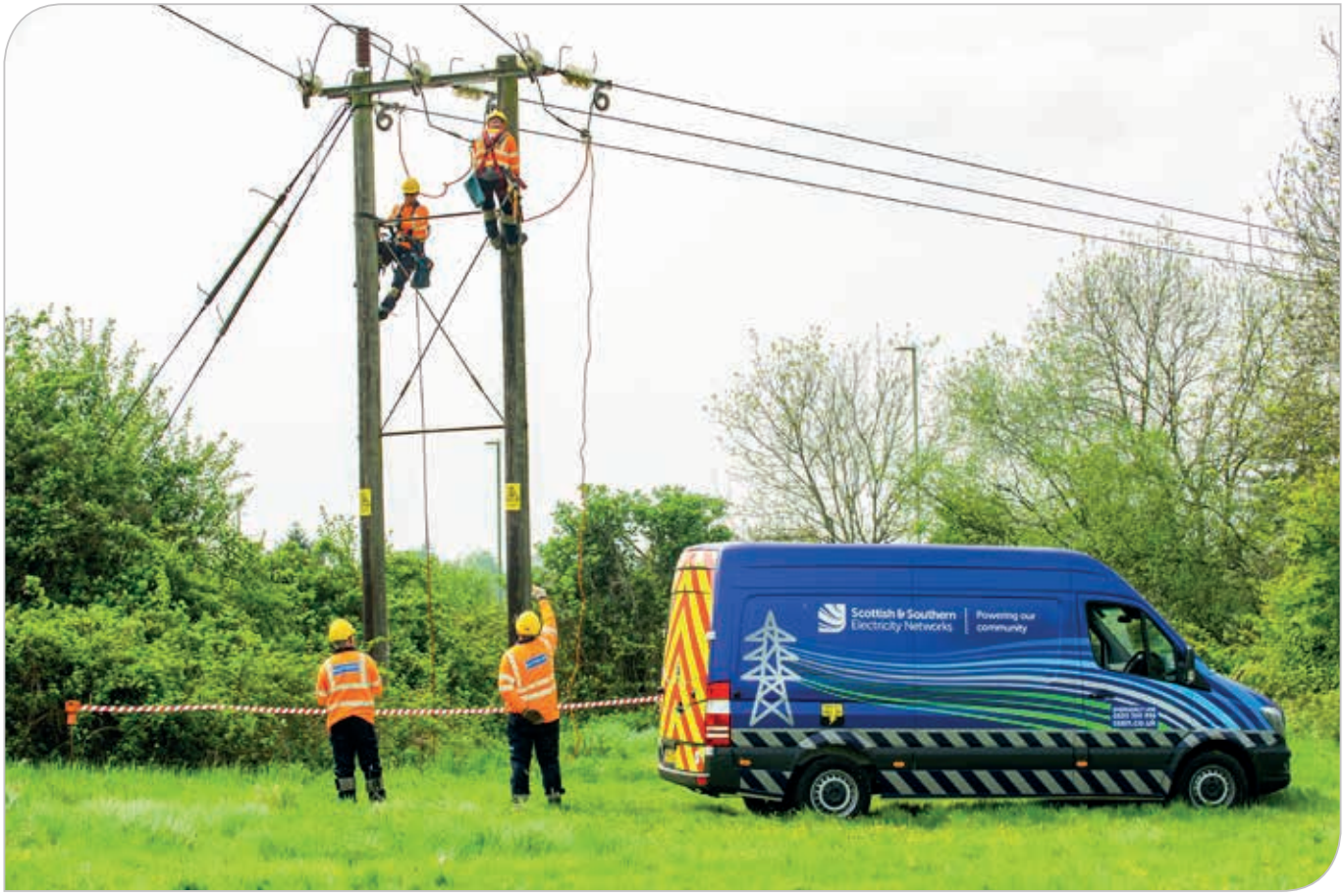


Table 2.4k – Summary of SEPD Losses Costs and Benefits from Activities in RIIO-ED1

SEPD Programme/ Project Title	2018/19 Regulatory Reporting Year			RIIO-ED1
	Distribution Losses Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative Reduced Losses to Data
	£m	MWh	tCO_2e	MWh
LV Cable Asset Replacement	0.01	93	26	156
LV Cable General Reinforcement	0.00	29	8	64
LV Cable Other	0.04	660	185	1291
HV Cable Asset Replacement	0.01	42	12	62
HV Cable General Reinforcement	0.01	72	20	127
HV Cable Other	0.05	364	102	752
DUOS recovery SEPD – domestic Other	N/A	53140	14879	109697
DUOS recovery SEPD – non domestic Other	N/A	26358	7380	64394

Table 2.4l – Summary of Amount of SEPD Losses Activities in Regulatory Reporting Year and Estimate for the Following Regulatory Year

SEPD Programme/Project Title	Description of Unit	Volumes in Regulatory Reporting Year	Forecast Volumes for Following Regulatory Year
LV Cable Asset Replacement	km	1	TBC
LV Cable General Reinforcement	km	0	TBC
LV Cable Other	km	7	TBC
HV Cable Asset Replacement	km	3	TBC
HV Cable General Reinforcement	km	2	TBC
HV Cable Other	km	14	TBC
DUOS recovery SEPD – domestic Other	#	5738	TBC
DUOS recovery SEPD – non domestic Other	#	371	TBC

Table 2.4m – Summary of SHEPD Losses Costs and Benefits from Activities in RIIO-ED1

SHEPD Programme/ Project Title	2018/19 Regulatory Reporting Year			RIIO-ED1
	Distribution Losses Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative Reduced Losses to Data
	£m	MWh	tCO_2e	MWh
LV Cable Asset Replacement	0.00	31	9	54
LV Cable General Reinforcement	0.00	3	1	8
LV Cable Other	0.04	551	154	1047
HV Cable Asset Replacement	0.00	16	4	32
HV Cable General Reinforcement	0.00	12	3	23
HV Cable Other	0.04	297	83	618
DUOS recovery SHEPD – domestic Other	N/A	23453	6567	49161
DUOS recovery SHEPD – non domestic Other	N/A	11333	3173	30150

Table 2.4n – Summary of Amount of SHEPD Losses Activities in Regulatory Reporting Year and Estimate for the Following Regulatory Year

SHEPD Programme/Project Title	Description of Unit	Volumes in Regulatory Reporting Year	Forecast Volumes for Following Regulatory Year
LV Cable Asset Replacement	km	0.3	TBC
LV Cable General Reinforcement	km	0.0	TBC
LV Cable Other	km	7.6	TBC
HV Cable Asset Replacement	km	0.3	TBC
HV Cable General Reinforcement	km	0.3	TBC
HV Cable Other	km	11.0	TBC
DUOS recovery SHEPD – domestic Other	#	2331	TBC
DUOS recovery SHEPD – non domestic Other	#	235	TBC

2.5. Other Environment-related Activities

2.5.1. Innovation

Environmental benefits are a common feature of many of the projects in our innovation portfolio, predominantly through the acceleration of the connection of new low carbon technologies and the resulting reduction in the carbon content of the energy we distribute. Some samples of our innovation projects that generate environmental benefits are detailed below.

2.5.1.1. Enhancing Wildlife & Biodiversity
Applied Integrated Vegetation Management (IVM) (NIA_SSEPD_0025): This project seeks to investigate potential improvements of efficiency, safety and environmental impact using 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 using 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 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.

More details can be found here:
http://www.smarternetworks.org/project/nia_ssepd_0025

2.5.1.2. Supporting Uptake of Low Carbon Technologies (LCTs)
Low Cost LV Substation Monitoring (NIA_SSEPD_0027): Historically, secondary substation monitoring was limited to Maximum Demand Indicators, which were appropriate in an environment where power flows were generally well understood and predictable. As more customers 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.

This NIA project has successfully developed monitors which are proving useful in providing a monitoring service at a much lower cost than were previously available. Two partners have provided the hardware, software and web portals which are providing valuable current and voltage information, while at the same time providing net financial benefits.

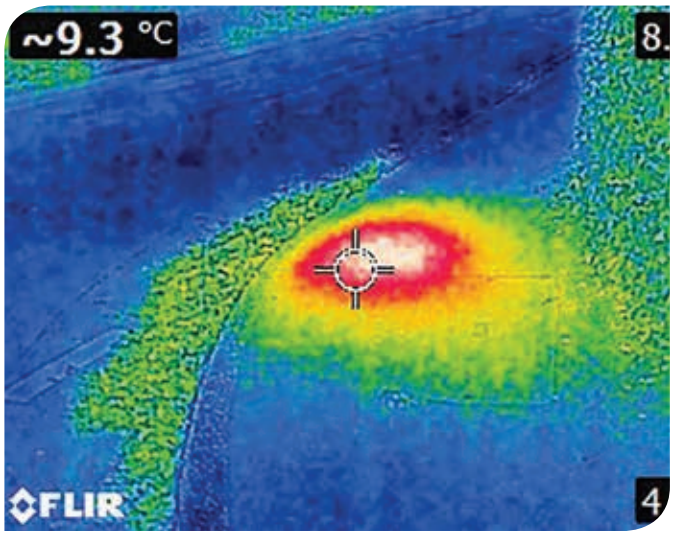
The success of the project has enabled further procurement of equipment to proceed within a BAU environment. The enhanced information available will enable the implementation of other smart technologies, which in turn will support the growth of solar panels and Electric Vehicles at a much lower cost relative to conventional reinforcement.

The business is now committed to deploying secondary substation monitoring across sections of the network to help prepare the network for the anticipated large-scale uptake of electric vehicles. From 2018 we committed to installing monitoring on networks serving nearly 80,000 customers and are now looking at doubling that number in 2020.

More details can be found here:
http://www.smarternetworks.org/project/nia_ssepd_0027

2.5.1.3. Reducing Noise & Air Pollution
Thermal Imaging of Underground Cables (TOUCAN) (NIA_SSEPD_0021): Thermal imaging cameras are currently being used within our Scottish and Southern regions. These cameras can detect underground network faults by accurately locating heat signatures from cable faults. The devices make no noise compared to traditional sniffer devices and due to their ability to accurately pin point faults it means fewer noisy excavation activities are required with the additional benefit of reduced excavated waste material and backfill.

More details can be found here:
http://www.smarternetworks.org/project/nia_ssepd_0021



2.5.2. Environmental Employee Awareness

Sometimes environmental awareness is not sufficient in itself to create real environmental benefits. To build on the effectiveness of awareness campaigns, SSEN has implemented the following good practice guidelines:

- Do not pump polluted substances into watercourses.
- Respect ecological exclusion areas.
- Importance of designing, building and maintaining efficient drainage.
- Assess risks and plan construction when working on contaminated land.
- Create archaeological exclusion areas and respect the archaeological watching brief.
- Segregate all waste to maximise recycling.
- When driving on site, follow the designed route to protect wildlife and preserve scenery.
- Build up stocks of turf, topsoil and subsoil separately and safely.
- Always use the supplied fuelling points on sites, where spill kits are available.
- Maintain any skilful reinstatements.
- Always consider other land users prior to commencing work.
- During the months of April to August, do not disturb breeding birds as they are protected by law.

Within SSE, there is an internal group that actively promotes environmental activities. The 'Better Off' campaign encourages colleagues to switch off monitors, desktops, thin clients and laptops overnight or at the weekend rather than being left on standby. Additionally, household water and energy consumption advice is also offered to further reduce employee's environmental impacts outside of working hours. SSEN also operate two groups on the social networking platform 'Yammer', which allows colleagues to keep updated with new environmental awareness information about the networks sector. Finally, we offer 'Be the difference' volunteering where employees can raise funds for charity by partaking in a variety of activities including environmental clean-up days.

2.5.3. Adaptation/flood preparedness

We have invested £1.49m over RIIO-ED1 on investigation work and flood prevention measures at 39 sites across our SEPD and SHEPD networks.

Flood defence surveys were carried out by contractors on all primary substations across both our regions. Along with further internal analysis it was identified that a number of sites were considered "at risk" to exceptional flooding events. Flood prevention measures were then implemented on these sites including levee building, door water proofing, air vent water proofing, cable sealing, installing water pumps, etc. The implemented measures now ensure that these sites are effectively protected against exceptional flooding events, preventing any reliability issues from occurring in the event of a flood. In 2018/19 an additional £12k was spent on design and mitigation methods at four additional sites that had high flood risk potential.

2.5.4. Waste/Landfill/Recycling

As part of the wider SSE Group, SSEN shares a common goal to 'substantially reduce waste generation through prevention, reduction, recycling and reuse' by 2030.

SSE uses and relies on a number of natural resources during construction and operational activities. It must therefore use these resources efficiently to minimise waste and negative environmental impacts and maximise positive impacts where possible.

More details can be found by accessing our SSE Group sustainability report: **https://sse.com/media/623847/SSE-Sustainability-report-2019-FINAL-spreads.pdf**

2.5.5. Contaminated Land Clean Up

In 2018/19, there were 6 incidents of land contamination in the SEPD area costing £51,000 in remedial work. For SHEPD, there was 1 reportable incident costing £28,500.

For further details on contaminated land clean up, please see worksheet **E2 – Environmental Reporting linked to the Appendix of this report.**

2.5.6. Noise Pollution

7 reportable noise complaints were made in 2018/19 across both our SEPD and SHEPD networks leading to costs of circa £3,700 to resolve the issues.

For further details on noise pollution, please see worksheet E2 – Environmental Reporting linked to the Appendix of this report.

2.5.7. Community Engagement

SSEN has implemented the Resilient Communities Fund which provides financial support for communities to prepare for extreme weather events. The fund originally ran over a 2-year period, awarding £1.25m in total to benefit communities in SSEN's electricity distribution network areas in the north of Scotland and central southern England. In 2016/17, due to the success of the fund, the decision was taken to extend it until 2023. In 2018/19 over £377,251 was awarded from the fund to support 61 community projects . In 2018/19 over £377,251 was awarded from the fund to support 61 community projects. Various projects have been funded to date, including projects to improve flood prone communities and projects to reduce the environmental impact of medical emergencies through the purchase of lower emission vehicles and the training of local emergency responders to reduce the travel requirement for medical staff.

More information regarding the Resilient Communities Fund is available here: **https://www.ssen.co.uk/Resiliencefund/**

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

3.1 Introduction

This section provides an overview of SSEN's innovation activities that are enabling a smooth transition towards a low carbon economy. Progress of our innovation projects that are aligned with our RIIO-ED1 strategy is displayed in this section along with details of benefits realised to date of technologies that have been successfully implemented into BaU. Progress on Smart Meter deployment and how we anticipate benefits from them is also covered here.

2018/19 forecasts suggest low carbon technology (LCT) uptake, such as electric vehicles (EVs), Photovoltaics (PVs) and increasingly energy storage, are set to increase in future years. On top of this, electricity demand patterns are changing as consumers respond to economic stimuli and attempt to reduce their carbon footprint. Established patterns of supply and demand, with well understood diversity factors will change as consumers change their behaviour and adopt these new technologies. There is also the potential for new disruptive supply models to be introduced, driven by the roll out of smart meters. As such, DNOs face an increasingly uncertain set of future requirements which will require a much broader set of capabilities. Therefore, SSEN have a wide-ranging Innovation portfolio to ensure we are well prepared for the future. Key areas for focus are described below.

Distribution System Operator (DSO): In 2018/19 this is one of the largest and most complex challenges currently facing the industry. A large amount of effort is being invested within SSEN on projects that will allow DNOs to move from the traditional DNO model to the new DSO model. It is expected that the move to DSO will remove barriers to smart technologies, assist in the evolution of the smart grid and make energy markets more flexible to provide more scope for low carbon and consumer benefits. SSEN have a number of key innovation projects which are helping to inform this change, including our latest large-scale innovation projects, Transition and LEO. SSEN are also fully engaged with the ENA led Open Networks project which is setting a Roadmap for transition to DSO across the whole industry.

http://www.energynetworks.org/electricity/futures/open-networks-project/open-networks-project-overview/

Electric Vehicles: 2018/19 uptake of EVs is steadily rising as technological improvements to batteries improve vehicle range and prices become more attractive to consumers. SSEN is specifically 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. Specifically, on engagement, we have significantly increased our interaction with the electric vehicles sector to include manufacturers, charging point suppliers, customer groups and relevant government agencies. We were also 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 Groups purpose is to smooth the transition toward the mass adoption of EVs. This work is being driven by our NIA project Smart EV – **https://www.eatechnology.com/projects/smart-ev/**
- Put in place measures to help us monitor the growth in EVs being connected to the network and the impact of clustering.
- Appointed an EV Readiness Manager, who will be responsible for making sure that SSEN are well prepared for any challenges that may arise from the widespread adoption of EVs.

Flexible Connections: 2018/19 demand to connect small scale renewable generation quickly and on constrained networks is increasing. To meet this demand SSEN has:

- Standardised the technical specification for our flexible Active Network Management (ANM) connections.
- Established and developed a specialised Active Solutions Team within our BaU function to provide customers with more flexible connection options and to continue to maintain and support these connections when they are complete.

- More flexible options available for the connection of new generation, which includes Timed Connections and Single Generator ANM options, for further details see: **https://www.ssen.co.uk/AlternativeGeneration Connections/**
- Continued to support and deliver innovative projects to develop further flexible arrangements. This includes the ACCESS project on the Isle of Mull where customers are using controllable demand to maximise the utilisation of distributed generation which would have been otherwise constrained.

Smart Meters: In 2018/19 these continue to be rolled out across both our Scottish and Southern networks. As the volume of smart meters deployed grows, this will provide DNOs with the potential to receive additional information on networks loading and notification of supply interruptions. SSEN has established a specialised Smart Meter team with the objective of realising benefits from the roll out of smart meters to ensure we create benefits for our customers.

Innovation Deployment: In 2018/19 we engaged in a number of large and small scale projects that are specifically designed to meet Ofgem's RIIO-ED1 outputs. The purpose of these projects is to ensure a broad range of benefits are realised for our customers. Examples of projects that have rolled out into BaU include ANM that assists with the connection of renewable energy generators and constraint managed zones (CMZ) that can defer the need for expensive capital investments.

Low Carbon Technologies (LCTs): The total uptake of LCTs has increased slightly in 2018/19 compared with last year on our Scottish Network. This is mainly due to an increase in Photo Voltaic (PV). In our Southern Network there was a decrease in LCTs, mainly attributed to a decrease in Electric Vehicle (EV) slow chargers and distributed generation (DG). Total amount of DG added to both our SEPD and SHEPD networks in 2018/19 was 577 units at a total size of 239.8 MW. We expect a similar trend of increasing LCT uptake next year, with more rapid uptake in the final years of RIIO-ED1.

For further details on low carbon technologies, please see worksheet E7 – LCTs linked to the Appendix of this report.

3.2. Progress on our innovation strategy

We originally published our Innovation Strategy along with our RIIO ED1 business plan. This outlined our plans 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: **http://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 3.2a.

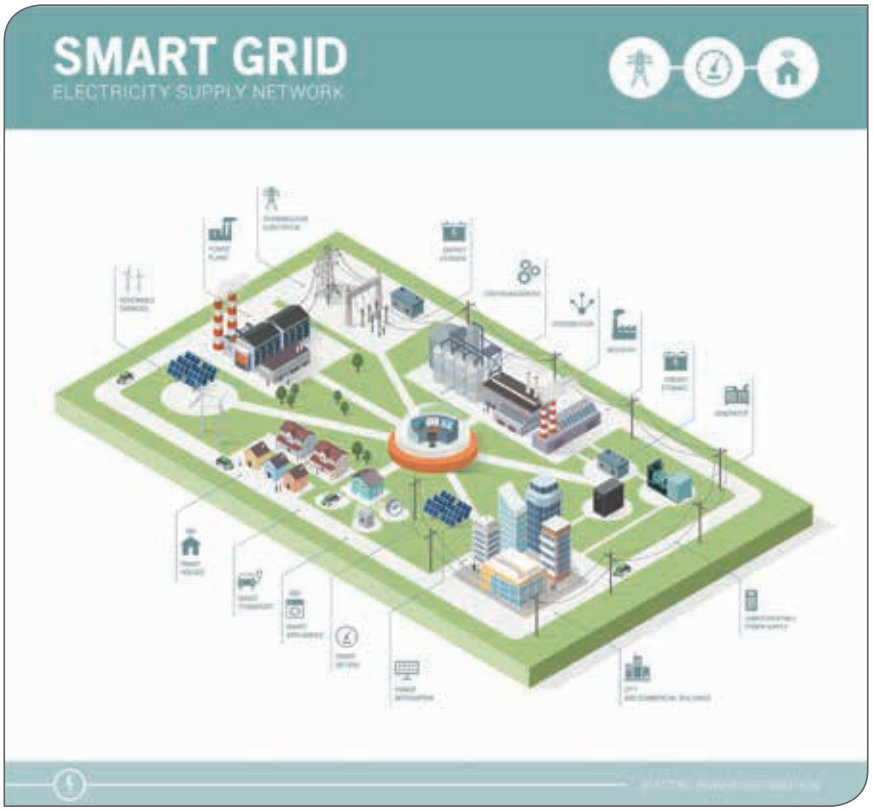


Table 3.2a – Top 20 innovations

RIIO ED1 Primary Output	Core Innovation for RIIO-ED1	2018/19 Update
Connections	Active network management – generator constraint management	Implemented into BaU
	Active network management – community demand management	Demo project underway to develop wider business model
	Demand-side management – thermal energy storage	Implemented into BaU, various sites being progressed via the Piclo Platform https://www.ssen.co.uk/SmarterElectricity/Flex/
	Dynamic circuit thermal rating	Fast following
	Fault current limiters	Fast following
	Local smart EV charging infrastructure	Outputs informing SSEN wider EV Readiness Strategy
	LV solid-state voltage regulator and power conditioning	This project has been suspended
	Static synchronous compensators (STATCOMs)	Implemented into BaU
Customer Service	Advanced distribution automation – network reconfiguration	Incorporated in wider BaU deployment
	Weather impact and response modelling tools	Implemented into BaU
Environment	Bidirectional hybrid generation plant	Implemented into BaU
	Wood pole alternative	Progressing as a live collaboration NIA project
Reliability	Automated demand response with commercial customers	Implemented into BaU, various sites being progressed via the Piclo Platform https://www.ssen.co.uk/SmarterElectricity/Flex/
	Energy efficiency approaches	Implemented into BaU, various sites being progressed via the Piclo Platform https://www.ssen.co.uk/SmarterElectricity/Flex/
	LV network modelling	BaU Deployment as part of wider GIS replacement programme
	LV network monitoring	Further BaU deployments to support EV Readiness, Investment Planning and operations
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

A more in depth breakdown of Active NIA projects can be found in the 2019 Annual NIA Summary Report located here **https://www.ssen.co.uk/InnovationLibrary/Distribution/**

3.2.1.Large-Scale Innovation Projects

During 2018/19, SSEN had three large-scale innovation projects in its distribution business that are detailed in the following sections.

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

Key activities
LEAN is focussed on reducing losses at primary substations by developing and applying Transformer Auto Stop Start (TASS) technology.

The key principal of TASS is to switch off one of a number of transformers in a primary substation at times of low demand to avoid the fixed iron losses associated with that transformer. The TASS system provides local, automated control within the substation to monitor the loading and control this switching, and to respond to SCADA alarms and status information from other network assets. In addition, commands incorporated into the Distribution Management System provide the central network Control Room with remote supervision and management capability.

Expected outcomes
The TASS system commenced trial operation in June 2018 and continues to operate as designed, demonstrating the ability to both reduce losses and respond appropriately to different network situations and mitigate security of supply risks.

A broad range of factors have been identified that will further influence the costs and benefits of implementing TASS both now and over future years, and the proportion of sites at which TASS would be economically viable. The project will also recommend actions needed to address any potential barriers to the application of TASS technology across the network.

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

3.2.1.2. Solent Achieving Value from Efficiency (SAVE) (SSET206)

Key activities
The SAVE project has now successfully ended. The trials consisted of evaluating four domestic demand side response (DDSR) 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 coupled with – data-informed engagement and community coaching. Each Of these mechanisms were trialled over three trial periods (TP1, TP2 and TP3). The methods have been chosen to allow an assessment of factors such as cost and effort required to implement.

Achieved outcomes

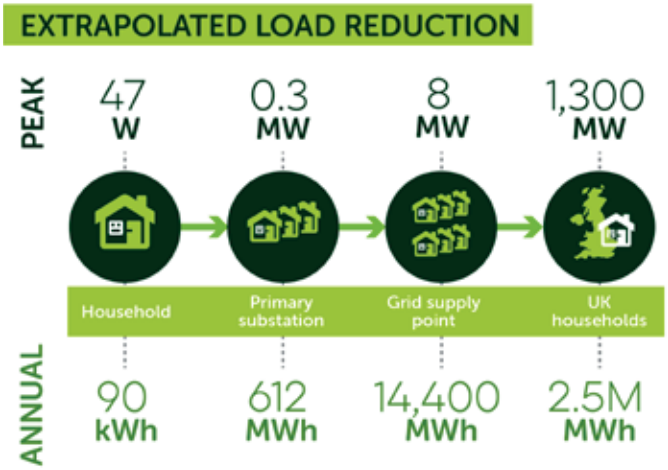


Figure 1 – Impact of LED trials

SAVE's LED trials tested an initial 'opt-in' based approach to the uptake of energy efficiency (EE). The trials provided an education campaign and the offer of discounted bulbs through a project website. Whilst 19% of the trial group visited a project website less than 1% procured bulbs. The project team used this learning to build an opposing 'opt-out' approach to EE engagement in the projects second trial period (TP2). The project designed a DNO led approach to LED engagement, which saw over 76% of the trial group have an average of 7 bulbs installed in their homes. The maximum observed effects showed a statistically significant[1] 47W (9%) reduction in demand per household across the peak period with an average annual reduction in energy of 90kWh or £15.82 per household. Treatment effects were calculated to be 5% higher on average for vulnerable customers.

1 Results were significant at the 90% confidence level (i.e. $p < 0.1$). Confidence intervals indicating the uncertainty around the estimated treatment effects for the LED trial can be found in SDRC 8.3.

As can be seen from Figure 2, when scaled across the UK this could result in a peak load reduction of 1.3GW or the same as the generation of a nuclear power station. Average annual savings in energy consumption across the UK would equate to 2.5TWh or over £400 million in annual household energy costs.

Funding Stream
LCNF Tier 2
£10.3m project

Start/end date
2014-2019

3.2.1.3. Distribution System Operator (DSO) Transition

Key Activities
The transition of Distribution Network Operators to Distribution System Operators is a major energy industry initiative that will transform the way our energy industry works, underpinning the delivery of a smart grid. It is a core component of Ofgem's future facing work to enable the energy system transition which is a culmination of work with the Department of Business, Energy & Industrial Strategy (BEIS), and forms part of the Government's Industrial Strategy. More details can be found here: **https://www.gov.uk/government/publications/upgrading-our-energy-system-smart-systems-and-flexibility-plan**

Government and Ofgem are calling for the industry to deliver a smarter, more flexible energy system by:

- Removing barriers to smart technologies, including storage
- Enabling smart homes and businesses
- Making markets work for flexibility

The infographic displayed in figure 3.2b illustrates that learnings gained from a broad range of SSEN projects will be utilised in the natural evolutionary transition towards a DSO.

The Smart Systems and Flexibility Plan envisages the development of a smart, flexible energy system that will reduce costs for consumers and industry and support the growth of innovative new businesses.

Expected Outcomes
Currently SSEN are focused on contributing to The Open Networks Project which is tasked with addressing the issue of DSO Transition. This project brings together 9 of UK and Ireland's electricity grid operators, respected academics, Non-Governmental Organisations (NGOs), Government departments and the energy regulator Ofgem. The objectives of the Open Networks Project are:

- Develop improved **Transmission-Distribution processes** around connections, planning, shared TSO/DSO services and operation.
- Assess the gaps between the **experience our customers** currently receive and what they would like and identify any further changes to close the gaps within the context of a 'level playing field' and common T & D approach.
- Develop a more detailed view of the required transition from **DNO to DSO** including the impacts on existing organisation capability.
- Consider the **charging** requirements of enduring electricity transmission/distribution systems.

Further information on Open Networks at **http://www.energynetworks.org/electricity/futures/open-networks-project/open-networks-project-overview/**

SSEN currently has two flagship DSO projects in operation:

TRANSITION: This project is progressing SSEN's understanding of moving from a DNO towards a DSO. The work is focussed on trialling novel tools, creating new system architecture and interacting with Distributed Energy Resource (DER) players.

LEO: This is one of the most ambitious, wide-ranging, innovative, and holistic smart grid trials ever conducted in the UK. LEO will improve our understanding of how opportunities can be maximised and unlocked from the transition to a smarter, flexible electricity system and how households, businesses and communities can realise its benefits.

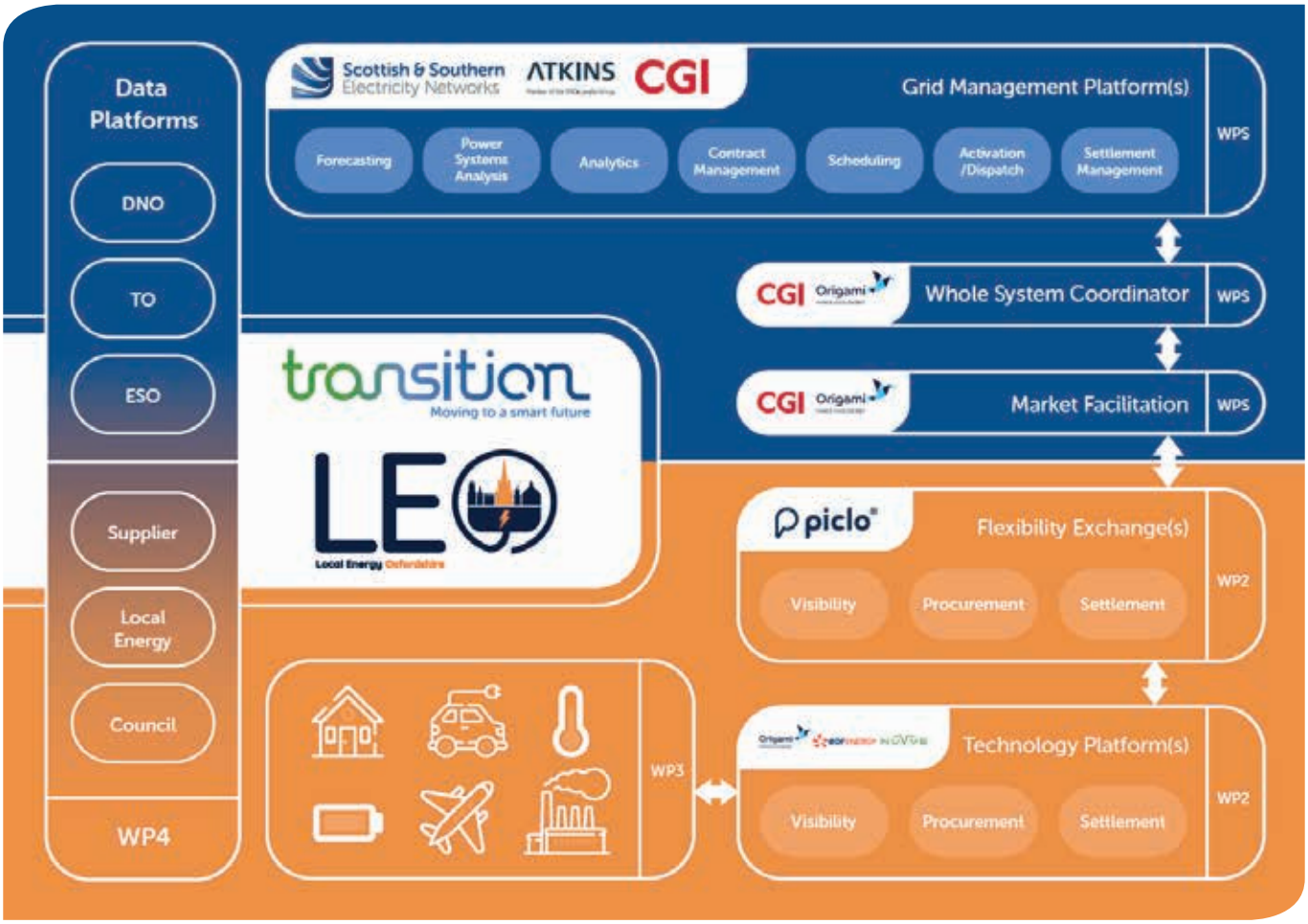
More information on these projects can be found at **https://ssen-transition.com/** and **https://project-leo.co.uk/**

Funding Stream
TRANSITION is funded from the Ofgem NIC – £12.79m

Local Energy Oxfordshire is being funded from the BEIS Industrial Strategy Fund – £37m

Start/End Date
January 2017 – 2022

Figure 3.2b – Illustration of the LEO and Transition project capabilities



3.2.1.4. Smart EV

Key activities
At present, there is no standardised method of controlling domestic EV chargers and a number of manufacturers have developed proprietary systems. Left alone, this will lead to a multitude of system types with little commonality which would make adoption of smart charge control much more difficult in the future. Alongside this, messaging to customers is critical to ensure buy-in and facilitate acceptance of demand side response with regards to connection and control of Plug in Vehicles (PIVs). The project is collaborating with cross-industry organisations to try to find a supported option for standardising the communication with and control of EV charging on the distribution network, with a focus on avoiding and resolving faults because of demand increases from EV charging. Consultation with cross-industry stakeholders has produced a consensus for both a short-term solution and long-term solution.

A standard specification for a device to fulfil the requirements of a short-term solution is currently being progressed via the Energy Networks Association.

The long-term solution will be based on a solution utilising the smart meter network.

Expected outcomes
While the project has closed, it was successful in raising awareness that DNOs in partnership with suppliers have an essential role to play in the development of EV charging. In particular, the necessity of DNOs to have an override control of EV charging in order to protect the low voltage distribution network from overload and possible fuse rupture has been acknowledged. This backstop arrangement should minimise customer interruptions.

It should be noted BEIS are presently consulting on proportional control of Smart EV charging using the Smart Metering network. This is a direct result of the issues raised and highlighted in this project and includes the provision of a DNO override.

With the acknowledgement that DNOs require an override control a modification has been raised to the Smart Energy Code (SECMP0046) to allow DNOs to have this measured control of Electric Vehicle chargers connected to Smart Meter infrastructure. This modification is now progressing out with the project and should reach a conclusion in around 12 months.

More information can be found at:
https://www.eatechnology.com/engineering-projects/smart-ev/

Funding Stream
Network Innovation Allowance
£430k project (extended to £680k)

Start/end date
2016-2017 (extended to Sep 2018)

3.3. Converting Innovations into Business as Usual

Prior to commencing any innovation project, a robust Cost Benefit Analysis (CBA) process is undertaken to ensure that the proposed initiative has a positive business case. This will involve making a number of assumptions to predict the future benefits. During the trial period these assumptions will be tested, to give better information on how the innovation will perform on our network. This will include an ongoing assessment on the potential benefits. At the end of the innovation trial 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 implement it into BaU. 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 have successfully implemented the below solutions into BaU.

3.3.1. 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 BaU solution by SSEN.

A Constraint Managed Zone is a geographic region served by an existing network where requirements related to network security are met through the use of load variation techniques, such as Demand Side Response, Energy Storage and stand-by generators. These techniques are CMZ services provided to SSEN by a CMZ Supplier, however across the wider industry these services are recognised as 'flexibility services'.

CMZs will be deployed in areas of our existing electrical network that are or could potentially experience one of the following scenarios;

- Forecast to exceed its firm capacity, where network requirements related to peak electrical demand are met using demand reducing or demand shifting techniques, CMZ techniques do not seek to increase capacity on the network but will reduce or time-shift demand to avoid capacity constraints.
- Will experience planned maintenance works, where DER flexibility services could be employed to maintain network operation or reduce the risk of outage,
- Could experience outages due to a combination of maintenance works and/or circuit faults, where DER flexibility services could be employed to avoid or minimise outages,

In the event of outages, DER flexibility services could be employed to aid in the restoration of normal supply by reducing loading or providing additional power injection.

CMZs 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 CMZs 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 sites we have identified for the initial CMZ deployment were sites 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 3.3a and Figure 3.3b. We have undertaken two tender rounds and are now in the middle of a third again with a positive response from a supportive market place.

Figure 3.3a – Illustration of CMZ service configuration, for post-fault services

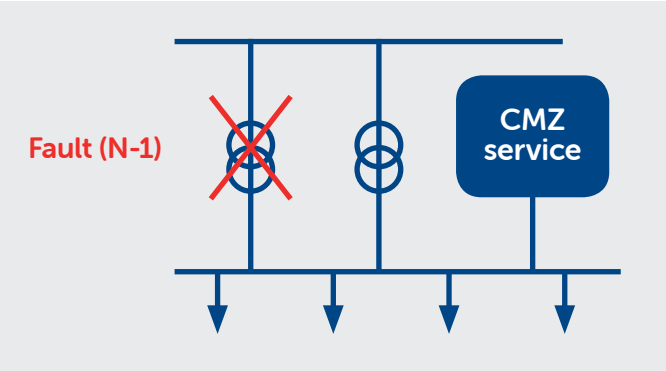
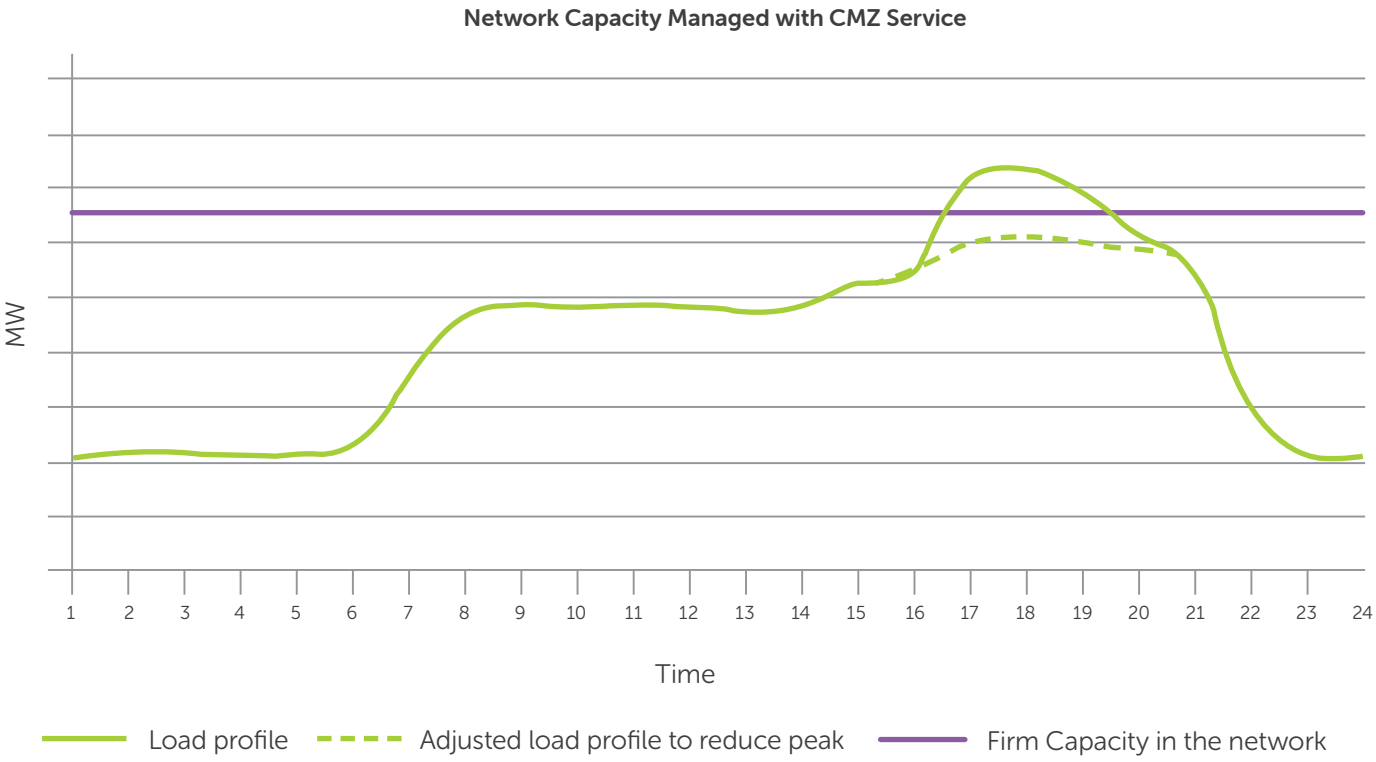


Figure 3.3b – Peak-lopping services re-shaping the load curve at the appropriate times



The Constraint Managed Zone 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 IFI project, the New 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. It also allows the potential for carbon reductions (against traditional mobile diesel generation/fossil fuel-based support) and societal benefits of encouraging local energy efficiency and DG uptake.

There are now multiple types of CMZ (existing and proposed), each one is mentioned below with a short description

CMZ Prevent
SSEN is considering electrical networks which are approaching a point where the pre-existing network capacity cannot meet power requirements should an outage coincide with periods of highest demand where the system's firm capacity (post outage) is lower than the demand. Traditional reinforcement techniques would increase overall capacity across all time periods by including an additional circuit or by up-rating an existing one. CMZ techniques do not seek to increase capacity but will reduce or time-shift demand to avoid capacity constraints. Since capacity constraints only occur at periods of maximum demand, and only if an outage coincides, CMZ techniques need only be available during pre-defined Service Windows.

CMZ Prepare
In the same manner as CMZ Prevent, SSEN will procure ahead of time the required power injection/demand response services from available DER providers based on network conditions to manage pre-planned outages.

CMZ Respond
SSEN will procure ahead of time, the ability of a Service Provider to deliver an agreed change in output to avoid or following a network fault, for example to avoid in N-1 scenarios overloading of the 2nd circuit or to constrain loadings during restoration or repair scenarios. Utilisation is then instructed when the fault occurs on the network (but only if loading is beyond the post fault rating of the remaining assets), or to enable constraint management during restoration activities.

CMZ Restore
Based on a static, rolling contract and utilising DER to manage networks more efficiently during fault conditions, SSEN will instruct a provider to either remain off supply, to reconnect with lower demand, or to generate into a network zone isolated from the main fault to support more efficient or effective load restoration within a specific network area.

Social CMZ
Through the Network Innovation Allowance (NIA), SSEN is developing a more socially focused version of the CMZ process which will run alongside is more commercially focused counterpart. The Social CMZ will provide wider societal benefits and aid SSEN in meeting its social obligations by focusing on domestic and community based DSR, Storage and Generation solutions.

The SCMZ approach is being targeted at more local DER provision, which will leverage partnership with Local Authorities, commercial organisations with localised interests, community groups to deliver demand management or power injection services from a range of providers unable to meet the defined commercial and procurement parameters currently insisted upon within the CMZ process, for example Achilles registration, TEDS (Tenders Electronic Daily) interaction or OJUE procurement process compliance.

The defined process of implementing SCMZ is being delivered through an NIA Project at time of reporting although the service itself will be implemented through BAU.

SSEN are constantly reviewing network conditions for new types of flexible services which can be trialed and released to Business as Usual service offerings. As these are developed, we will update this site to ensure our customers are aware of all the service opportunities available.

How do people get involved?
It is important to note that we do not consider this opportunity as a "demonstration" or innovation project, any service provision will be fully commercial in nature. SSEN does not intend to restrict CMZ suppliers from participating in any other market that is compatible with the CMZ contracted service.

A CMZ Service is a service provided by the CMZ Supplier to SSEN which gives SSEN the ability to manage the load at a specific point of the network at certain points in time, in order to manage network requirements which would otherwise trigger reinforcement in the network, could potentially result in outages or to support restoration activities if outages have occurred.

The CMZ Service comprises three elements which may be combined or offered individually: Availability, Utilisation and Storage. The CMZ Supplier can provide this CMZ Service through different alternatives:

a) Demand Side Response, via a customer or group of customers connected to the appropriate part of the SSEN network, which has the ability to reduce or increase the load at specific times in relation to what would have been the load if the CMZ Instruction had not been received.

b) Via technologies connected to the SSEN network, which export power into the appropriate part of the SSEN network and have the ability to increase or reduce the amount of export in relation to what would have been exported if the CMZ Instruction had not been received (typically a generator, an energy storage unit or similar).

c) Storage, via appropriate technologies connected to the SSEN network, which can increase the load or cease exporting to store energy, releasing the stored energy to increase export when the CMZ instruction is received.

d) A combination of the alternatives above.

SSEN will release new CMZ opportunities as they are identified and will acquire these services within a standard procurement process, specific details on the procurement process can be found above (link tab).

Zones will be advertised on these flexibility pages (see tab above) and you can register your assets on the flexibility register (see separate tab above).

Zones will also be made visible on **https://picloflex.com/dashboard** where you can register your assets for wider potential services.

We will also publish data on completed procurement rounds and historic zones on these pages (tab above). Should you have any questions or wish to discuss CMZ zones please contact the Flexible Solutions Team at **FlexibleConnections@sse.com**.

3.3.2. Flexible Connections

We are committed to finding and developing flexible solutions for our customers to allow them to connect at an earlier stage. In some areas of our networks, the network is already at full capacity and it is not possible to connect any further generation without upgrading the existing network. In these cases, customers would typically need to wait for the required reinforcement works to be completed before being able to connect to the network. However, there are a number of alternative options available to customers who are willing to consider a more flexible connection offering which, depending on the circumstance, may allow connection ahead of the required reinforcement works. We also offer flexibility in relation to payment options for connections.

The flexible connection offers that we provide can be found below, along with a brief description.

Forming a consortium
In some cases, the costs of network reinforcement or new connection assets can be prohibitive to a project. One potential option available to developers in this circumstance is to share this cost with other developers wishing to connect to the same part of the network. This can be done by forming a consortium. To assist developers with identifying others that may be interested in forming a consortium, we are considering developing an availability register as part of our Heat map tool, which can be accessed on our website.

Timed Connections
The timed export connection offers the customer the possibility of connecting to the network and exporting during certain periods of the day or week. In some areas of our network there is the potential to make use of generation or demand diversity. The examples we currently support are where the majority of generation in an area is PV then during non-daylight hours other types of generation can export freely, such as wind. Another alternative is where demand is high during the week but low over the weekend, for example in an industrial area, in this case a generator can export Monday – Friday but constrained over the weekend.

Intertrip
Scottish and Southern Electricity Networks must ensure that if there are two circuits running in parallel and one of the circuit's fails then the other circuit can pick up the load. This part of system planning standards. A generator may incur additional reinforcement charges due to the remaining circuit not having a sufficient excess capacity. Therefore, an intertrip connection may be offered. This allows a customer to connect onto the network under the condition that the generator will be disconnected from the network if one of the circuits fail.

Active Network Management (ANM)
In areas where there are several, complex constraints affecting a number of customers over a long period of time, full ANM systems will be implemented. The ANM systems continually monitor all the limits on the network in real-time and allocate the maximum amount of capacity available to customers in that area based on the date their connection was accepted.

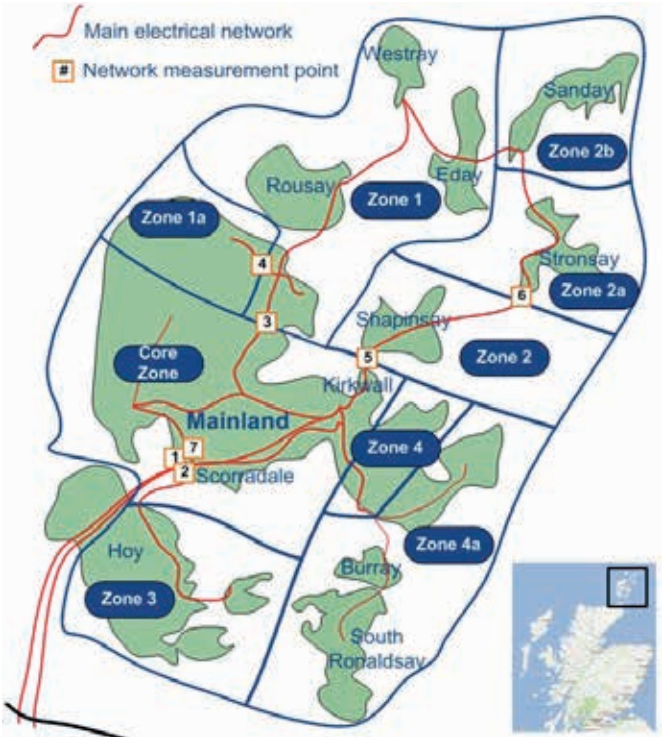
Orkney ANM System – operational but closed for further applications

Isle of Wight ANM System – operational and open for further applications

Shetland ANM – operational but closed for further applications

Western Isles ANM System – operational but closed for further applications

Further schemes are to be established following customer requests and then assessed on a case by case basis.



This picture shows Orkney ANM. To ensure the safe operation of the network it is divided into zones which represent constraint points in the network on account of the additional generation.

Single Generator Active Network Management (SGANM)
SGANM is similar to a full ANM scheme, except instead of managing multiple constraints and multiple generators it manages only one generator and up to two constraints. The SGANM will monitor constraints and issue the generator a safe level of export capacity in real-time. The SGANM will be offered to the first generator in the constrained area, should second generator request a connection in the same zone then a full ANM will be installed.

Contractual Flexibility
We consider flexibility in contractual terms in circumstances where a transitional solution may be available for a customer. Examples include situations where the local connection works can be completed early, but the full capacity is not available until reinforcement is complete. In this scenario, we can include special conditions within the Connection Agreement which can allow the customer to export some of their full capacity, dependent upon what the current network can accommodate.

Export-Limiting Devices
We will consider applications for export-limiting devices on a case by case basis. The customer will ensure the export limit given by us is not exceeded. We will also install a failsafe system so that in the event of the generators export limiting scheme failing, the generator will be disconnected.

Application Process
A new, streamlined flexible generation connection process was put in place and available for new applications from 18th April 2019. Our new flexible connections process is available for generation connections above 50kW where there are thermal constraints leading to significant reinforcement works. In existing network areas where ANM schemes are already in place no other flexible option will be available. The main points of the new process:

- You can now apply directly for a flexible connection;
- If you apply for a standard quotation and significant reinforcement works are triggered, we will provide two network studies (standard and flexible) and give you the option to change your connection type;
- Available for all new generation connection applications from 18th April 2019.

For more information, such as on how to apply, please visit **https://www.ssen.co.uk/FlexibleConnectionOptions/**

RIIO Commitment No88
We will work with local authorities and housing associations to anticipate where there are likely to be large volumes of new or low carbon technology connections to our network. This will allow us to apply innovative network solutions to minimise network reinforcement costs whilst also ensuring timely connections. We will defer network reinforcement on at least one circuit by working with a community to manage electricity consumption through energy efficiency and low carbon technologies through the SCMZ project and wider interactions with local energy strategies across our networks.

SWAN
The South West Active Network (SWAN) scheme has been developed by Southern Electric Power Distribution (SEPD) to allow connecting generation customers to meet a requirement set by National Grid Electricity Transmission (NGET). The requirement, identified during the generation customer's application to connect, stipulates the need for suitable monitoring and control of those connecting generators at certain grid supply points (GSPs) in our southern distribution area to within limits set by NGET. This monitoring and control is known as Active Network Management (ANM). This allows for the automated real time operation of generation to maintain an electrical network within operational constraints, to ensure statutory and regulatory obligations are met. Without it this generation could not be connected. As the name suggests the scheme spans across the south west area of our southern network.

Centralised ANM
Currently, ANM systems are deployed on physical IT server infrastructure which is often located near to the network connection and the flexible generation schemes they control. There is an opportunity to move towards more centralised architecture and system implementation enabling significant business benefits for the delivery and subsequent operation and maintenance of ANM. The centralisation of ANM systems (along with platform virtualisation) will increase the capacity and scalability of ANM technology solutions, reducing physical space and power requirements.

Centralised systems are easier to manage and less prone to environmental issues. Supportability is improved by removing (or significantly reducing) the requirement for remote maintenance work, as well as reducing (or removing) the requirement to travel to / attend site when technical issues arise. Over time, as the ANM virtualised production environment scales up, the expectation is that the cost of delivering ANM solution designs, the cost of ANM systems implementation and the subsequent operating and support costs, would all reduce.

The picture above shows a tidal generator in the docks ready to be installed as part of the NiNES ANM scheme in Shetland.

3.3.3. Summary of SSEN Innovations that are now Business as Usual activities

Active Network Management (ANM)
ANM has been implemented in multiple locations across our Scottish and Southern Networks 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. The time to connect was also very long as reinforcement projects often take several years to complete. For example, to connect new generation to the Western Isles additional capacity was required. The projected costs of traditional reinforcement required to create additional capacity was estimated at £20m and would take several years to complete the large-scale capital investment project. This high cost acted as a barrier to entry for new generators wanting to connect to the network. However, implementing ANM has enabled 9MVA of additional capacity to be freed up on the Western Isles network without the need for this reinforcement. As a result, generator(s) can connect at a far lower cost and at much faster timescales then were previously possible on the constrained network.

Benefits
£56.5M of costs avoided; 252,728 tCO_2e avoided for all ANM projects.

This project was made possible from learnings derived from our original SHEPD Orkney ANM project. Information on this project is available here:
https://www.ssepd.co.uk/OrkneySmartGrid/

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 & 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 Customer Interruptions (CI) or Customer Minutes Lost (CML) penalties as power can be restored within the three-minute regulatory window. Kelvatek, the suppliers of the Bidoyng technology, also provide 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 £10m gross avoided costs and over 252,012 Customer Interruptions and 32,439,388 Customer Minutes Lost avoided.

The technology was implemented straight into BaU.
More information can be found here:
https://www.camlingroup.com/product/bidoyng

Live Line Tree Harvesting
SHEPD Live Line Tree Harvesting involves a specialised machine that can cut down trees adjacent to live overhead power lines. The machine is far more efficient than hand felling and 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 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 CO_2. There is also a risk that the generator will trip causing a loss of power. 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 £6.4m gross avoided costs and 51,946 Customer Interruptions and 11,084,458 Customer Minutes Lost prevented.

This project has led to 2,753 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:
http://www.smarternetworks.org/project/2007_08

Thermal Imaging of Underground Cables (TOUCAN)
TOUCAN was an NIA project that investigated a technical method of using thermal imaging solutions as complementary tools in the context of locating underground cable faults in the power distribution network. When a cable fault occurs the repair, operative uses conventional methods to locate the fault and pinpoint the excavation site. However, in a scenario where there is not enough precision, thermal imaging techniques will be employed to help locate the fault and confirm the primary excavation site. Rapid and accurate pinpointing of underground cable faults is a key factor in minimising supply interruption time and repair costs. If this method locates a fault from a residual heat signature it will reduce the number of bore holes for cable sniffers or reduce the amount of stress induced by cable thumping. The method could also eliminate false clues from the potential fault location data.

Benefits
There has been an estimated £245k gross avoided costs and 7,113 Customer Interruptions and 642,870 Customer Minutes Lost prevented.

More information can be found here:
http://www.smarternetworks.org/project/nia_ssepd_0021

Forestry Mulcher
Forestry Mulcher was a NIA project that investigated the potential improvement of efficiency and safety using remotely operated vehicles to carry out tasks associated with forestry mulching. Manoeuvrability and the size of traditional mulching machinery pose significant issues when working adjacent to a live network or at smaller sites. In normal circumstances where the proposed machinery will be used, we would currently send four staff with a wood chipper where heavier machinery is not accessible. The remote-controlled forestry mulcher, which can tackle banks of a 45-degree angles, not only minimises the risks to operators over the conventional cutting systems, but also aims to reduce the amount of vegetation on embankments on railways and motorways. The machine allows for stump grinding and ease of transportation to inaccessible places to be possible.

Benefits
Approximately £157k in cost reductions have been achieved since this technology was deployed as BaU.

More information can be found here:
http://www.smarternetworks.org/project/nia_ssepd_0018

The Cost Benefit Analysis models can be found in tables E6. Refer to the annexe for more details.

3.3.4.Smart Meters

Throughout 2018/2019 Scottish and Southern Electricity Networks (SSEN) implemented its Information Technology (IT) and communications infrastructure to become a live Data Communications Company (DCC) user, meeting our Smart Energy Code (SEC) obligation.

SSEN became a live DCC user on the 8th December 2017 and subsequently closed its Smart Metering Programme. A dedicated smart meter operational team were put in place to manage the ongoing roll-out of smart meters and comply with the SEC, whilst preparing to realise benefits from the data smart meters will provide in the future.

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. 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 Smart Meter Implementation Programme (SMIP); these are defined as SMETS1 and SMETS2 meters.

- SMETS1 meters provide a significant amount of smart functionality, however they will not provide the same level of functionality to DNO's as SMETS2 meters and will therefore affect the benefits SSEN is expected to realise. SMETS1 meters have not been connected to the DCC's central communications and data infrastructure during 2018/19 but there are plans to migrate these meters to the DCC during 2019/20.

- 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 2018/2019 is provided in Table 3.3d.

Table 3.3d – Volume of smart meters installed during 2018/19

Licence Area	SMETS[1]			SMETS[2]		
	Installed in 2018/ 2019	Total Installed	% Penetration (year end)	Installed in 2018/19	Total Installed	% Penetration (year end)
SHEPD	67,876	171,989	21.98%	1,525	1,528	0.19%
SEPD	250,179	790,696	25.57%	42,142	42,149	1.36%

It should be noted that due to the level of uncertainty associated with the connection, functionality and accuracy 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 have developed 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 have connected our IT infrastructure with the DCC and developed 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 Smart Energy Code (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 2018/2019 are detailed in worksheet E5, they are also summarised in Table 3.3e

Table 3.3e – IT expenditure for Smart Meters during 2018/2019

Licence Area	SM IT Costs (£k)	SM Communication Licence (DCC) Costs (£k)	Elective Communication (DCC) Costs (£k)
SHEPD	134	732	0
SEPD	538	2,654	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:

- 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

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 2018/2019 are detailed in Table 3.3f.

Table 3.3f – Progress on delivery of benefits from Smart Metering throughout 2018/2019

Category of Benefit	Work Undertaken
Avoided losses to network operators	• Implemented our Networks DCC Access Gateway (NDAG) to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Developed and submitted our Data Privacy Plan to Ofgem for approval to enable access to consumption data. • Work on data storage and analytics capability to maximise use of consumption data.
Reduction in CML	• Implemented our NDAG application to ensure that power outage and power restore alerts are available for use in appropriate areas of the business. • Integrated our outage management system (SIMS) into our NDAG application so our Customer Contact Centres can receive and respond to power outage and power restore alerts from smart meters. • Continued engagement with the DCC regarding the future operation of power outage and power restore alerts.

Reduction in operational costs to fix faults	• Implemented our NDAG application to ensure that:
	  • We can 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.
	• Implemented the integration of SIMS into our NDAG application to:
	  • Enable the initiation of supply energisation status checks from relevant locations.
	  • Receive power outage and power restore alerts from smart meters.
	• Continued engagement with the DCC regarding the future operation of power outage and power restore alerts.

Reduction in calls to faults and emergencies lines	• Implemented our NDAG application to ensure that power outage and power restore alerts are available for use in appropriate areas of the business. • Integrated our outage management system (SIMS) into our NDAG application so our Customer Contact Centres can receive and respond to power outage and power restore alerts from smart meters. • Continued engagement with the DCC regarding the future operation of power outage and power restore alerts.

Category of Benefit	Work Undertaken
Better informed investment decisions for electricity network enforcement	• Implemented our NDAG application to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Developed and submitted our Data Privacy Plan to Ofgem for approval to enable access to consumption data. • Work on data storage and analytics capability to maximise use of consumption data.

Avoided cost of investigation of customer complaints about voltage quality of supply	• Implemented our NDAG application to ensure that voltage related alerts are available for use in appropriate areas of the business.
	• Implemented integration of SIMS into our NDAG application 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.

Looking Forward to 2019/2020

Details of the actions we propose to take during 2019/2020 in relation to each of the benefit categories identified are detailed in Table 3.3g.

Table3.3g– Smart meter actions proposed for 2019/2020

Category of Benefit	Work to be Undertaken during 2019/2020
Avoided losses to network operators	• Successfully communicate with installed smart meters. • Gain approval of our submitted Data Privacy Plan by Ofgem to access consumption data. • Obtain and pass smart meter data to our data storage and analytics tool to maximise the use of data for benefits realisation.
Reduction in CML	• Successfully communicate with installed smart meters. • Customer Contact Centre and Operation teams to use power outage and power restore data in SIMS. • Monitor and track benefits realisation through the use of this data. • Continued engagement with the DCC regarding the future operation of power outage and power restore alert performance and ongoing data quality.

Category of Benefit	Work to be Undertaken during 2019/2020

Reduction in operational costs to fix faults	• Successfully communicate with installed smart meters
	• Our Customer Contact Centre teams will embed the use of smart information into fault management to ensure that:
	  • We can 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.
	• Ongoing business engagement, communication and training for identified user groups as volumes of smart meters increase and more data becomes available.
	• Continued engagement with the DCC regarding the future operation of power outage and power restore alert performance and ongoing data quality.

Reduction in calls to faults and emergencies lines	• Successfully communicate with installed smart meters • Our Customer Contact Centre teams will attempt to proactively contact customers upon receipt of a smart meter outage alert • Ongoing business engagement, communication and training for identified user groups as volumes of smart meters increase and more data becomes available • Continued engagement with the DCC regarding the future operation of power outage and power restore alert performance and ongoing data quality.
Better informed investment decisions for electricity network enforcement	• Successfully communicate with installed smart meters • Gain approval of our submitted Data Privacy Plan by Ofgem to access consumptions data. • Obtain and pass smart meter data to our data storage and analytics tool to maximise the use of data for benefits realisation. • Ongoing development of benefit realisation plans to utilise consumption data when making decisions on network reinforcement.
Avoided cost of investigation of customer complaints about voltage quality of supply	• Successfully communicate with installed smart meters • Pass extreme voltage alerts to our Customer Contact Centres through SIMS. • Continue trials obtaining voltage log data and how this can be used to reduce the need to install voltage recorders and improve the management of voltage complaints.
Network capacity investment savings from electricity demand shift	• Continue to work with suppliers to better understand how recent DCUSA changes and subsequent initiatives are managed relating to network loading to minimise future network investment.

In order to enable delivery of the smart meter related benefits we will continue to;

- Implement the collection of consumption data once approval received from Ofgem of our DPP.
- Continue collaboration with the DCC on the power outage and restore alert performance.
- Continue collaboration with the DCC, ENA and other Distribution Network Operators to identify and resolve data quality issues with smart meter data.
- Monitor and progress our detailed plan on benefit realisation and gain early learning from the data we receive from smart meters now and as the roll-out progresses.
- 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 fourth year of RIIO-ED1 provides a clear message to our stakeholders that we are have a clear programme to deliver environmental benefits and are aware of our responsibilities to our surroundings and out customers. We have made further progress in the last year and will continue to look to the future and pursue solutions that deliver enduring benefits.

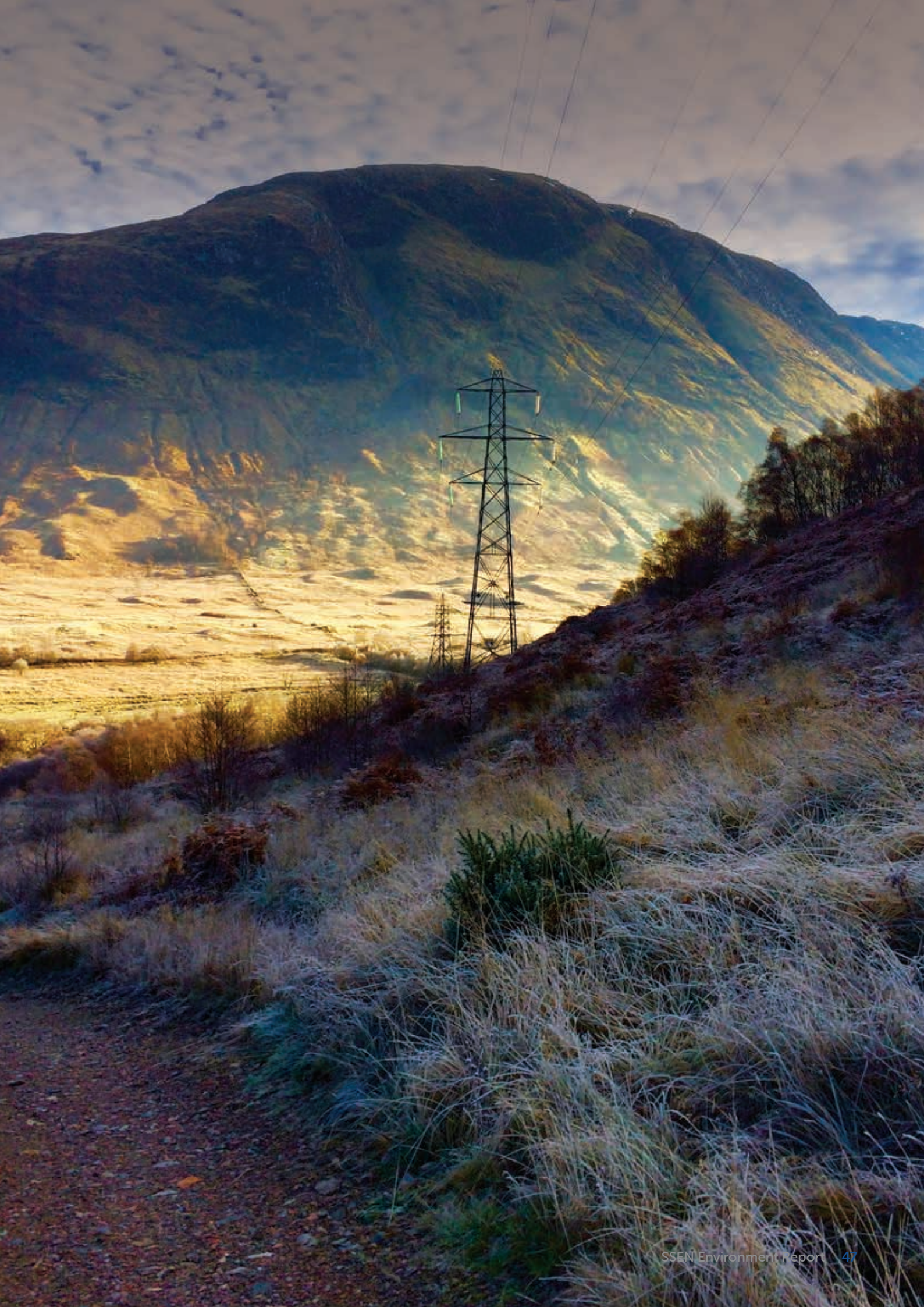
5. Contact us

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

Email: futurenetworks@sse.com
Phone: 0345 300 2315
Website: https://www.ssen.co.uk
LinkedIn: https://www.linkedin.com/groups/8249399
Twitter: https://twitter.com/SSEN_FN

6. Appendix

Licensee	Installed Capacity (kg)
Environment Report 2017	https://www.ssen.co.uk/DistributionPriceControlReview/
Environmental Report 2017 E1-E8 Tables	
Environment Report 2017 E4 & E6 CBAs	
Environment Report 2017 E1-E8 Commentary	



7. Glossary

Business Carbon Footprint (BCF)
A measure of the total Greenhouse Gas Emissions (in tonnes of CO_2 equivalent) resulting from operations on which the DNO has full authority to introduce and implement its operating policy and contractors' emissions.

Common Distribution Charging Methodology
Used to calculate charges to users who are connected to the LV and HV levels of the network. More details can be located here: **https://www.eonenergy.com/for-your-business/large-energy-users/understand-energy/understanding-distribution-charges**

Demand Side Response
Demand side response is a scheme where customers are incentivised financially to lower or shift their electricity use at peak times. This helps manage load and voltage profiles on the electricity network.

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
Standard Condition 47 sets out requirements for the licensee to publish an annual Environment Report about activities that it has undertaken in relation to environmental matters.

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 to prevent pressure reaching the Pressure emergency (PE) level prior to jointing or repair should be excluded.

Fluid 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 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.

IFI
This acronym stands for Innovation Funding Incentive. This was the funding mechanism that existed for small scale innovation projects pre RIIO-ED1. It has now been replaced with the Network Innovation Allowance (NIA).

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 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 because of DNO's equipment and activities.

Network Innovation Allowance (NIA)
A set allowance per network licensee:

- To fund smaller technical, commercial, or operational projects directly related to the licensee's network that have the potential to deliver financial benefits, and/or
- to fund the preparation of submissions to the Network Innovation Competition (NIC)

Regulatory Instructions and Guidance (RIGs)
The term RIGs refer 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 1st April 2015 to 31st March 2023.

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

SSEH
This stands for Scottish & Southern Energy Hydro. It is the acronym provided to our Scottish network

SSES
This stands for Scottish & Southern Energy South. It is the acronym provided to our Southern network

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

Tagging
Tagging is the process where the worst performing cables are targeted and injected with radioactive isotopes, which helps to identify leaks, monitor the cables and track their performance over time.

tCO_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.

Media enquiries should be directed
to SSE's Press Office on
+44 (0)345 0760 530

Investor enquiries should be emailed to
ir@sse.com

Scottish & Southern
Electricity Networks