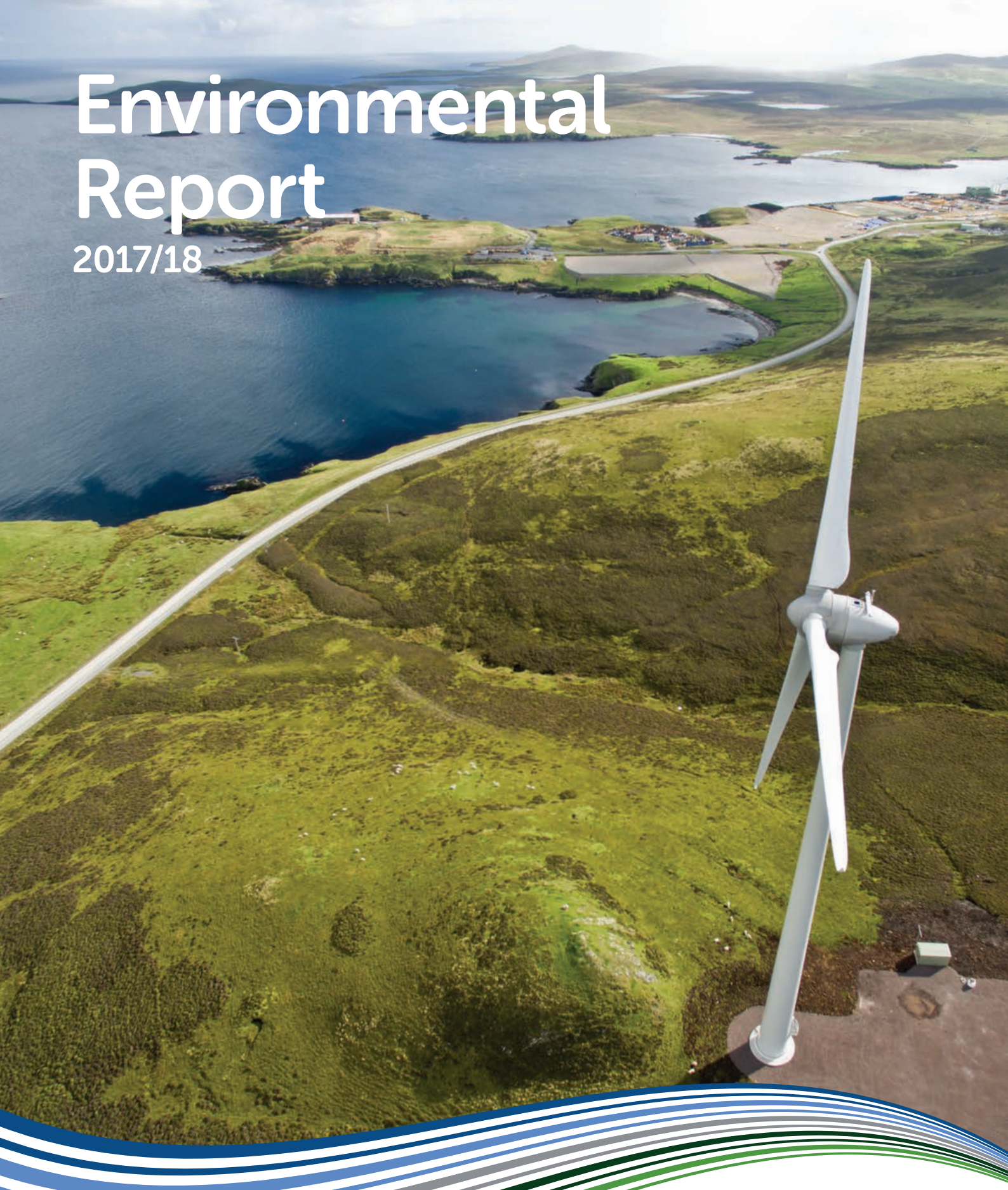
Environmental Report

2017/18



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 are performing against our RIIO-ED1 environmental targets and details 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.

Through our business activities we have managed to reduce our total business carbon footprint for 2017/18 to 49,893 tonnes of CO_2 excluding network losses, a reduction of over 23% of the 2012/13 baseline figure. This improvement is mainly due to the result of reductions in emissions from fuel combustion and operational transport. Our emission reduction has been so significant that we have surpassed our RIIO-ED1 Business Carbon Footprint (BCF) target. 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 is known to cause negative environmental impacts. As a result, we plan to replace 21 kilometres of fluid-filled cable in our SHEPD network and 55km in our SEPD network over the RIIO-ED1 period. In 2017/18 we removed a total of 2km of oil filled cable across both our networks.

Overhead lines especially those at higher voltage running through areas of outstanding natural beauty (AONB) are seen as unsightly by many. Over RIIO-ED1 we targeted our funding for AONB and national parks on our High Voltage network by dismantling a total 10.42km of overhead line, including 1.92km within Loch Lomond and the Trossachs National Park in 2017/18. We also plan to underground a further 25.16km of overhead line in such areas within our SEPD network and 20.15km within our SHEPD network over RIIO-ED1.

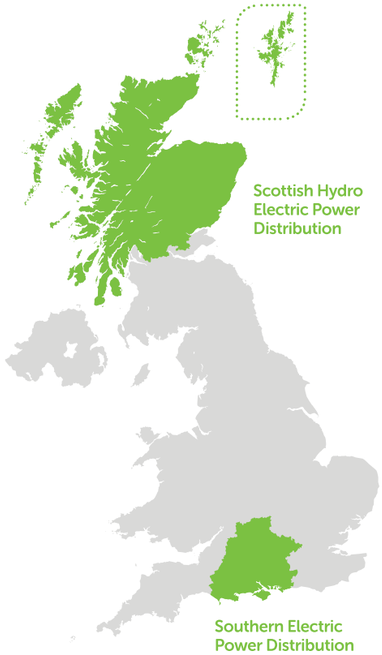
With respect to our losses strategy, we have achieved a significant losses reduction since 2009 and aim to maintain our focus to continue these reductions further in upcoming years. We have commenced the implementation of all the measures outlined in our Losses Strategy and these include:

- 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.

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.

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.

Our story in numbers (approximate)



570,000
Over 570,000 vulnerable customers identified through our Priority Services Register

£1.2m
Over £1.2m contributed to local community projects through our Resilient Communities Fund

130,000km
130,000km of overhead lines and underground cables

100+
100+ subsea cables, powering island communities

3.8m
customers served by our networks

3m+ in southern England

770,000+ in the north of Scotland

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

83 depots located in the heart of the communities they serve

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

740,000+ calls received from our customers last year

106,000 substations

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).

SSEN's network covers 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 our design and construction phases.
- 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 SSEN's commitment to addressing environmental matters. This includes, but is not limited to, our role in the low carbon transition. It is intended to provide a holistic overview and clear rationale for our actions and details of actual benefits to customers. It provides an important update on our continuing progress to meet our environmental targets and shows 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 42km of OHL in AONB, National Parks and National Scenic Areas (NSA).

Oil & Fluid Filled Cables

- Replace 55km of fluid filled cable.
- Reduce oil leakage by 15%.

Business Activities

- Reduce the energy consumption in our buildings by 15%.
- Undertake no more than 0.5 business flights per employee per year.
- Reduce the average mileage of SSEPD cars by 10%.
- Reduce zero landfill from offices and depots.
- Reduce rate of leakage of installed SF_6 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.

SSEN 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: (**http://sse.com/media/522476/sse-plc-sustainability-report-2018.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 that increase the carbon footprint we have on our planet. We are committed to reducing our footprint by reducing emissions associated with vehicles, reducing energy usage in our buildings, minimising the amount of SF_6 that is leaked from our assets and keeping 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

Our distribution networks consist of overhead lines, substations and at a number of isolated locations, small power stations that provide back-up generation. We recognise that this equipment can have an adverse impact on visual amenity especially in sensitive environments such as AONB, National Parks and NSA. 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 main 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 given defined funding by Ofgem for undergrounding of overhead lines in protected landscapes. The allocation of funding is influenced by stakeholder engagement completed in these 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, which are then considered and prioritised to ensure consistency in assessment across all SEPD and SHEPD areas.

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 15,499 km of overhead lines within designated areas at the year end of 2017/18 across both of our DNO areas. Over RIIO-ED1, we have spent £1.96m in locations chosen by our Stakeholders and improved our visual amenity by reducing the amount of overhead line in these designated areas by 10.42km. Details of the schemes are provided in the Tables below and overleaf.

Table 2.2a – Undergrounding schemes completed in Designated SEPD areas up to end 2017/18

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

As presented in Tables 2.2b and 2.2c, there are 20 visual amenity schemes in progress in SEPD and SHEPD licence areas. We will continue to engage with our stakeholders to ensure that ongoing and forthcoming projects achieve the best outcomes for landscape, biodiversity and communities.

Table 2.2b – SEPD Undergrounding schemes in progress

Scheme	Designated Area	OHL km Planned	Progress	Planned Completion Date
National Trust, Sherborne, Gloucestershire	Cotswolds AONB	1.4	Design	19/20
West Kennett, Gunsite Road & Silbury Hill	North Wessex Downs AONB	1.9	Design	19/20
Monkton Medieval Settlement, Chilgrove	South Downs National Park	1.75	Project Closure Phase	18/19
Ulwell Gap, Godlingston Hill, Purbeck	Dorset AONB	3.3	Design	20/21
Woodyates PMT Martins Down	Cranbourne Chase	1.9	Design	19/20
Plush	Dorset AONB	0.2	Design	19/20
Bignor Park	South Downs National Park	1	Project Closure Phase	18/19
Winterbourne Near Newbury	Winterbourne Near Newbury	1.5	Design	20/21
Valley of Stones Nature Reserve	Dorset AONB	4	Design	20/21
South Burley	New Forest National Park	6.6	Design	19/20
Rivar Hill, Shalbourne	North Wessex Downs AONB	0.42	Design	18/19
Turville Village, LV	Chilterns AONB	0.12	Design	18/19
Itchen Abbs	South Downs National Park	0.2	Design	19/20
Franklin Farm	South Downs National Park	0.87	Design	19/20

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 – SHEPD Undergrounding of schemes in progress

Scheme	Designated Area	OHL km Planned	Progress	Planned Completion Date
Glen Tromie	Cairngorms National Park	8.0	Project Closure Phase	18/19
Balquidder	Loch Lomond & The Trossachs National Park	0.25	Cancelled (Wayleave Termination)	Cancelled
Kingussie	Cairngorms National Park	7.0	Design	19/20
Blair Atholl	Cairngorms National Park	2.2	Project Closure Phase	18/19
Loch Tummel	Cairngorms National Park	0.3	Design	18/19
Strathyre	Cairngorms National Park	2.4	Design	18/19

Table 2.2d – Undergrounding schemes completed in Designated SHEPD areas up to end 2017/18.

Scheme	Designated Area	OHL km Planned	Completion Date
Callander	Loch Lomond & The Trossachs National Park	1.92	2017/18

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

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 potentially 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. We committed to tagging our 25 worst performing circuits on an annual basis resulting in a reduction in our oil leakage of at least 15% relative to 2012/13.

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.

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 cabled between 2015/16 and 2016/17 was mainly due to data cleansing, whereas the 2km drop between 2016/17 and 2017/18 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. With our annual process of tagging the 25 worst performing circuits and our planned capital replacement and refurbishment programmes targeting high priority circuits both in SHEPD and SEPD, it is expected that we will meet our commitment to reduce oil leakage by at least 15% relative to 2012/13 position.

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

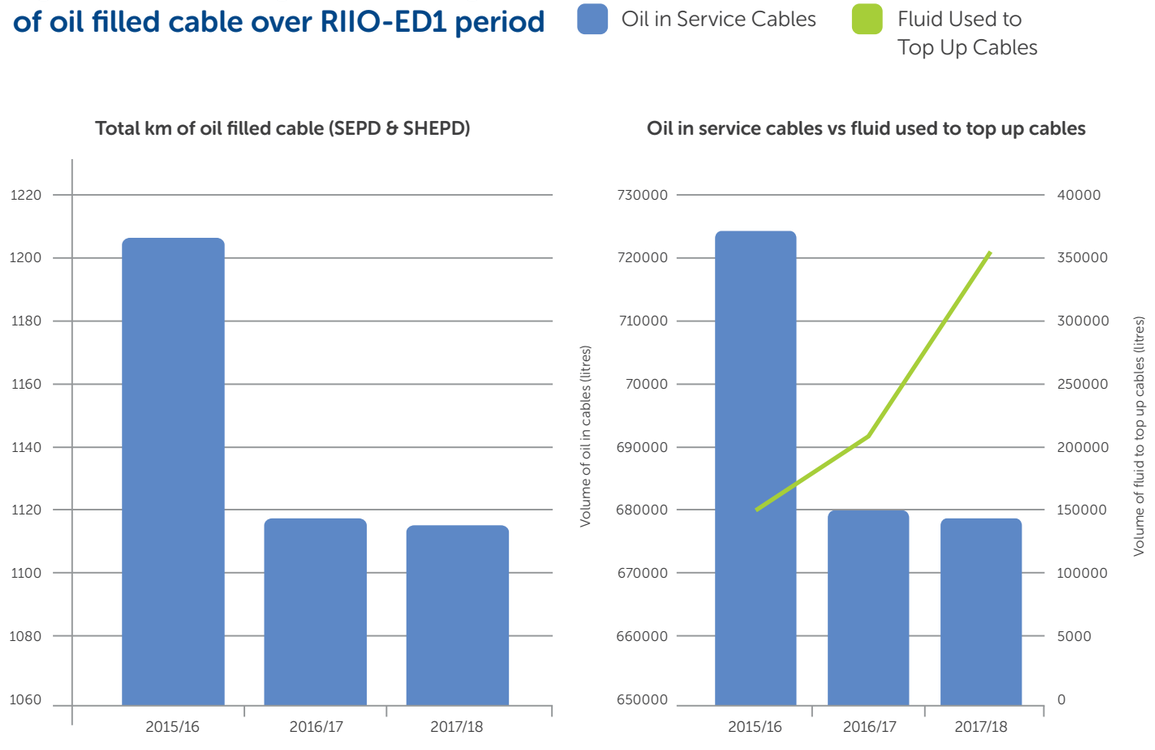


Figure 2.3b – Oil in service cables vs fluid used to top up cables over RIIO-ED1

The total amount of oil in service cables has dropped over RIIO-ED1, which is as expected due to the total reduction of oil filled cables in service 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. At present, we do not recover fluid from cables.

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 to review performance. We will continue this work for the remainder of 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 £1.941 million on 50 oil mitigation schemes, while SHEPD has spent £7.8k on 5 schemes.

For further details on Oil Leakage, please see worksheet E2 – Environmental Reporting linked to the Appendix of this report

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 2017/18. 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.

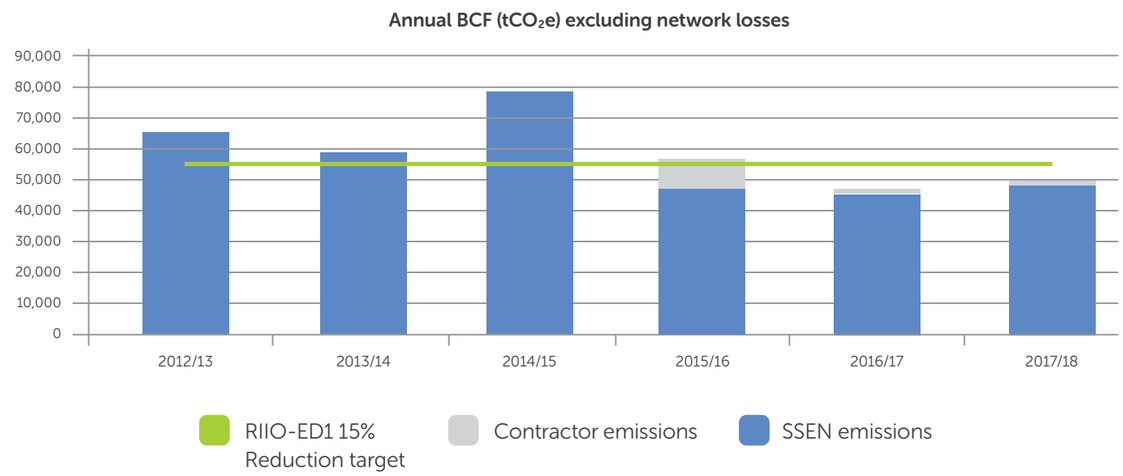
The BCF is an account of the impact that our operational activities have on the environment. We collate the data from across our business using the methodology described within international business carbon footprint standards, the Greenhouse Gas (GHG) reporting protocol and ISO14064-1. We convert our data using 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 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 2017/18, the combined total greenhouse gas emissions for SEPD and SHEPD were $0.81MtCO_2e$ (including losses) for the 2 licence areas. Of our carbon emissions, by far the largest contributor is electrical losses. This accounts for circa 89% of SHEPD's and circa 96% of SEPD's carbon emissions. The other activities that contribute from an SSEN perspective to our environmental footprint are sulphur hexafluoride (SF_6) and the emissions resulting from our vehicle fleet and buildings' energy usage.

Our target is to reduce the Business Carbon Footprint of our business activities by 15% during the RIIO-ED1 period, on a like-for-like basis, excluding exceptional events.

Figure 2.4a – Annual BCF excluding losses



As shown in Fig 2.4a above, our BCF (excluding losses) has been exceeding our RIIO-ED1 reduction target since 2016/17. Contractor emissions were only recorded from 2015/16 onwards, which is why data is lacking for previous years.

Figure 2.4b – Annual BCF including losses

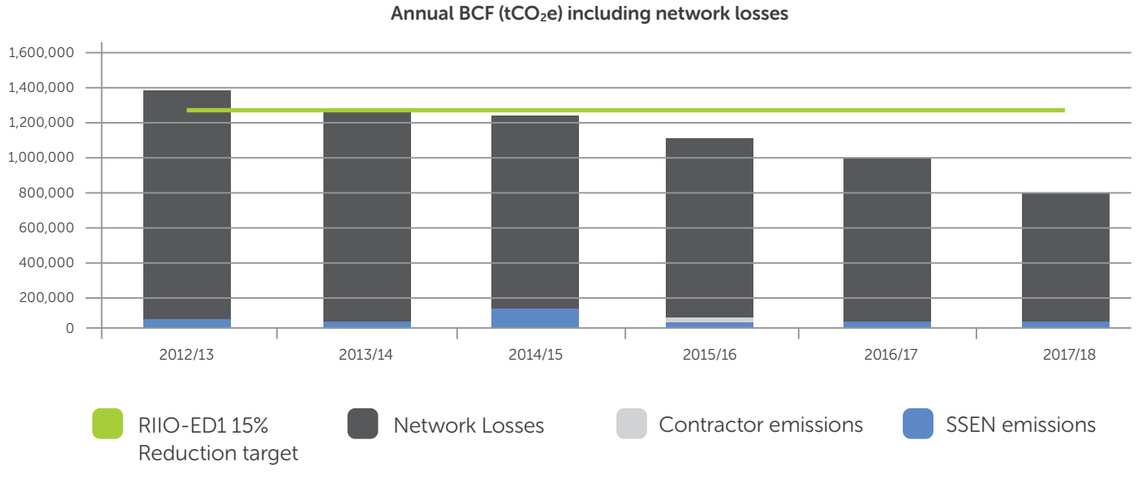


Figure Fig 2.4b shows the contribution that our network losses makes to our overall BCF in relation to our operational emissions and contractor emissions.

Progress to achieve our RIIO-ED1 BCF target (excluding losses) was reached in 2016/17 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 this year, but this largely is due to a more accurate DEFRA calculation methodology being used.

2.4.1.1. RIIO-ED1 Commitments

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

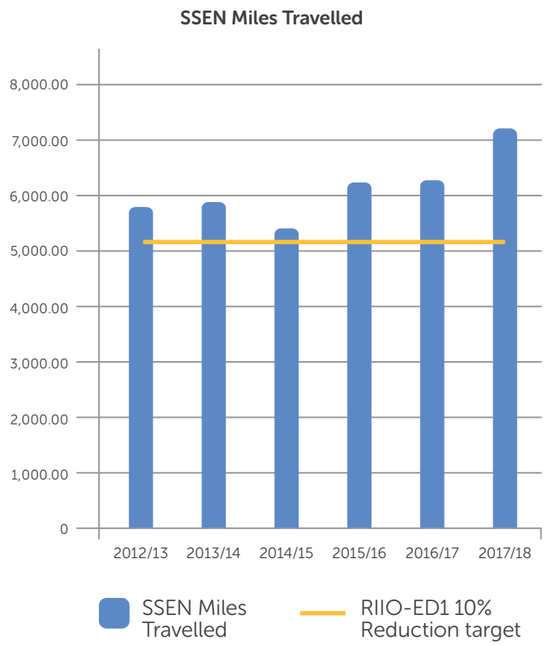
- Reduce the average mileage of SSEN vehicles by 10%
- Reduce Energy consumption in our buildings by 15%

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 left, our Annual vehicle mileage decreased between 2013/14 and 2014/15. It has since steadily increased. However, annual emissions associated with vehicle mileage have dropped significantly as shown in figure 2.4d.

Figure 2.4d – Annual vehicle emissions

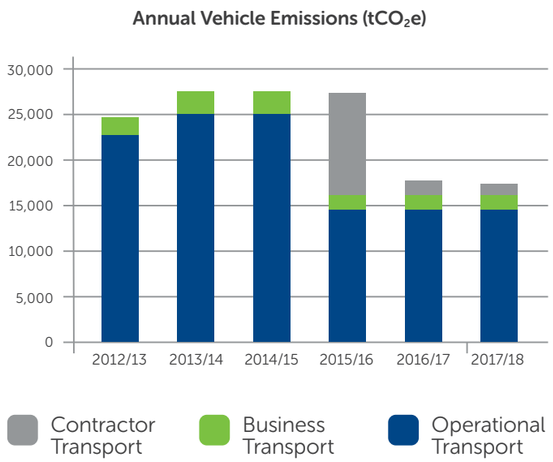


Figure 2.4d is a graph of emissions from business and operational transport, which shows that we're moving in the right direction in terms of reducing our CO_2 emissions from transport. Although we have not met our target of reducing average annual vehicle mileage by 10%, CO_2 emissions from transport in 2016/17 shows a reduction of 27% 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 2016/17 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 where we were able to take more control. 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-year period, 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 original target was to achieve a reduction of 15% from a 2011/12 baseline. In the last financial year, 2017/18 this was extended to an 18% reduction from the original 2011/12 baseline.

A summary of the investment made over the last six-year period and the correlating carbon and financial savings is shown below:

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 T	£39,740	£149,628	£189,368
2013/14	£2,399,000	7,819 T	£164,492	£93,828	£258,320
2014/15	£2,360,000	35,020 T	£632,540	£420,240	£1,052,780
2015/16	£3,083,000	6,170 T	£1,134,412	£104,273	£1,238,685
2016/17	£1,568,000	2,203 T	£229,786	£35,468	£265,254
2017/18	£704,000	2,314 T	£241,363	£273,478	£514,841
Totals	£11,884,000	79,410 T	£2,692,273	£1,129,895	£3,822,168

During 2017/18 investments over £700k designated as energy efficiency improvement work were delivered across the non-operational buildings estate including solar powered EV car charging points at our Perth HQ.

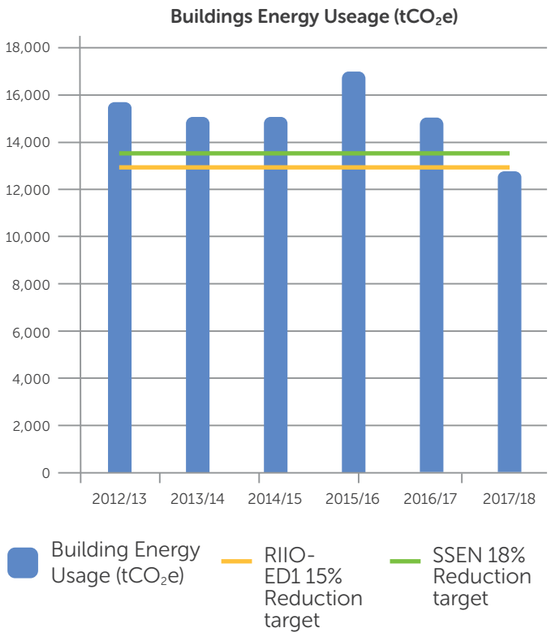
An indicative target of 5% CO_2 reduction per three-year period (up until 2030), is challenging, but remains achievable and is now the non-operational building visionary key performance indicator from this financial year onwards. A new relevant baseline for 2017/18 was created and this data set will be utilised to measure future performance.

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, 94 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.

Figure 2.4e – Annual building energy usage



As shown in figure 2.4e above, our Annual building energy usage has fluctuated since 2012/13, but is now currently outperforming our 15% and 18% reduction targets. This graph displays building energy use associated with SSEN rather than the entire SSE Group as shown in table 2.4a.

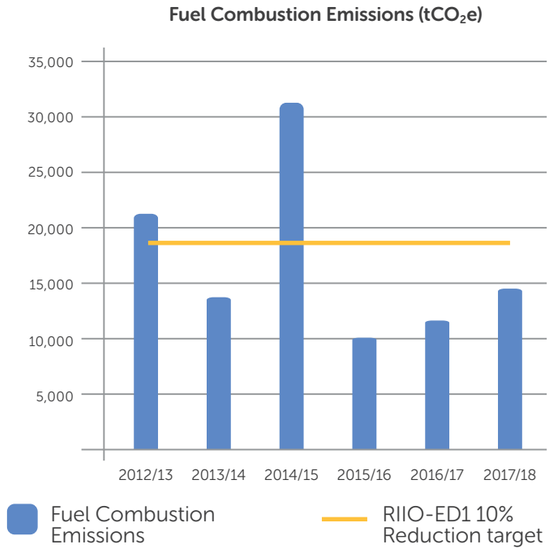
One of the core reasons for the large reduction in building energy use has been a move to 'Agile Working', which allows employees more flexibility in terms of working times and locations. We have also moved one of our major office hubs in Reading to a new and significantly more energy efficient building.

2.4.1.4. Fuel Combustion

Fuel combustion from temporary mobile generators produces a carbon footprint as diesel is used as the fuel source. It is essential that SSEN effectively manages its fleet of mobile generators to ensure customers have power restored temporarily while our engineers work on repairing permanent faults that have caused the outage to occur. They are also used during planned outage situations when maintenance work occurs.

We do not have RIIO-ED1 targets for reducing fuel combustion, as it is essential that we continue to supply a service to our customers ensuring power can be restored as quickly as possible. However, we have managed to reduce the overall amount of fuel combusted due to advances in Network Switching capabilities allowing customers to be back-fed from other sources.

Figure 2.4f – Annual fuel combustion emissions



The above graph shows fuel combustion emissions over time. A 15% reduction target has been added to demonstrate that although we do not have any environmental objectives in this area, we are still managing to reduce our tCO_2e emissions. Those years with higher emissions show where more mobile generators were necessary during fault and planned outage situations.

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 2.4b below:

Figure 2.4b – Installed SF_6 capacity per Licensee

Licensee	Installed Capacity (kg)
SHEPD	5,654
SEPD	23,942
TOTAL	29,595

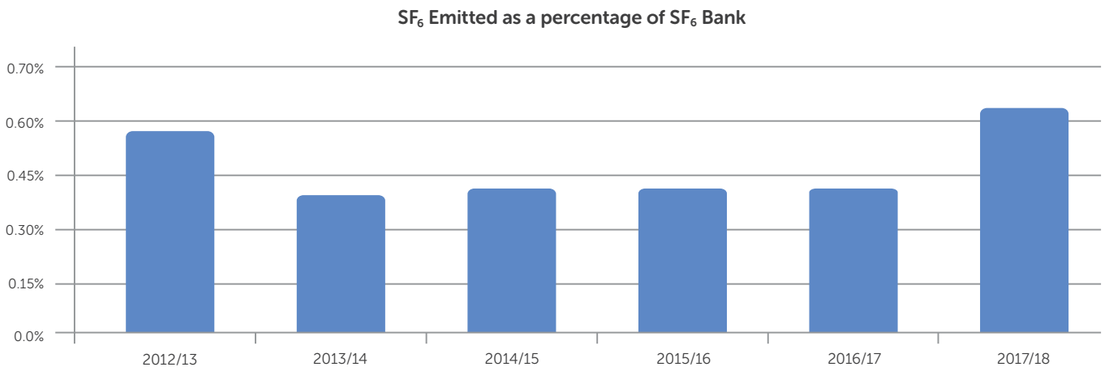
Emissions of SF_6 are calculated by combining the volume of SF_6 used in routine maintenance and the volume used during fault repair.

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.

Figure 2.4g – Actual loss of SF_6 to bank



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 SF_6 leakage location project: **http://www.smarternetworks.org/project/2013_13**

Figure 2.4h – Annual SF_6 emissions

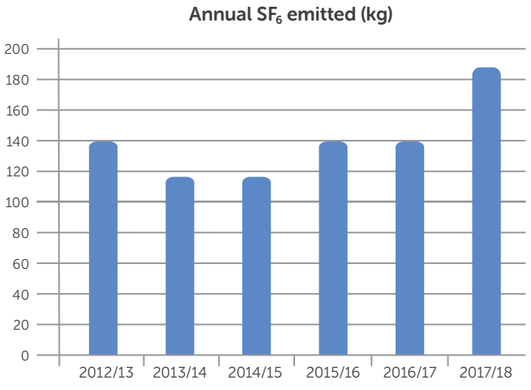


Figure 2.4g shows that our actual emissions of SF_6 as a percentage of total banked SF_6 (refers to the total amount of SF_6 stored in plant) was 0.57% in 2013. Our SF_6 emitted as a percentage of total SF_6 banked initially decreased and then gradually increased up to 2016/17. There has been a significant increase in SF_6 as a percentage of bank in 2017/18 due to an ageing population of assets. Ageing assets require more frequent SF_6 top ups as they tend to have higher leakage rates, thus causing SF_6 emissions to increase. Once these assets reach the end of their life they will be replaced by assets less prone to leakage or with assets that do not contain SF_6, which will reduce annual emissions.

As shown in figure 2.4h bottom left, our SF_6 emissions decreased between 2012/13 and 2013/14 and then gradually started to increase up to 2016/17. In 2017/18 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 dong 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. These 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). Electricity losses have a significant financial and environmental impact upon consumers. The annual cost of distribution network losses is approximately £1 billion per annum across GB (2015 estimate).

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 17/18 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 which in combination make losses notoriously difficult to measure accurately. For example, today's domestic metering does not record when energy is used in between each reading, this means it is not possible to completely align measurements of energy entering and leaving our network. However, current assessment of the losses on our network has been estimated as shown in table 2.4c. Figure 2.4j shows the percentage losses in the networks in relation to total electricity distributed.

Table 2.4c – Total losses in the network

Year 2017/18	Total Distribution Losses MWh	Equivalent tCO_2e
SHEPD	534,047	187,750
SEPD	1,634,9189	574,772

Figure 2.4j – Percentage of energy losses 2010–2017

From the graph above, there appears to be a significant reduction in SEPD losses. However, this is due to a change in the calculation methodology (now more accurate) as opposed to intervention methods.

2.4.3.4. Losses Strategy in Action

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

1 Energy Efficient Transformers

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

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 measures relate to installation of equipment that affects both SSEN and external stakeholders such as Independent Connection Providers (ICPs). We have undertaken a detailed process of engagement with these key stakeholders to make them aware of the change, and have implemented the policy changes necessary to make these changes effective from 1st April 2016.

3 Non-Technical Losses

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

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

1 Understanding Where to Intervene

- Building on our existing strategy by directly funding new pieces of analysis to better develop our understanding of losses and focus our actions.
- Improve preparation for the Smart Meter rollout by leveraging the learning and modelling techniques derived from our existing LCNF projects including SAVE and NTVV, mentioned in section 3.2.1.
- Initiating engagement with adjoining DNOs and upstream Transmission Operator/System Operator to ensure that networks operations are optimised across boundaries.

2 Understanding How to Intervene

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

3 Intervening Effectively

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

We will continue to progress these initiatives through the remainder of the RIIO – ED1 period.

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.

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

SEPD Programme/ Project Title	2017/18 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	0.02	51	24	61
LV Cable General Reinforcement	0.00	24	12	35
LV Cable Other	0.11	457	217	618
HV Cable Asset Replacement	0.00	17	8	21
HV Cable General Reinforcement	0.01	47	22	60
HV Cable Other	0.01	287	136	424
DUOS recovery SEPD – domestic Other	N/A	35,959	17,045	56,557
DUOS recovery SEPD – non domestic Other	N/A	20,767	9,844	38,035

Table 2.4e – 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	4	TBC
LV Cable General Reinforcement	km	1	TBC
LV Cable Other	km	20	TBC
HV Cable Asset Replacement	km	1	TBC
HV Cable General Reinforcement	km	3	TBC
HV Cable Other	km	2	TBC
DUOS recovery SEPD – domestic Other	#	4,703	TBC
DUOS recovery SEPD – non domestic Other	#	409	TBC

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

SHEPD Programme/ Project Title	2017/18 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	18	9	22
LV Cable General Reinforcement	0.00	3	2	5
LV Cable Other	0.17	364	172	485
HV Cable Asset Replacement	0.00	12	6	17
HV Cable General Reinforcement	0.00	9	4	12
HV Cable Other	0.05	238	113	351
DUOS recovery SHEPD – domestic Other	N/A	15,828	7,503	25,708
DUOS recovery SHEPD – non domestic Other	N/A	10,303	4,884	18,817

Table 2.4g –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	1.4	TBC
LV Cable General Reinforcement	km	0.0	TBC
LV Cable Other	km	17.6	TBC
HV Cable Asset Replacement	km	0.4	TBC
HV Cable General Reinforcement	km	0.4	TBC
HV Cable Other	km	2.0	TBC
DUOS recovery SHEPD – domestic Other	#	2,009	TBC
DUOS recovery SHEPD – non domestic Other	#	72	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 and 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.

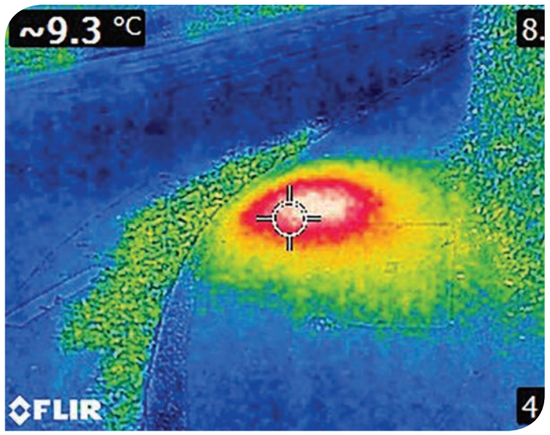
The success of the project has enabled further procurement of equipment to proceed within a BAU environment The enhanced information available will enable the implementation of other smart technologies, which in turn will support the growth of solar panels and Electric Vehicles at a much lower cost relative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

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

2.5.1.3. Reducing Noise and 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 vs 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 saving 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.

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.

Why is this important to SSE?

SSE's vision is to be a leading provider of energy and related services in a low-carbon world. It develops, owns and operates a diverse and sustainable portfolio of energy assets. This portfolio will focus on networks and renewables, with complementary flexible thermal generation.

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: **http://sse.com/media/522476/SSE-plc-Sustainability-Report-2018.pdf**

2.5.5. Contaminated Land Clean Up

In 2017/18, there were three incidents of land contamination in the SEPD area costing £35,500 in remedial work. No reportable incidents of contaminated land clean up occurred in SHEPD.

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

14 reportable noise complaints were made in 2017/18 across both our SEPD and SHEPD networks leading to costs of £95,000 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 2017/18 over £508,000 was awarded from the fund to support 77 community projects. Various projects were funded 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.

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): 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 carbon and consumer benefits. SSEN have a number of key innovation projects which are helping to inform this change, including our latest Network Innovation Competition project – TRANSITION. 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: Uptake of EVs is steadily rising as technological improvements to batteries improve vehicle range and prices become more attractive to consumers. SEN 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.

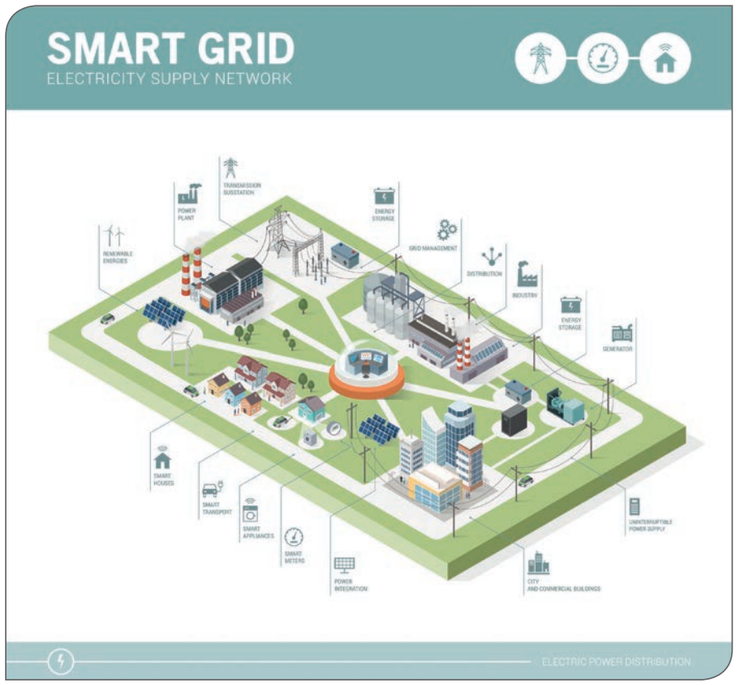
Flexible Connections: Demand to connect small scale renewable generation quickly and on constrained networks is increasing. To meet this demand SSEN has:

- 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/AlternativeGenerationConnections/**

- 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: 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: SSEN is 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 are being rolled out into BaU include LiDAR that assists with our vegetation management programme 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 this year compared with last year for both our networks. On our Southern Network this is mainly due to an increase in distributed generation (DG) and fast charging EVs. In our Scottish Network the increase is mainly attributed to an increase in photovoltaics (PV). Total amount of DG added to both our SEPD and SHEPD networks in 2017/18 was 5042 units at a total size of 308.4 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	2017/18 Update
Connections	Active network management – generator constraint management	Implemented into BaU
	Active network management – community demand management	Project closed and successful learnings obtained
	Demand-side management – thermal energy storage	In progress of being implemented into BaU in CMZ
	Dynamic circuit thermal rating	Fast following
	Fault current limiters	Fast following
	Local smart EV charging infrastructure	Progressing as a live NIA project
	LV solid-state voltage regulator and power conditioning	This project has been suspended
	Static synchronous compensators (STATCOMs)	Implemented into BaU
Customer Service	Advanced distribution automation – network reconfiguration	In process of being implemented into BaU and trialled as NIA project
	Weather impact and response modelling tools	Implemented into BaU
Environment	Bidirectional hybrid generation plant	Implemented into BaU on a small-scale powering SSEN mobile offices
	Wood pole alternative	Progressing as a live NIA project
Reliability	Automated demand response with commercial customers	In progress of being implemented into BaU in CMZ
	Energy efficiency approaches	Progressing in SAVE NIC project and in CMZ
	LV network modelling	NIA Project and NTVV project has now completed, and results used to inform other projects.
	LV network monitoring	Implemented in LV automation and losses activity and progressing as into BaU.
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 2018 Annual NIA Summary Report located here: **https://www.ssen.co.uk/InnovationLibrary/Distribution/**

3.2.1. Large-Scale Innovation Projects

During 2017/18, SSEN had four 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 focusses on reducing transformer losses on primary substations. The key principal of the approach to be trialled is to switch off one of a number of transformers in a primary substation at times of low load, to avoid the fixed iron losses associated with that transformer. A second method, Alternative Network Topology, will be deployed where appropriate to further reduce losses and maintain network supply integrity.

Expected outcomes
LEAN builds on learning captured from SSEN previous LCNF Tier 1 and IFI projects and seeks to demonstrate new methods that can be applied to existing assets to reduce losses in the shorter term. Approximately 6% of electricity generated is lost each year in the GB distribution network, incurring costs in the region of £1bn to customers.

Funding Stream
LCNF Tier 2
£3.1m project

Start/end date
2014 – 2019

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

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

Expected outcomes
To gain insight into the drivers of energy efficient behaviour for specific types of customers; identify the most effective channels to engage with different types of customers; gauge the effectiveness of different measures in eliciting energy efficient behaviour with customers; and determine the merits of DNOs interacting with customers on energy efficiency measures as opposed to suppliers or other parties.

SAVE's LED lighting trials have tested a DNO led approach to installing bulbs, whereby the network operator installs bulbs within customers' premises, removing inefficient bulbs in areas used at peak time. The project achieved a 76% response rate across a trial population of 1000 homes. This cumulated in an average reduction in peak demand of 5-7% (not statistically significant). Whilst data informed and price based trial elicit a mixture of results the project is highlighting minimal impact of e-mail based campaigns, whilst letter based campaigns have seen up to 6% reduction in peak demand (not statistically significant). The next trial period will look to test a DNO banded tariff as a form of dynamic pricing never tested before in the UK.

This project will establish a tool to identify the energy efficiency measures which are most cost effective in terms of managing a particular network constraint.

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

Start/end date
2014 – 2019

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:

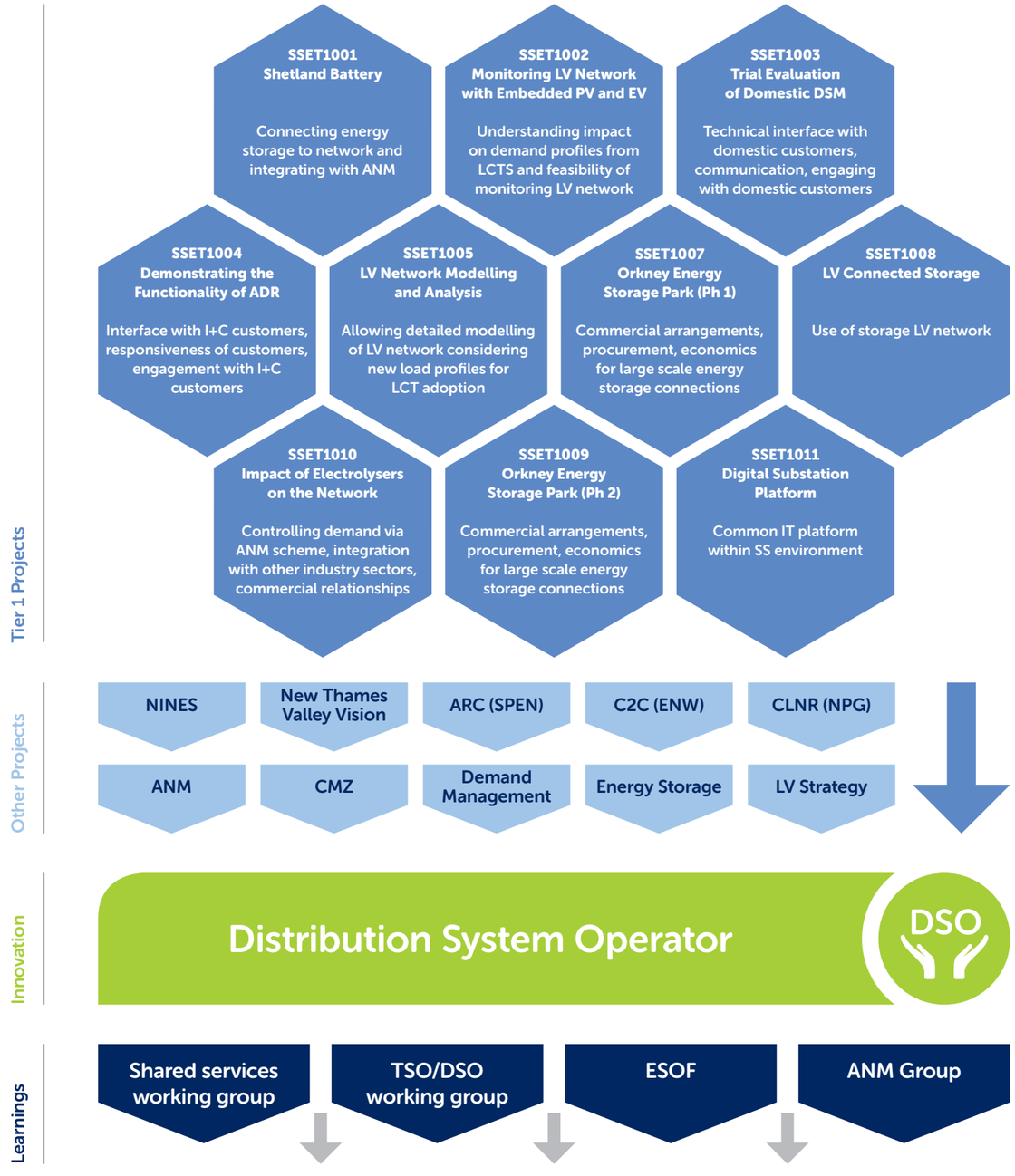
1. Develop improved **Transmission-Distribution processes** around connections, planning, shared TSO/DSO services and operation.
2. Assess the gaps between the **experience our customers** currently receive and what they would like, and identify any further changes to close the gaps within the context of a 'level playing field' and common T & D approach.
3. Develop a more detailed view of the required transition from **DNO to DSO** including the impacts on existing organisation capability.
4. 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/

Funding Stream
The Open Networks project is being funded by the participating licensees out with any of the various Ofgem Innovation funding mechanisms.

Start/End Date
January 2017 – 2030

Figure 3.2b – Illustration of SSEN projects and how their learnings are utilised for DSO development



3.2.1.4. Smart EV

Key activities
At present, there is no standardised method of controlling 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 Esprit-type 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 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. They carried out two consultations with cross-industry participants on potential solutions in the short and longer-term, as well as with customer steering groups, and is due to produce a specification which will aim to inform a standard that can be used by industry. In addition, the project has started the process of requesting a modification to the Smart Energy Code to investigate using smart metering infrastructure as a solution.

Expected outcomes
The project is looking to create an industry accepted standard for managing EV charging on distribution networks, as well as a customer messaging strategy and recommendations for its implementation to support the managed EV charging concept.

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 are actively progressing 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.

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 are 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 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

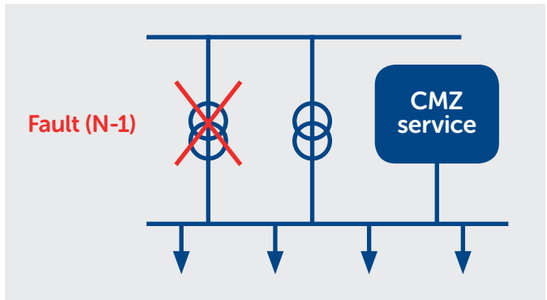
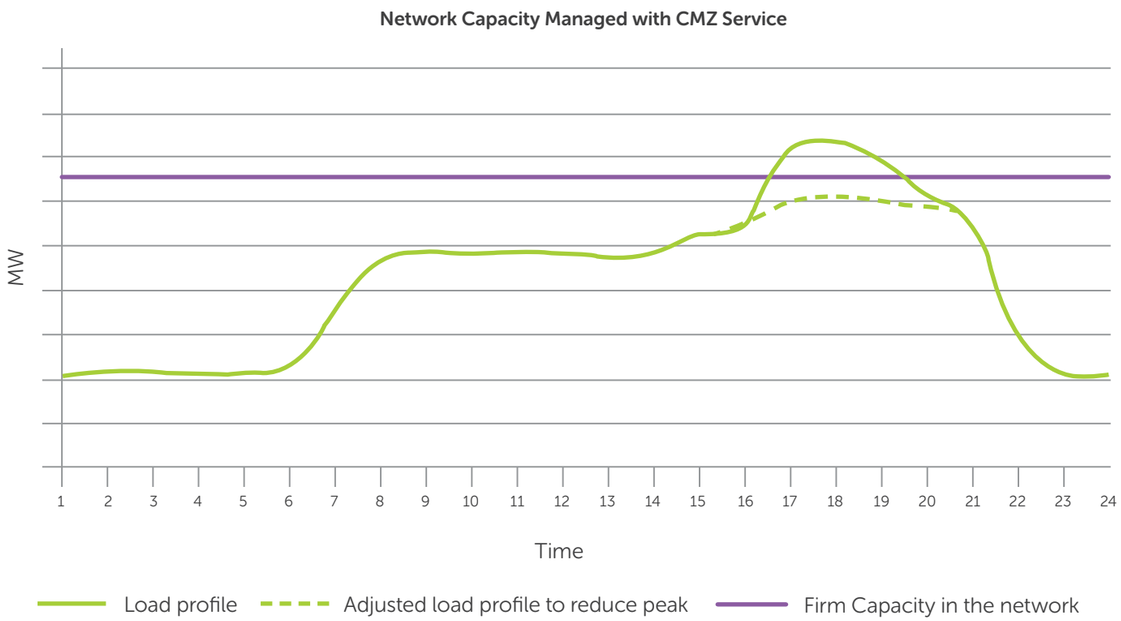


Figure 3.3b – Peak-lopping services re-shaping the load curve at the appropriate times



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.

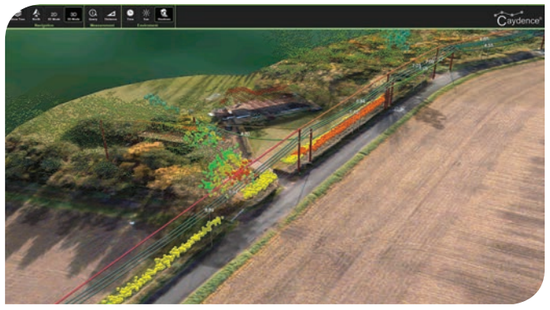
3.3.2. Light Detecting Aerial Radar (LiDAR)

SSEN has invested in state of the art LiDAR technology, which has now mapped all our overhead assets in both our Hydro and Southern network regions. This provides key information in relation to vegetated spans and the heights of our overhead lines from ground and structures. From a tree cutting perspective, the data allows us to ensure we operate and maintain our network more efficiently, by targeting tree cutting at spans closest to our overhead lines. We have adjusted our tree cutting operational processes accordingly and intend to perform repeat LiDAR surveys of our networks to maximise benefits from this technology.

To maximise the benefits from the LiDAR survey data we have made significant changes to our Overhead Line Inspection, Maintenance and our Tree cutting Policies and Procedures, including:

- **Overhead line inspection:** The changes allow us to maximise the efficiency of our inspection operations by moving a percentage of our assets from a four to an eight-year frequency.
- **Maintenance:** The updated maintenance requirements ensure that any defect identified from either ground patrols or aerial surveys are validated and rectified based on risk priority basis.
- **Tree cutting:** LiDAR data provides vegetation intrusion information per span that is far more accurate and quicker to obtain vs ground patrol tree surveying that was previously utilised. This allows us to move to a much more focussed dynamic tree cutting programme. We anticipate that this approach will increase our cutting efficiency and reduce the risk of non-compliance.

Figure 3.3c – Example of LiDAR imagery courtesy of NM Group



3.3.3. 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 be required 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.

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.

Below are the flexible connection offers that we provide along with a brief description.

Timed connections
Our Southern network tends to have predictable load and generation patterns which enable us to determine when limitations in capacity may occur. We are therefore able to offer connections that are given an operating schedule with defined times and levels of capacity available to the customer.

On our Scottish Hydro network, we allow generators to connect without the requirement to wait for transmission reinforcement works to be carried out, where they are under 50kVa in size.

Intertrip
Some of our networks are constrained due to a single upstream asset requiring reinforcement, or a single limit being infringed under certain conditions. Through monitoring these conditions, further capacity can be released when these limits or assets are within normal operating parameters. In these circumstances, we may allow customers to connect on the basis that when the limit being monitored is breached, the customer's connection will be constrained off.

This alternative connection is suitable for all capacities and voltage levels, although there will be a maximum number of participants per area.

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.

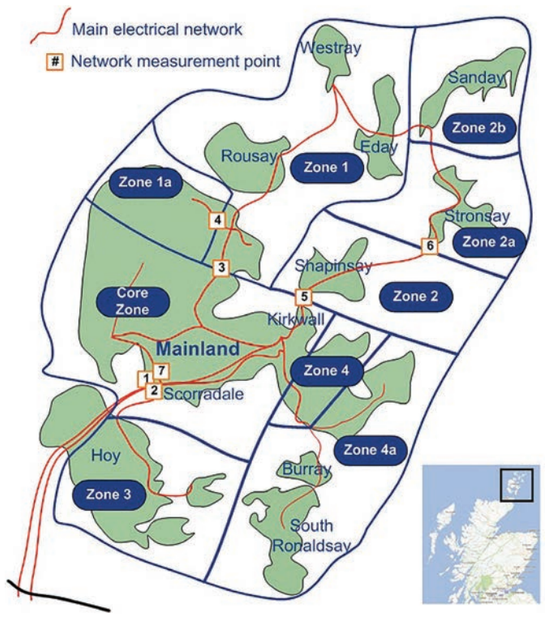
Orkney ANM System – operational but closed for further applications

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.



Single Generator Active Network Management (SGANM)
SGANM is a way of getting ANM functionality for a single generator connection. There are limitations to this option and we are currently only able to provide one such connection in any specific area.

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

Constraint Managed Zones (CMZ)
A CMZ is a geographic region served by an existing network where requirements related to network security are met using load variation techniques, such as Demand Side Response, Energy Storage and stand-by generators. These techniques are CMZ Services provided to us by a CMZ Supplier.

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. Where approved by us, we would also require additional measures to be put in place to monitor power quality and ensure that the network operates within the required limits.

Application process
We are considering reducing the time for quotes to be completed by 50% plus one day, this would mean as soon as we know there is reinforcement required on the network we would contact the customer and ask if they would like a Flexible connection, if they do then we would start the application process and get them to apply.

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 by April 2018 – Currently held meetings with Perth & Kinross Council regarding Energy Storage and the possibility of using a flexible connection in over 80 schools.

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.

3.3.4. Summary of SSEN Innovations that are now BaU

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. 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; 222,702 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) fines 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 £4.3m gross avoided costs and over 186,462 Customer Interruptions and 23,777,242 Customer Minutes Lost prevented.

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 large quantities of CO_2. There is also a risk that the generator will trip causing a loss of power to potentially thousands of people. The live line harvester therefore offers significant improvement in safety and efficiency, while also reducing the environmental impact of tree cutting.

Benefits
There has been an estimated £2.7m gross avoided costs and 47,750 Customer Interruptions and 8,949,698 Customer Minutes Lost prevented.

This project has led to 1,774 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 £107k gross avoided costs and 2,274 Customer Interruptions and 520,260 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 £164k 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.

3.3.5 Smart Meters

Throughout 2017/2018 Scottish and Southern Electricity Networks have been working towards completing the development and implementation of its Information Technology (IT) and communications infrastructure in preparation for the roll-out of smart meters. Due to the level of complexity associated with the governance, security and IT requirements for connection to the Data Communication Company (DCC)'s systems, SSEN created an internal programme to develop the necessary business processes and build new IT infrastructure to enable connection to the DCC and comply with the relevant code.

In our RIIO-ED1 business plan in March 2014 we identified that we would go live and connect to the DCC's systems in September 2015. There have been a number of changes to the GB Smart Meter Implementation Programme (SMIP) which have had a knock-on impact for delivery of a number of functionalities. The SSEN smart meter programme implemented its new IT systems and became a live DCC user on the 8th December 2017. It is anticipated that around 3.5 million smart meters will be connected to our networks and whilst is it expected that DNOs will have the means to communicate and gather information from the majority of smart meters we also believe that there will be a sizeable proportion of smart meters that we will not be able to communicate with or receive alerts from. Further information is provided in the following sections.

Meter Types and Volumes of Meters Installed
Specifications for two versions of smart meters have been developed by the SMIP; these are defined as SMETS1 and SMETS2 meters.

- SMETS1 meters provide a significant amount of smart functionality but currently they are not able to connect to the DCC's central communications and data infrastructure. Whilst there are plans to connect these meters to the DCC during 2019, 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.

- 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 2017/2018 is provided in Table 3.3d.

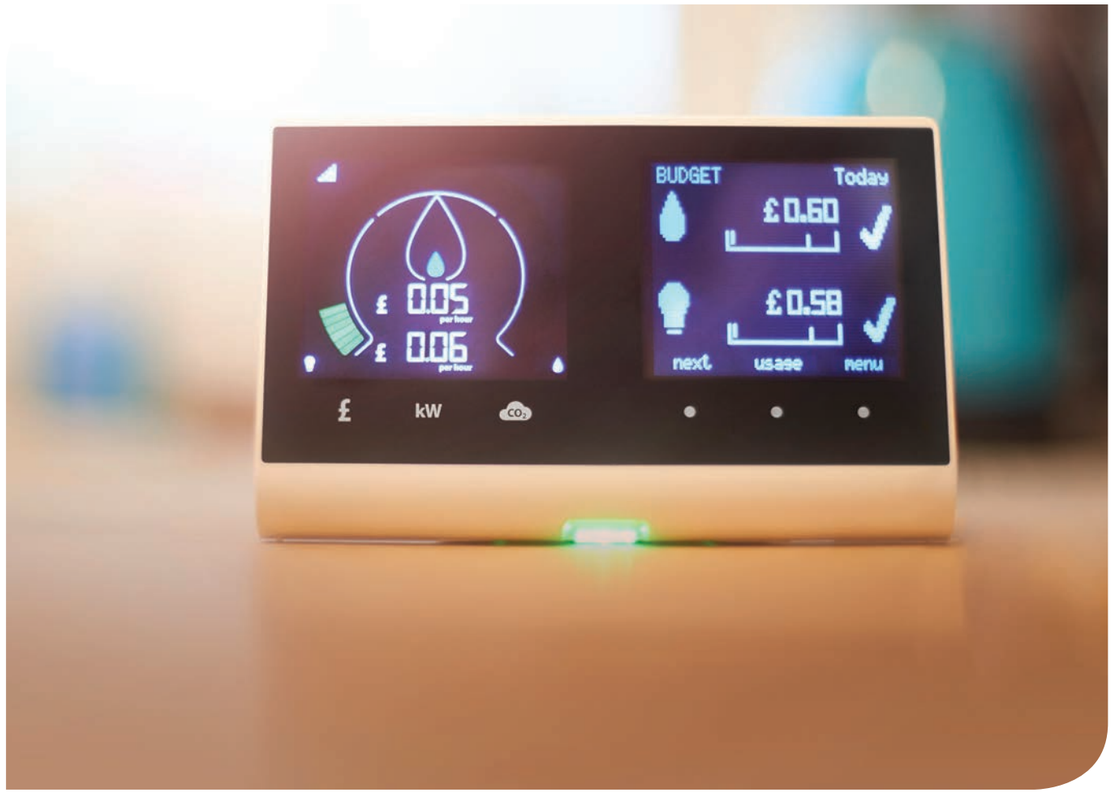


Table 3.3d – Volume of smart meters installed during 2017/18

Licence Area	SMETS[1]			SMETS[2]		
	Installed in 2017/ 2018	Total Installed	% Penetration (year end)	Installed in 2017/18	Total Installed	% Penetration (year end)
SHEPD	52,223	104,113	14.17%	3	3	0
SEPD	252,808	540,517	18.32%	7	7	0

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 2017/2018 are detailed in worksheet E5, they are also summarised in Table 3.3e.

Table 3.3e – IT expenditure for Smart Meters during 2017/2018

Licence Area	SM IT Costs (£k)	SM Communication Licence (DCC) Costs (£k)	Elective Communication (DCC) Costs (£k)
SHEPD	514	502	0
SEPD	2,056	1,817	0

Delivering Value from Smart Metering Data

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

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

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

In the design of our systems we considered the need to have access to data that will enable us to use the information to provide benefit to both customers and the wider Scottish and Southern Electricity Networks business. In the development of our smart metering business processes and systems consideration has been made to ensure that maximum benefit can be delivered from how we use data from smart meters. Our efforts throughout 2017/2018 are detailed in Table 3.3f.

Table 3.3f – Progress on delivery of benefits from Smart Metering throughout 2017/2018

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. • Work on our Data Privacy Plan in preparation to submit to Ofgem for approval to enable access to consumption data. • Work on data storage and analytics 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 to 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 operational costs to fix faults	• Implemented our NDAG application to ensure that: o We can check the energisation status of individual customers via their smart meter. o 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: o Enable the initiation of supply energisation status checks from relevant locations. o 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. • Implemented integration of SIMS into our NDAG application to 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.

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. • Work on our Data Privacy Plan in preparation to submit to Ofgem for approval to enable access to consumption data. • Work on data storage and analytics 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: o Receive voltage related alerts from smart meters. o 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 2018/2019

Details of the actions we propose to take during 2018/2019 in relation to each of the benefit categories identified are detailed in Table 3.3g.

Table 3.3g– Smart meter actions proposed for 2018/19

Category of Benefit	Work to be Undertaken during 2018/2019
Avoided losses to network operators	• Successfully communicate with installed smart meters. • Submit and gain approval of our Data Privacy Plan by Ofgem to access consumptions data. • Implement our data storage and analytics capability to maximise the use of mart meter data for benefits realisation.
Reduction in CML	• Successfully communicate with installed smart meters. • Pass power outage alerts and power restore alerts to our Customer Service Centres and Operations teams through 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 alerts through the early life study.
Reduction in operational costs to fix faults	• Successfully communicate with installed smart meters • Our Customer Service teams will embed the use of smart information into fault management to ensure that: o We can check the energisation status of individual customers via their smart meter. o 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 alerts through the early life study.
Reduction in calls to faults and emergencies lines	• Successfully communicate with installed smart meters • Our Customer Service 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 alerts through the early life study.
Better informed investment decisions for electricity network enforcement	• Successfully communicate with installed smart meters • Submit and gain approval of our Data Privacy Plan by Ofgem to access consumptions data. • Implement our data storage and analytics capability to maximise the use of mart meter 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 Service Centres through SIMS. • Trial the use of 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 have identified we will continue to:

- Develop and submit our smart meter data privacy plan to Ofgem.
- Continue collaboration with the DCC on the power outage alert studies.
- Continue progress of our detailed plan on benefits realisation and gain early learning from the data we start to receive from smart meters.
- 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 second year of RIIO-ED1 provides a clear message to our stakeholders that we are committed to deliver the benefits set out in our business plan. We have made further progress in the last year and will continue to look to the future and pursue not only those solutions that provide a short-term return but those which will deliver enduring benefits.

5. Contact Us

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

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6. Appendix

Additional Data	Location
Environment Report 2017 Environmental Report 2017 E1-E8 Tables Environment Report 2017 E4-E6 CBAs Environment Report 2017 E1-E8 Commentary	www.ssen.co.uk/DistributionPriceControlReview

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.

LiDAR
This is an acronym for Light Detecting Aerial Radar. This technology maps network assets and clearance distances to a high level of accuracy.

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.

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