Environmental Report 2019/20

Scottish & Southern Electricity Networks

Contents

1. Introduction

1.1. Executive Summary

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

Business Carbon Footprint
Through our business activities we have managed to reduce our total business carbon footprint for 2019/20 to 49,403 tonnes of CO_2 excluding network losses. This is a reduction of just over 24% of the 2012/13 baseline figure which outperforms our RIIO-ED1 Business Carbon Footprint (BCF) reduction target of 15%. This improvement is mainly due to the result of reductions in emissions from building energy use and operational transport. In addition to this we have reduced our SF_6 leakage in 2019/20 compared to 2018/19 levels. This is not yet meeting our original RIIO-ED1 target of a 15% reduction compared to 2012/13 baseline, but we have implemented a new strategy to reduce our emissions in this area.

Oil Leakage from Fluid Filled Cables
Oil leakage from fluid filled cables is known to cause negative environmental impacts. As a result, we made a commitment to replace 21km of fluid-filled cable in our SHEPD network and 55km in our SEPD network over the RIIO-ED1 period. In 2019/20 we removed a total of 6.86km of fluid filled cable across both our networks. This equates to a total of 10.9km of fluid filled cables removed in RIIO-ED1 to date in SHEPD and 23.9km in SEPD. We have achieved almost half our RIIO-ED1 target to date and will continue with our strategy of cable tagging and replacement throughout the rest of the price control period.

Visual Amenity
Overhead lines, especially those at higher voltage running through areas of outstanding natural beauty (AONB) are considered unsightly by many. We targeted our funding for AONB and National Parks on our High Voltage network and have so far dismantled a total 15.44km of overhead line over RIIO-ED1, with an additional 50.76km of undergrounding projects planned by the end of the price control period. We committed to underground up to 90km of overhead line in designated areas in response to stakeholder interest and engagement. The details of the projects we have planned, and their completion dates are in section 2.2 below.

Losses
With respect to losses, we have achieved a saving of circa 10 GWh since the start of RIIO-ED1 by delivering interventions identified in our losses strategy. This includes implementing the following measures:

- Installing energy efficient transformers that deliver enhanced losses performance, including replacing inefficient pre-1960 transformers.
- Adjusting the minimum sizing of cables and transformers to reduce losses.
- Upgrading network voltages in specific areas of our network to reduce losses.
- Switching off underutilised plant during periods of low loading.
- Initiatives to reduce non-technical losses.

Innovation
Our innovation strategy has delivered over £40m of benefits to date in RIIO-ED1, whilst avoiding over 330,000 tonnes of carbon emissions. Our RIIO-ED1 innovation focus areas include an emphasis on environment, reliability and facilitating connections to our networks, which will be essential in achieving our net zero ambitions. We currently have 16 innovation projects targeting these areas, as well as having technologies such as our flexible solutions, LV substation monitors and forestry mulchers that have been delivered to BAU.

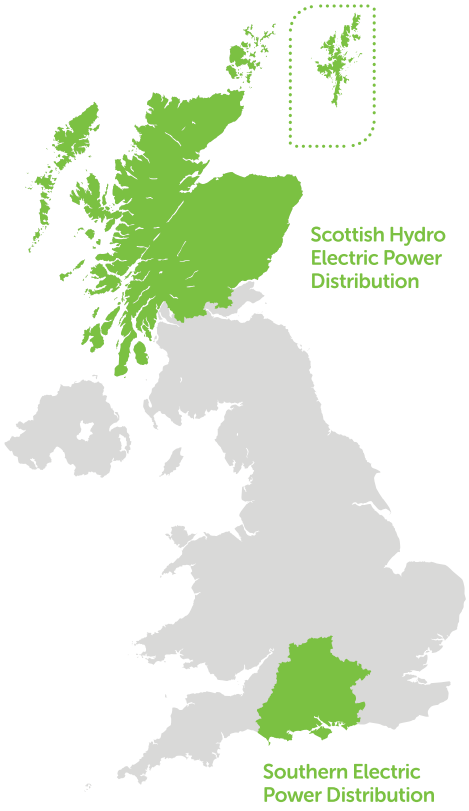
Distribution System Operator
SSEN, in keeping with other DNOs, is transitioning towards a Distribution System Operator (DSO) model. This transformation is one of the biggest challenges currently facing the industry. Our two flagship DSO projects TRANSITION and LEO are already providing insights into the scope of this transition, whilst our newly launched NIA projects TraDER and MERLIN will support industry findings. This transition along with the development of new technologies and smart meter implementation will allow for greater network flexibility to pave the way towards a smarter network.

1.2. Our Business/Who We Are

Our business explained

We are Scottish and Southern Electricity Networks (SSEN), responsible for developing, 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 story in numbers (approximate)



Over 3.8m
customers served by our networks

3.1m in southern England

780,000 in the north of Scotland

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

740,000
Over 740,000 vulnerable households identified through our Priority Services Register

£3.4m
Over £3.4m contributed to local community projects through our Resilient Communities Fund

127,000km
Over 127,000km of overhead lines and underground cables

100+
Over 100 subsea cables, powering island communities

700,000
Over 700,000 calls received from our customers last year

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

75
75 operational premises located in the heart of the communities we serve

110,000
Over 110,000 substations

Our Networks business consists of two electricity distribution businesses, Scottish Hydro Electric Power Distribution plc (SHEPD) and Southern Electric Power Distribution plc (SEPD), and one electricity transmission business, Scottish Hydro Electric Transmission plc (SHE Transmission). This report relates only to the activities carried out by SHEPD and SEPD.

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

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

- Deliberate environmental planning during the design and construction phases of projects.
- Reducing the amount of overhead line in designated areas e.g. areas of outstanding natural beauty and special scientific interest. Reducing our business carbon footprint.
- Reducing the amount of oil leakage caused by our assets.
- Reduce SF_6 emissions from our assets.
- Reducing our business carbon footprint.
- Keeping distribution losses as low as reasonably practicable.
- Continuously innovating to reduce our environmental impact.

1.3. Purpose of the Report

The purpose of this Environmental Report is to provide stakeholders with a transparent and public account of our commitment to addressing environmental matters in RIIO-ED1. This includes, but is not limited to, our role in the low carbon transition. It is intended to provide a holistic overview and clear rationale for our actions and details of actual benefits to customers. It provides an important update on our continuing progress to meet our environmental targets and demonstrates how stakeholders shape this going forward e.g. in areas such as investment in visual amenity projects.

Our RIIO-ED1 environmental commitments are summarised below:

Visual Amenity

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

Fluid Filled Cables

- Replace 76km of fluid filled cable and tag our worst performing circuits.
- Reduce oil leakage by 15% relative to 2012/13 levels..

Business Carbon Footprint

- Reduce our business carbon footprint (excluding losses) by 15% relative to 2013/13 levels.
- Reduce the average mileage of SSEN cars by 10%.
- Reduce rate of leakage of installed SF_6 by 15% relative to 2012/13 levels.

Electrical Losses

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

Security of Supply

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

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

- **Promote our core value of sustainability:** We aim to achieve our sustainability targets that are set across the entire SSE umbrella company. More information can be found in our annual sustainability report: **https://www.sse.com/media/eh0dqrrw/sse-sustainability-report-2020.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 and National Scenic Areas (NSA). The removal of overhead lines returns the locations to a more natural state and is led 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 assets.

Business Carbon Footprint: SSEN operates over a wide geographical area and employs thousands of people. We are committed to reducing our carbon footprint by reducing emissions associated with vehicles, reducing energy usage in our buildings and keeping electrical losses as low as reasonably practicable. We are also committed to minimising the amount of SF_6 that leaks from our assets.

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

2.2. Visual Amenity

At the start of RIIO-ED1 we committed to undergrounding up to 90km of overhead line (OHL) in designated scenic areas in Great Britain across both our distribution networks. To date we have completed 10.92km in SEPD and 4.52km in SHEPD. In addition to this we have a further 50.76km OHL undergrounding projects in progress which are scheduled to be completed by the end of RIIO-ED1.

Work is initiated by interest from our stakeholders and we actively seek their input. We recognise that our overhead lines can have an adverse impact on visual amenity especially in sensitive environments such as AONB, National Parks and NSA. Some people can find overhead lines unsightly and consider the attractiveness of the landscape reduced by their presence. This might impact on individual wellbeing and local economies if, for example, the primary local industry is tourism. The communities we serve are key stakeholders for our business and therefore, this is an important issue for us.

Both SHEPD and SEPD were provided specific funding by Ofgem for undergrounding of overhead lines in protected landscapes in RIIO-ED1. The work carried out in this area is driven by stakeholder requests, using a nomination scheme. 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 integral to the scheme selection process. This is achieved by using a Visual Amenity Impact scoring model, developed in agreement with the AONB and National Park officials within our Licence Areas. Schemes are nominated by these stakeholders, and then considered and prioritised to ensure consistency in assessment across all SEPD and SHEPD licence areas and delivery of maximum value for money.

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

Since April 2015 to date we have spent £2.7m (in 2012/13 prices) in locations chosen by our Stakeholders and improved our visual amenity by reducing the amount of overhead line in these designated areas by 15.44km.

Details of the schemes are provided in the Tables overleaf:

Table 2.2a – Undergrounding schemes completed in Designated SEPD areas up to end 2019/20

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	3.53	2016/17
Turville Village	Chilterns AONB	2.5	2016/17
Bignor Park	South Downs National Park	0.82	2019/20
Itchen Abbs	South Downs National Park	0.2	2019/20

Table 2.2b – SEPD Undergrounding schemes in progress

Scheme	Designated Area	OHL km Planned	Progress	Planned Completion Date
PS002791 – Monkton Chilgrove	South Downs National Pack	1.01	Execution	20/21
PS001397 – Plush	Dorset AONB	0.15	Execution	20/21
PS003427 – Winterbourne Near Newbury	North Wessex Downs AONB	1.6	Execution	20/21
PS003064 – Rivar Hill, Shalbourne	North Wessex Downs AONB	0.36	Execution	20/21
PS003301 – Vineyard Hole	South Downs National Park	1.4	Execution	20/21
PS004269 – Church Road	South Downs National Park	0.92	Refinement	20/21
PS002754 – Sherborne	Cotswolds AONB	1.31	Refinement	21/22
PS003052 – South Burley	New Forest National Park	6.60	Refinement	21/22
PS003743 – Franklin Farm	South Downs National Park	0.87	Refinement	21/22
PS004207 – Worth Matravers	Dorset AONB	0.16	Refinement	21/22
PS004373 – Clayhanger	Dorset AONB	1.90	Refinement	21/22
PS004474 – North Cerney	Cotswold AONB	0.33	Refinement	21/22
PS004473 – Kingwood Common	Chilterns AONB	0.87	Refinement	21/22

PS002787 – Godlingston Hill	Dorset AONB	3.68	Refinement	22/23
PS004454 – Valley of Stones Nature Reserve	Dorset AONB	3.30	Refinement	22/23
PS004391 – Cheselbourne Village	Dorset AONB	1.81	Refinement	22/23

Table 2.2c – SHEPD Undergrounding Schemes completed up to 2019/20

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

Table 2.2d – SHEPD Undergrounding Schemes in progress

Scheme	Designated Area	OHL km Planned	Progress	Completion Date
PH003008 – Glen Muick	Cairngorms National Park	0.9	Refinement	20/21
PH003041 – Hoy	Hoy, Orkney	5.73	Refinement	20/21
PH002337 – Strathyre	Loch Lomond and the Trossachs	2.4	Execution	20/21
PH002018 – Glen Tromie	Glen Tromie	7.96	Execution	20/21
Kingussie – PH002259	Cairngorms National Park	7.00	Refinement	21/22
PH003091 – Auchtertyre House, Crianlarich	Loch Lomond and the Trossachs	0.5	Refinement	21/22

As presented in Tables 2.2a and 2.2c, we have completed 11 visual amenity schemes in our SEPD and SHEPD license areas to date, which totals 15.44km of overhead lines removed.

As presented in Tables 2.2b and 2.2d, there are 22 visual amenity schemes in progress in our SEPD and SHEPD license areas which are scheduled for completion by the end of RIIO-ED1. Once these 22 schemes are complete, we will have undergrounded a further 50.76km of OHL, bringing the forecast total to 66.2km by the end of RIIO-ED1. We will continue to engage with our stakeholders to ensure that ongoing and forthcoming projects achieve the best outcomes for landscape, biodiversity and communities.

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.

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

To mitigate the environmental impact and any associated supply disruption, we employ a pro-active leak location process, known as tagging. This process allows the circuit to remain in service while the leak is being located by dosing the cable system with a fault detection fluid. This method of detection is capable of detecting more than one leak on the circuit at each operation. Once identified, repairs and any necessary remedial works will be carried out using a risk based approach. This process is built in to the routine maintenance process of our FFC assets.

In addition to our pro-active 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 achieve a 15% reduction in oil leakage from FFC relative to 2012/13 levels, and to replace 21 kilometres of fluid-filled cable in SHEPD and 55km in SEPD, totalling 76km across both our networks. We also committed to tag our 25 worst performing circuits on an annual basis.

In 2019/20 for both SHEPD & SEPD, there has been a decrease in the volume of oil used to top up FFC (81% & 17% respectively compared to the previous year). During 2019/20 SSEN implemented a new strategy for FFC to minimise leakage and achieve our RIIO-ED1 commitments. This has involved a number of internal changes, including: establishing a working group to address FFC leakage; updating and consolidating procedures and policies related to FFC; introducing a more pro-active approach using analytics to better target FFC leakage prevention.

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

2.3.2. SSEN Fluid Filled Cable industry engagement

We continue 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 normal operations and ongoing innovative projects. We hold regular meetings with the Environment Agency and Scottish Environmental Protection Agency (SEPA) to review performance. We will continue this work for the remainder of ED1.

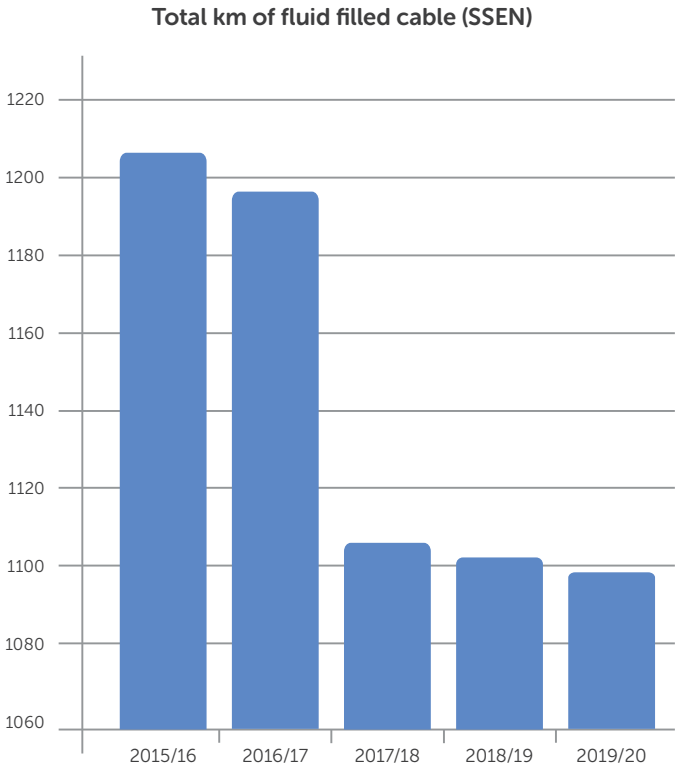
2.3.3. Oil Mitigation Schemes

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 worksheet requirement linked to this report in the Appendix.

Over the RIIO-ED1 period SEPD has spent £3.32 million on 87 oil mitigation schemes, while SHEPD has spent £15k on 6 schemes.

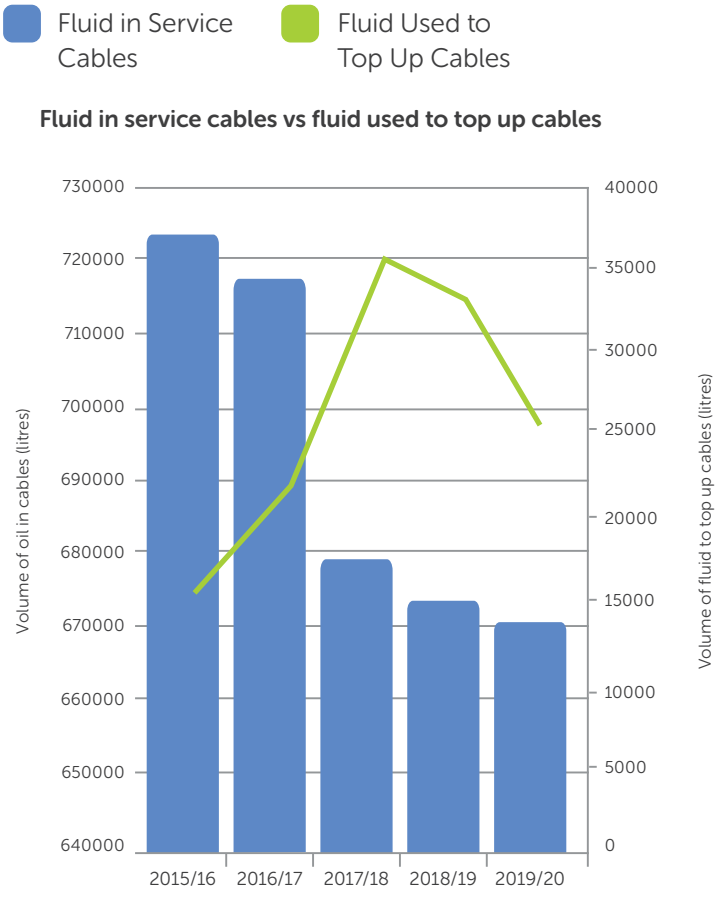
For further details on Oil Leakage, please see worksheet E2 – Environmental Reporting linked to the Appendix of this report

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



The significant drop in FFC between 2016/17 and 2017/18 was mainly due to data cleansing. The subsequent drop of 15km between 2017/18 and 2019/20 is due to removal of FFC.

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



The total amount of oil contained in FFC in service has dropped over RIIO-ED1. The fluid used to top up FFC is now on a consistent downward trend, as shown in figure 2.3b.

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 2019/20. 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 worksheet E3 attached as an appendix to this report.

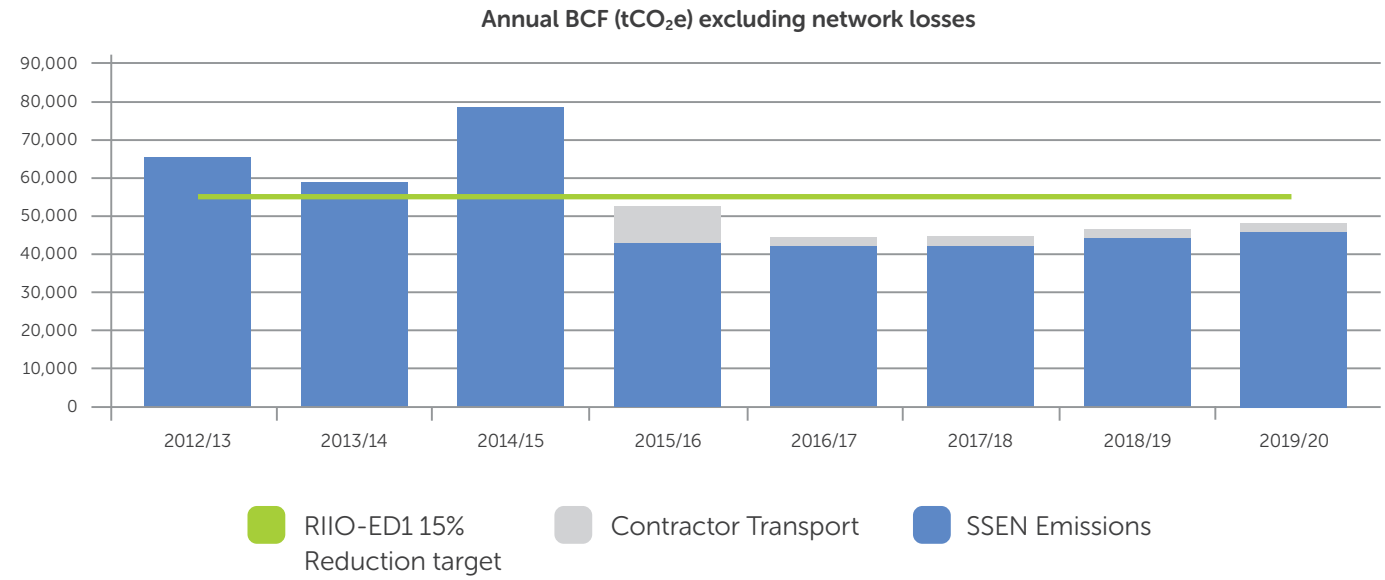
The BCF is an account of the impact that our operational activities have on the environment. We collate the data from across our business using the methodology described within international business carbon footprint standards, the Greenhouse Gas (GHG) reporting protocol and ISO14064-1. We convert our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

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

In 2019/20, the combined total greenhouse gas emissions for SEPD and SHEPD were 0.59 $MtCO_2e$ (including losses) for the two licence areas. Of our carbon emissions, by far the largest contributor is electrical losses. This accounts for circa 85% of SHEPD's and circa 94% of SEPD's carbon emissions. The other activities that contribute from an SSEN perspective to our environmental footprint are sulphur hexafluoride (SF_6) and the emissions resulting from our vehicle fleet and buildings' energy usage.

Our RIIO-ED1 commitment was to reduce our Business Carbon Footprint (excluding Losses) by 15% during the RIIO-ED1 period relative to 2012/13.

Figure 2.4a – Annual BCF tCO_2e excluding losses



As shown in Fig 2.4a above, our BCF (excluding losses) has decreased by 24% from 2012/13. For the RIIO-ED1 period, we have consistently been below target but have seen a slight increase from 2016/17 to 2019/20. In 2019/20, we are still sitting 11% below the RIIO-ED1 reduction target.

Figure 2.4b – Annual BCF including losses

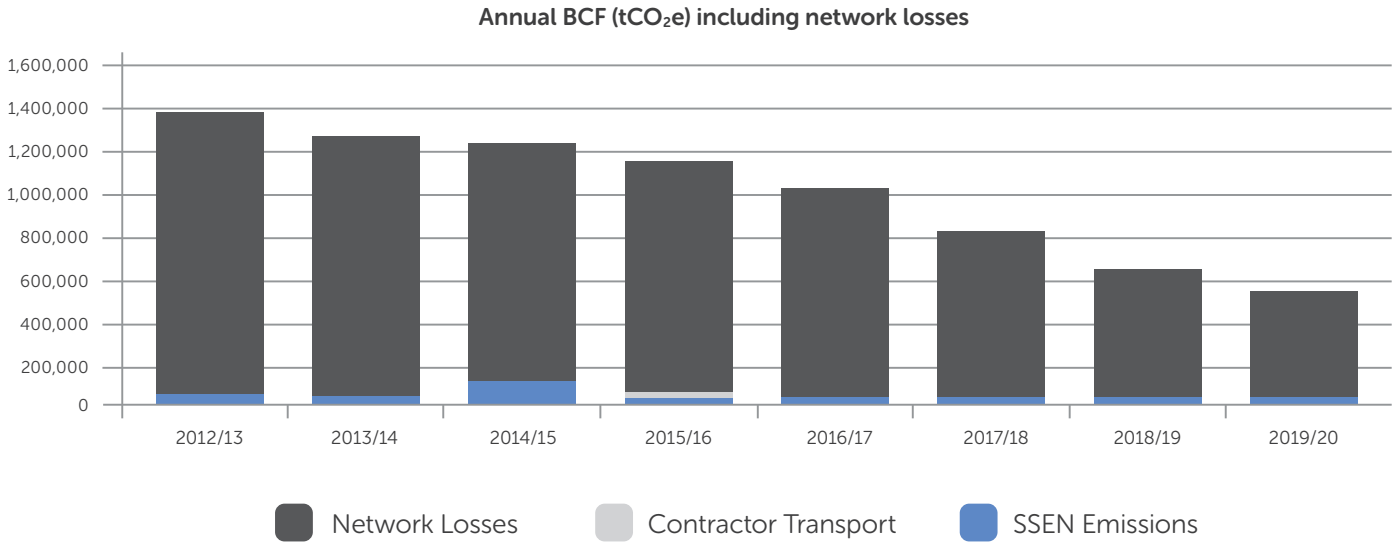


Fig 2.4b shows the contribution that our network losses makes to our overall BCF in relation to our operational emissions and contractor emissions.

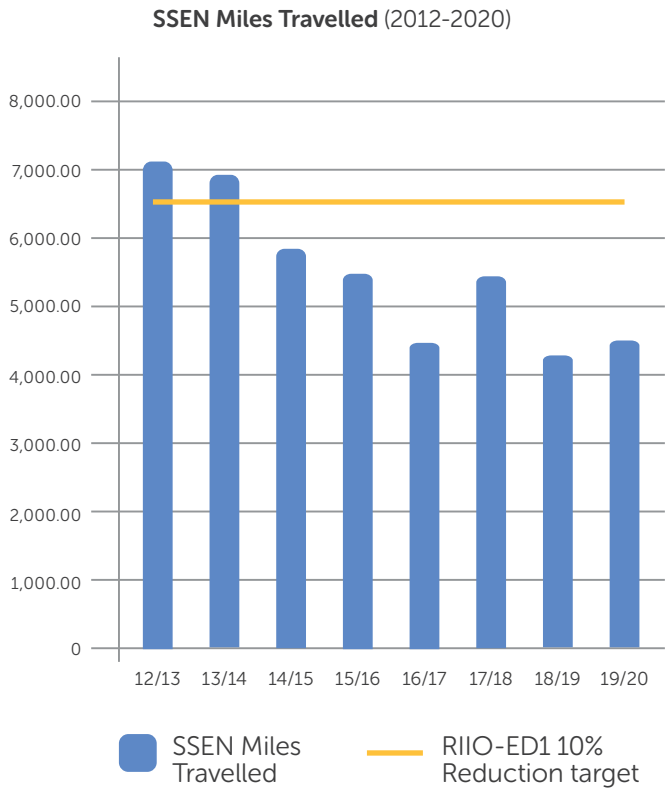
Losses tCO_2e has dropped significantly since 2016/17. This was due to a significant downward change in the factor used to derive carbon impact in this emission category. The conversion factor used was updated every year following the latest published figures by Department of Environment, Food & Rural Affairs (DEFRA). In addition to this, SSEN adopts a more pro-active measures to reduce losses e.g. increasing minimum cable size and reducing energy theft as detailed in section 2.4.3

2.4.1.2. Reducing the mileage of SSEN vehicles

One of the largest emissions is from our vehicle fleet for business transport. Our focus is therefore on reducing the average mileage from our business cars.

Our commitment is to reduce the average mileage of SSEN cars by 10% during the RIIO-ED1 period relative to 2012/13. Figure 2.4c shows our progress at meeting this target.[1]

Figure 2.4c
Annual vehicle mileage



As shown in Figure 2.4c above, our average annual vehicle mileage has varied since 2012/13, however it has remained significantly under our 10% reduction target since 2014/15. We have increased our usage of digital technologies such as Skype and Microsoft Team which has contributed to this decrease.

Figure 2.4d
Annual transport emissions

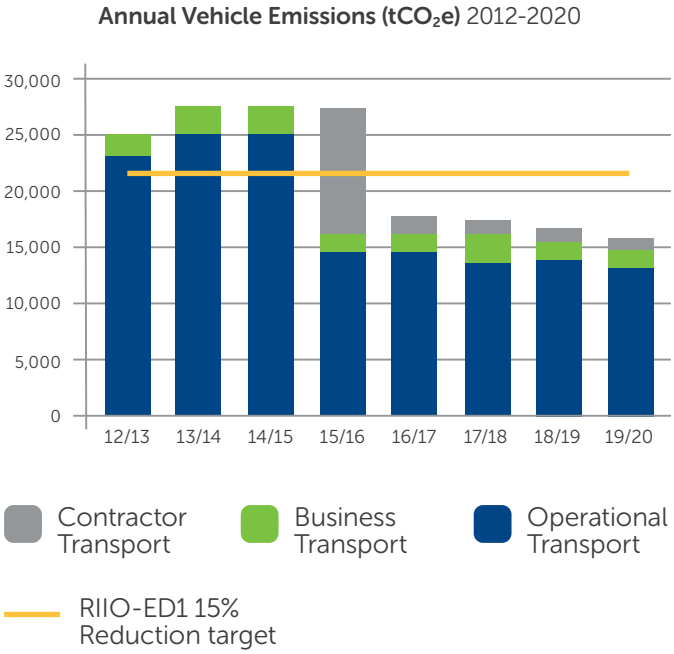


Figure 2.4d is a graph of emissions from business transport and operational transport, which shows that we're moving in the right direction in terms of reducing our CO_2 emissions from transport. Our commitment to reduce the average mileage of our business cars was intended to reduce our annual transport emissions. Both our average business car mileage and overall CO_2 emissions from transport in 2019/20 show a significant reduction relative to 2012/13. The reduction in our operational transport emission is due to an increase in use of diesel and hybrid power vehicles and the significant efficiencies that have been made by our contractors.

As shown in Fig 2.4d, our contractors' transport emission in 2019/20 shows a downward trend from 2015/16. This is because there has been a shift away from using 'external' contractors in 2016/17, with a number of the core areas being brought into the Networks business. This has led to an overall reduction in fuel consumption in this area, thus reducing CO_2e output. It should be noted here that contractor emissions were recorded as part of operational transport prior to 2015/16. After this point they were recorded separately as shown in the graph.

1. Previous reports have focussed on overall mileage instead of average mileage. Our business commitment was to reduce average mileage of SSEN cars through business travel. While the number of business cars has increased, along with overall business mileage, the average mileage per car has decreased.

2.4.1.3. Reducing energy consumption in our buildings by 15%

Over the last six years, the SSE Group's non-operational building carbon footprint has experienced a reduction in carbon emissions, in particular, a reduction of 12% in 2019/20 compared to the year before. It is important to note here that SSEN makes up one part of the wider SSE Group, which is comprised of a number of other energy services businesses. By sharing building space with other SSE businesses, we can keep costs down and reduce energy consumption. To date, investments in a range of energy efficiency projects have been successful in returning financial and carbon emissions savings and enhancing SSE's reputation in meeting our commitment to minimising environmental impact. As shown in figure 2.4e below, we met our target to reduce emissions by 15% from a 2012/13 baseline by the second year of this price control and continue to reduce emissions in this category.

As part of SSE Group, we have an internal target of 5% CO_2 reduction per three-year period (up until 2030) based on 2017/18 baseline. This has thus far been achieved, with a 27% reduction in our building's energy use since the introduction of the target in 2017/18. This is now the non-operational building key performance indicator.

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.

Figure 2.4e
Annual building energy usage

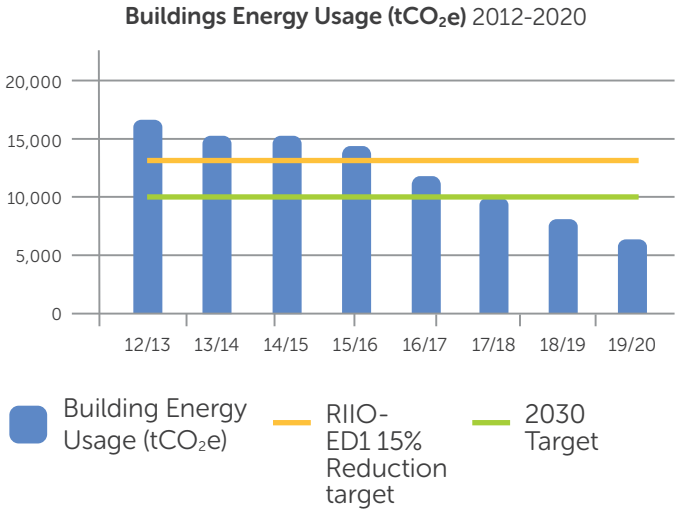


Table 2.4a – SSE Group's Energy Efficiency Performance 2011 to 2020

Year	Energy Efficiency Investment (per annum)	Reported Annual Carbon Reductions	Energy Saving (annually recurring)
2012/13	£1,170,000	12,469	£39,740
2013/14	£2,399,000	7,819	£164,492
2014/15	£2,360,000	35,020	£632,540
2015/16	£3,083,000	6,170	£1,134,412
2016/17	£1,568,000	2,203	£229,786
2017/18	£2,237,910	2,314	£107,733
2018/19	£429,244	3,765	£207,228
2019/20	£450,000	5,268	£2,457,580
Totals	£13,697,154	75,028	£4,973,511

2019/20 carbon and energy savings detailed in the above table reflect the transition of all Facilities Managed sites to green electricity supply contracts and sale of SSE's domestic energy service to Ovo Energy.

During 2019/20, investments in a range of energy efficiency projects including solar PV generation, LED lighting and heat recovery ventilation systems were progressed at several sites including Perth and Thatcham. Investment in solar PV generation has totalled £210,000 at the SSE Perth Campus and heat recovery ventilation systems were installed at Thatcham and Perth. Total energy efficiency investment for the year was £450,000 across SSE group. This will equate to recurring energy savings realised in future years.

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. Our behavioural change initiative is branded internally as the "Better Off campaign", with 42 Energy Champions recruited across multiple SSE sites and from all business units. These Energy Champions actively promote behavioural changes to colleagues to achieve energy and water reduction across SSE sites. Through actively engaging with these colleagues, it has been possible to roll-out a number of key behavioural changes in a consistent manner. This approach has also facilitated a heightened awareness of SSE's energy efficiency aspirations.

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

2.4.2. Sulphur Hexafluoride (SF_6) Emissions

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

The total capacity of SF_6 used in assets on our network is just over 27,000kg across our two licence areas as presented in Table 2.4b below. This is a reduction of 981 kg compared to 2018/19, as result of our new strategy and subsequent policies and procedures leading to removal of high leaking units:

Figure 2.4b
Installed SF_6 capacity per Licensee (2019/20)

Licensee	Installed Capacity (kg)	SF_6 Leakage (kg)	Percentage of Bank
SHEPD	5,117	10.96	0.21%
SEPD	22,039	161.34	0.73%
TOTAL	27,156	172.30	0.63%

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.

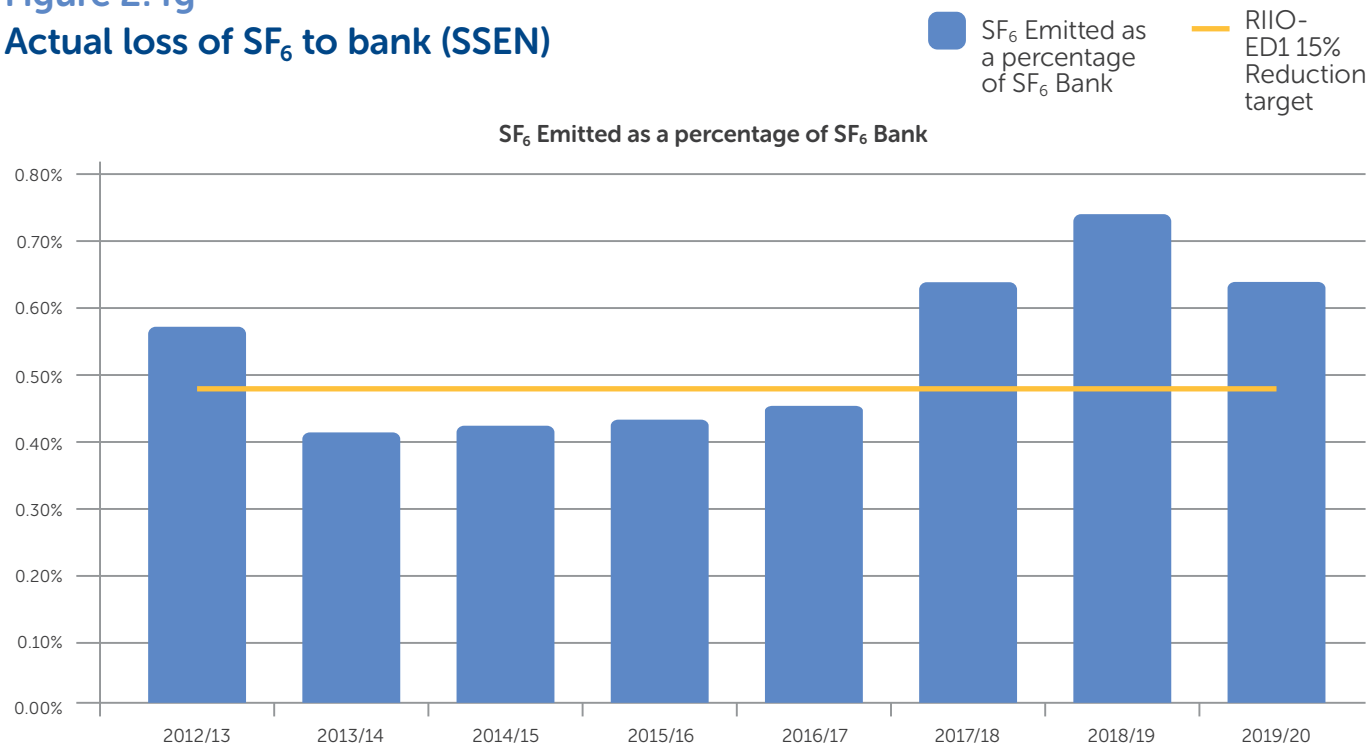
Unfortunately, both networks are behind our RIIO-ED1 target to reduce SF_6 emissions by 15%. However, given improvements in data in RIIO-ED1 we now believe targets were set at inappropriate levels and we are now looking to reset targets for RIIO-ED1. That aside, during 2019/20 we implemented a new strategy to minimise SF_6 leakage from switchgear. This has involved a number of internal changes, including: establishing a working group to address SF_6 leakage; utilising a more pro-active approach to the SF_6 switchgear repairs process and changes to internal systems to better target leaking SF_6 assets for replacement or intervention.

An innovation project was commissioned looking at opportunities for utilising alternatives to SF6 at medium voltages. We also commissioned data analytics to do a deep dive in to the causes of SF_6 leakage on distribution equipment, the results of which will help us better target improvements in leakage reduction.

Externally, SSEN is taking an active role in addressing the issue of SF_6 across the industry and currently chairs Energy Networks Association SF_6 Task Force group. The working group was established to input to the EU consultation on the Fgas regulations but is now working to understand the current situation regarding SF_6 alternatives and to drive change in this area.

These interventions have led to a reduction in SF_6 leakage in 2019/20 compared to 2018/19 levels. Whilst this is not yet meeting our RIIO-ED1 target of a 15% reduction in SF_6 leakage (using 2012/13 as a base), we expect the progress made from this increased focus to continue to reduce SF_6 emissions in future years.

Figure 2.4g
Actual loss of SF_6 to bank (SSEN)



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

2.4.3. Distribution Losses

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

2.4.3.1. Overview

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

2.4.3.2. Losses Strategy

Our Distribution Losses Strategy 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 meet the EU Eco Directive, including replacing historical high loss transformers on our network.
- Increasing the minimum size of new secondary transformers.
- Increasing the minimum cable size for both LV and HV to the next size up for specific cables.
- Upgrading network voltages in specific areas of our network.
- Switching off underutilised plant during periods of low loading.
- 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/

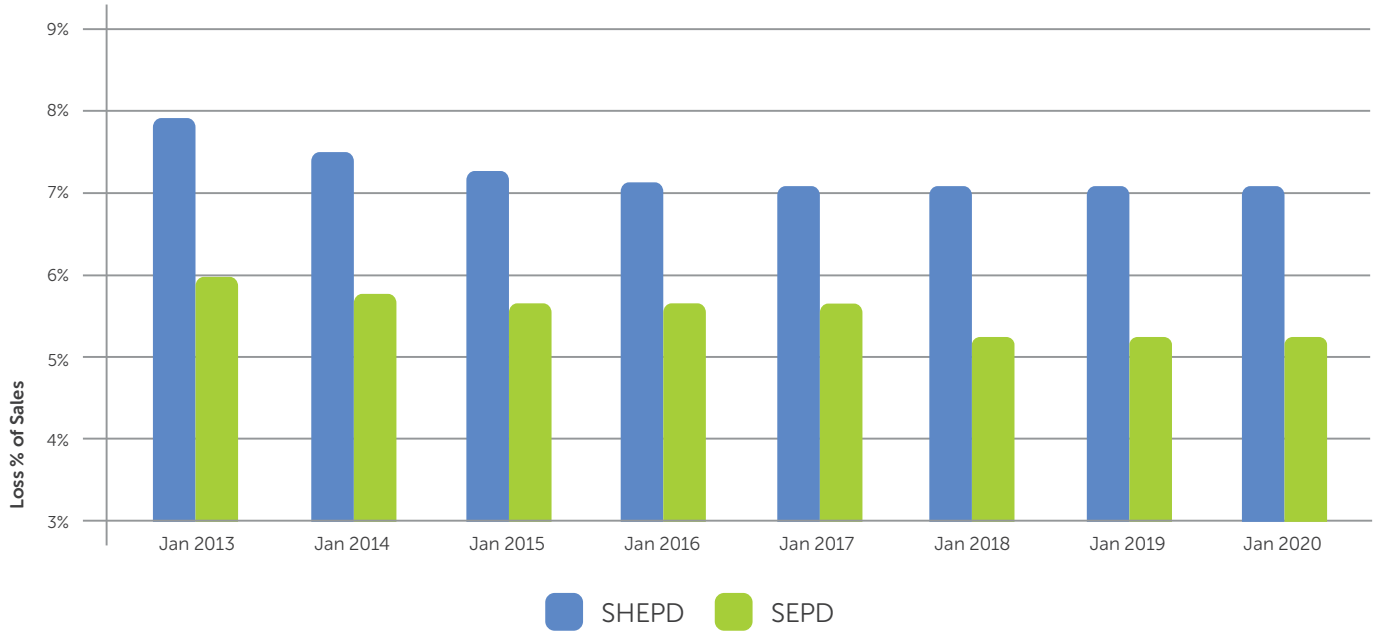
2.4.3.3. Losses Volume

The total amount of electrical losses in 2019/20 was slightly over 2.1 GWh as shown in table 2.4c. This 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. 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 2019/20	Total Distribution Losses MWh	Equivalent tCO_2e
SHEPD	516,527	132,024
SEPD	1,591,532	406,795

Figure 2.4j
Percentage of energy losses 2013–2020



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

2.4.3.4. Losses Strategy in Action

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

1 Energy Efficient Transformers

We have been installing plant and equipment that delivers enhanced losses performance and meets the EU Transformer Eco Directive2 Tier 1. This includes replacing inefficient pre-1960 secondary transformers with modern equivalents that perform at much lower losses levels. These interventions have delivered over 24,000 MWh losses savings to date in RIIO-ED1, however these savings have not been in included in worksheet E4 as they are now considered the minimum standard set by the EU Ecodesign Directive.

2 Minimum Sizing of Cables and Transformers

In general terms, increasing the diameter of conductors lowers losses. Therefore, we have put in place measures to increase the minimum size and rating of new cables and transformers. These upgrades are made as part of our asset replacement scheme once the original asset has reached the end of its life, as well as for new connections. Losses savings of over 8,000 MWh have been achieved to date in RIIO-ED1 following cable and transformer upsizing.

3 Non-Technical Losses

As losses are proportional to the square of the current, and current is directly proportional to the voltage, increasing network voltages can reduce losses for the same power transfer. As part of our network capacity increase and standardisation, we have been upgrading legacy 6.6kV networks to 11kV in our SEPD region. This has resulted in 1,800 MWh losses savings to date in RIIO-ED1.

4. Switching off Underutilised Plant

As of June 2018, we have been trialling the use of Transformer Auto Stop Start (TASS) technology to switch off one of a number of transformers in a primary substation at times of low demand to avoid the fixed iron losses associated with that transformer. The business case assessment demonstrates that TASS offers a financially viable, as well as technically feasible option for reducing losses at individual substations. Over 100 MWh losses savings were achieved across the two substations during the trial period. Further applications of this technology will be considered throughout the rest of the RIIO-ED1 and into RIIO-ED2.

5. Non-Technical Losses

Our Network Protection team continues to focus on reducing non-technical losses by addressing MPAN (Metering Point Administration Numbers) discrepancies. The team have investigated an average of 4,778 records per month and have resolved an average of 7,821 records per annum since being established in 2014. This work has delivered significant non-technical losses savings to date over RIIO-ED1.

2.4.3.5. Losses Reporting Progress

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

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

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

SEPD Programme/ Project Title	2018/19 Regulatory Reporting Year			RIIO-ED1
	Distribution Losses Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative Reduced Losses to Data
	£k (19/20 prices)	MWh	tCO_2e	MWh
Technical Losses Projects				
LV Cable Asset Replacement	4.37	107	27	262
LV Cable General Reinforcement	0.22	30	8	94
LV Cable Other	56.95	867	222	2302
HV Cable Asset Replacement	7.92	73	19	135
HV Cable General Reinforcement	5.43	92	24	219
HV Cable Other	74.14	666	170	1587
6.6kV to 11kV Upgrade	0.00	532	136	1838
Non-Technical Losses Projects				
DUOS recovery SEPD – non domestic Other	N/A	68254	17446	177951
DUOS recovery SEPD – non domestic Other	N/A	31510	8054	95904

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
Technical Losses Projects			
LV Cable Asset Replacement	km	0.8	TBC
LV Cable General Reinforcement	km	0.04	TBC
LV Cable Other	km	10.6	TBC
HV Cable Asset Replacement	km	1.9	TBC
HV Cable General Reinforcement	km	1.3	TBC
HV Cable Other	km	18.1	TBC
6.6kV to 11kV Upgrade	km	0.00	TBC
Non-Technical Losses Projects			
DUOS recovery SEPD – domestic Other	#	3619	TBC
DUOS recovery SEPD – non domestic Other	#	350	TBC

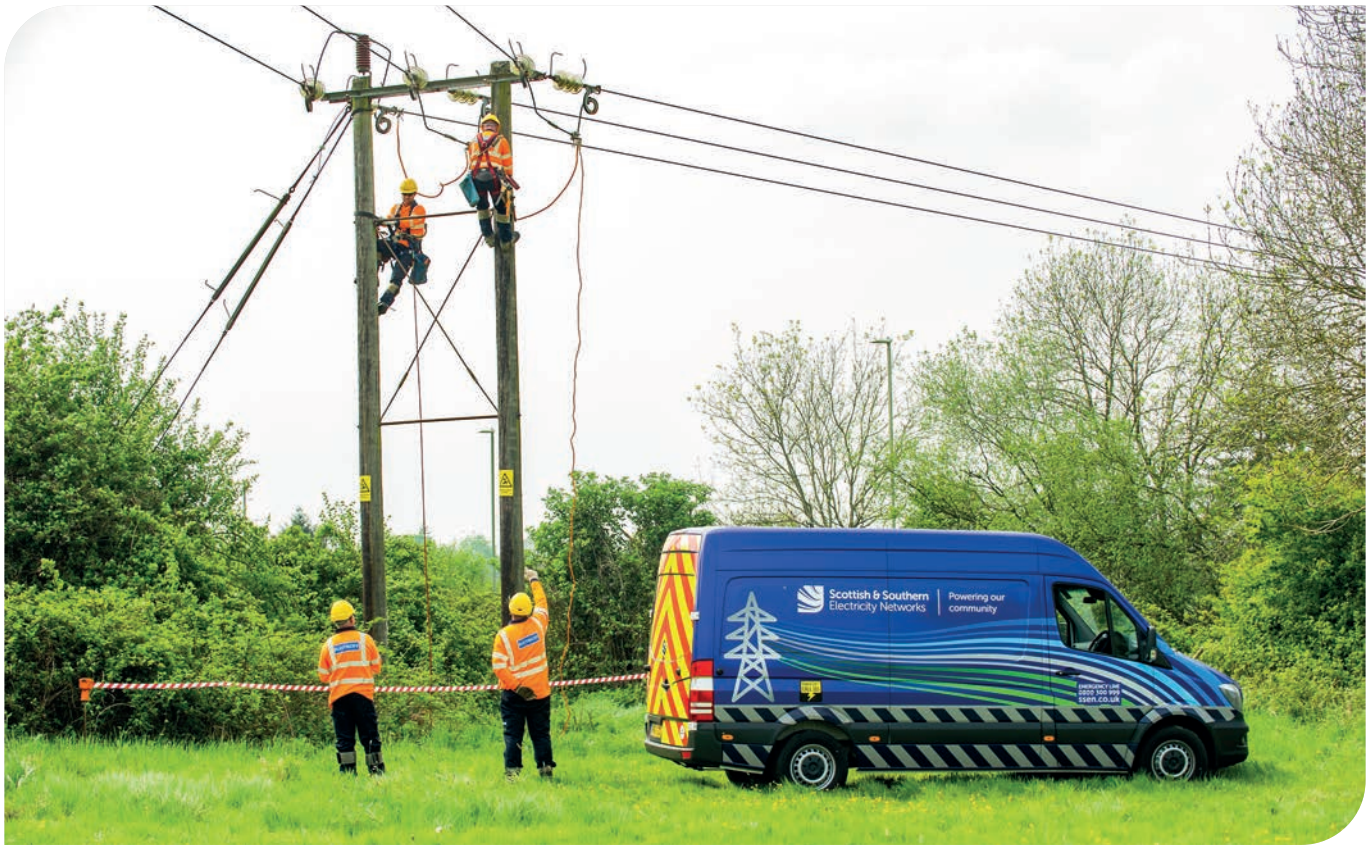


Table 2.4f – Summary of SHEPD Losses Costs and Benefits from Activities in RIIO-ED1

SHEPD Programme/ Project Title	2018/19 Regulatory Reporting Year			RIIO-ED1
	Distribution Losses Justified Costs	Reduced Losses	Reduced Emissions Associated with Losses	Cumulative Reduced Losses to Data
	£m	MWh	tCO_2e	MWh
Technical Losses Projects				
LV Cable Asset Replacement	1.90	35	9	89
LV Cable General Reinforcement	0.43	4	1	12
LV Cable Other	35.63	683	175	1793
HV Cable Asset Replacement	12.42	37	9	68
HV Cable General Reinforcement	1.22	15	4	38
HV Cable Other	20.34	425	109	1089
Non-Technical Losses Projects				
DUOS recovery SHEPD – domestic Other	N/A	30407	7772	79568
DUOS recovery SHEPD – non domestic Other	N/A	12963	3313	43113

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
Technical Losses Projects			
LV Cable Asset Replacement	km	0.4	TBC
LV Cable General Reinforcement	km	0.1	TBC
LV Cable Other	km	6.6	TBC
HV Cable Asset Replacement	km	3.0	TBC
HV Cable General Reinforcement	km	0.3	TBC
HV Cable Other	km	5.0	TBC
Non-Technical Losses Projects			
DUOS recovery SHEPD – domestic Other	#	1684	TBC
DUOS recovery SHEPD – non domestic Other	#	173	TBC

Underground Fault Location Technologies (NIA_SSEN_0037)

2.5. Other Environment-related Activities

2.5.1. Innovation

Environmental benefits are the key driver of a number of projects in our innovation portfolio. Some examples of our innovation projects that deliver environmental benefits are detailed below.

2.5.1.1. Supporting Uptake of Low Carbon Technologies (LCTs)

E-Tourism (NIA_SSEN_0038): This project, in partnership with the Scottish Government and other key stakeholders, aims to identity how best to plan for electric vehicles (EV) at known tourist spots.

It aims to understand how increased EV uptake, combined with tourist behaviour, will impact on seasonal peak electric demand on the network. There will be an in-depth study into eight tourist locations in the North of Scotland to identify the potential scale, location and duration of any increased charging demand. This will help to inform any future investments in the network, local flexibility or distributed generation to address any areas of constraint caused by EV charging.

The project will also engage with local community groups, local authorities and other organisations to help them understand the impact that heightened EV tourism will have on local demand, and the potential for them to contribute to solutions.

Start/end date: July 2019 – September 2022

For more information see:
https://www.smarternetworks.org/project/nia_ssen_0038

Electric Heat Pathway (NIA_SSEN_0039): This project looks to investigate the potential of electric storage heating in heat decarbonisation and the shift to a smart, flexible electricity system. The outcome of the project is a report which will stimulate public debate on the role of traditional storage heating and provide a better understanding of the opportunities and benefits of flexible heating demand. Heat decarbonisation will potentially add significant demand on the network which may require significant network reinforcement. however, by identifying options to meet this demand flexibly, reinforcements could be avoided. The report was produced for SSEN by Grid Edge Policy, led by Maxine Frerk, who has significant industry expertise including previous experience as Senior Partner Networks at Ofgem.

The report enabled SSEN to hold two external webinars to share findings.

Start/end date: October 2019 – April 2020

More details can be found here:
https://www.smarternetworks.org/project/nia_ssen_0039

2.5.1.2. Reducing Greenhouse Gas Emissions

Feasibility of Utilising Compressed Dry Air in 33kV Insulated Switchgear (NIA_SSEN_0042): Sulphur Hexafluoride (SF_6) is an extremely potent greenhouse gas, but its insulating properties mean it is used in more than 10,000 items of switchgear on the SSEN network. This project will determine the feasibility of utilising compressed dry air as an SF_6 alternative.

Start/end date: December 2019 – June 2020

More details can be found here:
https://www.smarternetworks.org/project/nia_ssen_0042

2.5.1.3. Reducing Excavations

Underground Fault Location Technologies (NIA_SSEN_0037): This project aims to improve the accuracy of low voltage fault location techniques to more precisely pinpoint the location of underground faults. This will reduce the carbon footprint associated with repairs by minimising the need for unnecessary, carbon intensive excavations as part of the fault location process. As well as this it will reduce cable repair times and shorten outages for customers. A range of underground fault location devices are being trialled and processes established to inform best practice.

Start/end date: June 2019 – December 2020

More details can be found here:
https://www.smarternetworks.org/project/nia_ssen_0037

2.5.2. Environmental Employee Awareness

Within SSE, there is an internal group that actively promotes environmental activities. These include:

- The 'Better Off' campaign, which encourages colleagues to switch off monitors, desktops, thin clients and laptops overnight or at the weekend rather than being left on standby.
- A water efficiency and saving programme, which is a behavioural change campaign to encourage water savings at work and at home. As a result of this,in 2019/20 total SSE non-operational buildings water consumption reduced by 9.3% compared to the previous year.
- Our 'Be The Difference' volunteering initiative allows employees to raise funds for charity by partaking in a variety of activities including environmental clean-up days. We have seen an increase in staff participation in the Be The Difference programme from 40% in 2015/16 to 48% in 2019/20.
- SSEN have two groups on the social networking platform 'Yammer', which allows colleagues to keep updated with new environmental awareness information about the networks sector.

2.5.3. Adaptation/flood preparedness

SSEN has invested £9.65m to date in RIIO-ED1 on investigation works and flood mitigation measures in SEPD, with £0.83m also invested in SHEPD over the same period (in 2012/13 prices).

This includes flood defence surveys carried out by contractors on all primary substations across both our regions and implementing flood prevention measures such as levee building, door water proofing, air vent water proofing, cable sealing, installing GeoDesign deployable flood barriers and water pumps.

In 2019/20 £30k was spent on surveying substation sites in SEPD to review against the new statutory requirements of Engineering Technical Recommendation (ETR) 138. This requirement stipulates that primary substations with 10,000 or more unrecoverable customers should now be defended to a 1:1000 year flood risk event, compared to the previous 1:100 year requirement for these substations. A 1:1000 year event is less likely to occur but more catastrophic if it does. The surveys identified substations at risk of flooding under the new ETR 138 requirements, however further investigation works are required to determine the level of protection needed to ensure that these sites are effectively protected against exceptional flooding events.

2.5.4. Waste/Landfill/Recycling

As part of the wider SSE Group, SSEN follows the waste hierarchy to reduce, reuse and recycle waste. Recycling facilities are provided at key office locations and operational sites to reduce the amount of consumable waste sent to landfill.

In recent years SSE has been implementing a waste improvement program to improve the management and reporting of its waste performance. A waste minimisation strategy and targets are set to be developed by 2021, with performance against these targets reported from there onwards.

More details can be found by accessing our SSE Group sustainability report: **https://www.sse.com/media/eh0dqrrw/sse-sustainability-report-2020.pdf**

2.5.5. Contaminated Land Clean Up

In 2019/20, there were 17 incidents of land contamination in the SEPD licence area costing £175,000 in remedial work. These are related to oil leaks from transformers which were replaced due to bad condition. For SHEPD, there was one reportable incident costing £4,000.

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

Eight reportable noise complaints were made in 2019/20, of which six were reported in SEPD and two in SHEPD. These included complaints relating to substation noise or noise from transformers, and led to costs of circa £3,000 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. Biodiversity

Our distribution network runs through some of the country's most biodiverse environments which support a wide variety of habitats, flora and fauna. As such, our projects are subject to ecological assessments, to ensure impacts to sensitive species and habitats are avoided or reduced.

In 2019 SSEN recruited an Ecologist to support the delivery of our cable undergrounding projects. This included conducting protected species surveys to ensure our operations remain legally compliant and that appropriate mitigation measures are implemented. For example, in 2019/20 surveys to confirm the presence or absence of great crested newts (GCN) were completed for approximately 16 cable projects, totalling around 45 ponds, with GCN being recorded in several ponds. Other surveys such as those for dormouse, common reptiles, sand lizard, badger, water vole and bats have also been completed, allowing us to design and deliver our projects in a way that protects these species.

Protected species licences from Natural England are obtained where necessary, such as the badger licence granted in 2020 for our Stedham Village 11kV Cable Replacement Project. The results of surveys completed this year have already confirmed the need for water vole and sand lizard licences for cable projects to be delivered in 2021.

Several of our projects require us to work in legally protected sites, such as Sites of Special Scientific Interest (SSSI), which are of national or international importance for wildlife. We work closely with Natural England and other organisations to ensure all works within these sites are designed and delivered appropriately.

For example, the Glydia Farm 11kV Cable Replacement Project required the removal of overhead lines in the New Forest SSSI; these works were supported by Natural England and Forestry England following the production of a Habitats Regulations Assessment and a mitigation strategy to ensure the protection of breeding birds and heathland habitat, both of which are vulnerable to disturbance.

Additionally, to deliver biodiversity net-gain, enhancements have also been incorporated into the design of our cable projects, including habitat improvement works; the installation of nest boxes for raptors, bats and dormice; and increasing species diversity when re-instating hedgerows.

2.5.8. Community Engagement

SSEN has implemented the Resilient Communities Fund which provides financial support for communities to prepare for extreme weather events. The fund originally operated over a two-year period, awarding £1.25m in total to benefit communities in SHEPD and SEPD. In 2016/17, due to the success of the fund, the decision was taken to extend it until 2023. In 2019/20 over £322,919 was awarded from the fund to support 39 community projects. Various projects have been funded to date, including projects to support 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.

In 2019/20 SSEN provided funding to Deaf Scotland to help them produce quality film material so that deaf people can become more involved in resilience planning. Additionally, SSEN funded the Footprint Trust on the Isle of Wight which helped improve the skills of vulnerable people experiencing rural isolation and fuel poverty. This was achieved by providing:

- Two training sessions for frontline workers, targeting 20 people
- 55 home visits to 110 people living with a long-term physical or mental health condition, the elderly, young families and people in poverty
- Ten rural community outreach events engaging with 100 people
- Guidance leaflets and media distributed to 60,000 people

The project helped people to be more resilient in the event of a power failure and to deal with adverse weather conditions.

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 intended to drive innovation across a range of challenges associated with transitioning to a low carbon network, whilst continuing to look at innovations that will improve efficiency and maintain network reliability to reduce costs and improve customer service. Progress of our innovation projects that are aligned with our RIIO-ED1 strategy are displayed, along with details of benefits realised to date of from technologies that have been successfully implemented into BaU. Progress on Smart Meter deployment and how we anticipate benefits from them is also covered here.

3.1.1. Key challenges facing the industry

The energy system is facing an unprecedented change as we transition towards Net Zero. To meet the challenge of Net Zero, we must now go further and faster, especially in decarbonising transport, heating and our industrial use of energy. To achieve net zero will require a huge increase in renewable and low carbon electricity, especially to meet new sources of demand such as electric vehicles and new forms of decarbonised heat. A robust and reliable electrical network will be essential to facilitate this transition and delivering the network capacity required to achieve this will require significant investment either in the form of traditional investment in assets or new flexibility services. Providing this network, whilst maintaining network reliability, resilience, customer service and efficiency is a key challenge facing networks.

There are a number of key topic areas which will need to be addressed, including ever increasing volumes of renewable generation connecting to the network, the widespread adoption of EVs, the decarbonisation of heat, the development of Whole System design and operation, the shift towards DSO and enabling new flexibility solutions. Additionally, customer expectations from the network will change as they become increasingly reliant on electricity for both heating and transport. At the same time, we need to ensure that we can bring efficiency benefits to our existing BaU activities to operate and maintain the network.

3.1.2. Our areas of focus

We are committed to creating a more flexible, cost effective and secure electricity network, which adopts and responds to our stakeholders' needs, whilst supporting the delivery of the country's Net Zero targets. This includes:

- Innovation Development and Deployment
  We are currently engaged in a number of large and small scale innovation projects that will deliver a broad range of benefits for our customers. Projects have been aligned to the six RIIO-ED1 primary outputs identified as focus areas for innovation, these include projects on LV fault finding and wildlife protection. Our innovation portfolio has delivered over £40m of benefits to date in RIIO-ED1, whilst avoiding over 330,000 tonnes carbon dioxide emissions.

- Distribution System Operator (DSO)
  SSEN, along with other DNOs, is transitioning towards a Distribution System Operator model which will deliver significant benefits and transform the way we operate. A DSO, as defined by the ENA, is an active distribution system comprising networks, demand, generation and other flexible distributed energy resources to deliver security, sustainability and affordability in the support of whole system optimisation. Our two flagship DSO projects TRANSITION and LEO are already providing insights to help remove barriers to smart technologies, assist in the evolution of a more flexible network as well as helping to facilitate new markets. On top of this we have launched two new projects, TraDER and MERLIN, which will test financial markets and flexibility scenarios of a future DSO world.

- Decarbonisation of Transport and Heat
  A key requirement for Net Zero is the decarbonisation of transport and heat. In March 2020 we published our Electric Vehicle strategy which sets out our principles to support the uptake of 10 million EVs in the UK by 2030. To support this, we have a variety of innovation projects focused on the decarbonisation of both transport and heat, including the RESOP (Regional Energy System Optimisation Planning) NIA project which launched in 2019/20 to support the coordination of the low carbon transition.

- Flexibility Deployment
  Demand to connect small scale renewable generation quickly and on constrained networks is increasing. To meet this demand SSEN is providing flexible connection options to generators via Active Network Management (ANM) solutions. To date in ED1, we have enabled over 345MW of renewable generation to connect to our network via these schemes. In 2019/20 our first Constraint Managed Zone (CMZ) contract was implemented for a total of 6MW worth of services on the Isle of Islay, this not only produced financial benefits for customers but also avoided over 2,200 tonnes of CO_2 emissions. A further suite of CMZ solutions are expected to be deployed in 2020/21.

- Smart Meters
  The number of smart meters on our network continues to rise. We currently have over 220,000 connected across our Scottish network and over 1.1 million connected in our Southern region. It is anticipated that around 3.5 million will be connected by the end of the smart meter implementation programme rollout in 2024. In April 2020 our Data Privacy Plan was agreed by Ofgem. This success, complemented by developments in our ICT systems, will allow SSEN to collect suitably aggregated Consumption Data from smart meters in the future. This is critical in allowing SSEN to realise the benefits associated with smart meter rollout, to provide a more reactive network for the future.

3.1.3. Low Carbon Transition

Low Carbon Technologies (LCTs)
The total uptake of LCTs has increased slightly in 2019/20 in our Scottish Network compared with 2018/19. This is due to an increase in EV fast charge points being installed. In our Southern network there has been a slight decrease in the rate of LCT uptake in 2019/20 compared with 2018/19. This is due to a decline in Photo Voltaic (PV) installations. The total amount of distributed generation (DG) added to both our SEPD and SHEPD networks has increased in 2019/20, with SEPD connecting 225.8MW and SHEPD 217.6MW. More details are provided in the following sections:

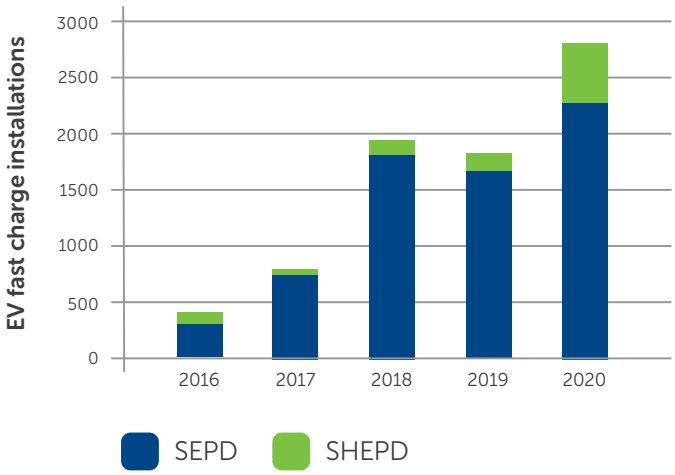
SSEN has worked hard in 2019/20 to promote the delivery of the UK's 2050 Net Zero (2045 in Scotland) ambition through engagement and support at all levels from UK and Scottish Governments, Ofgem, Local Authorities, ENA to trade bodies, third party stakeholders and individual organisations. Looking forward, supporting LCT uptake and achieving both Net Zero and a Green Recovery will remain a high priority for SSEN.

3.1.3.1. EV Charge Points

Electric Vehicle (EV) uptake has increased in RIIO-ED1 as technological improvements to batteries improve vehicle range and prices become more attractive to consumers. A larger number of manufacturers are now offering fully electric and hybrid vehicles which has provided a better choice for consumers and competition within the marketplace. This has been reflected in the volume of charging points installed in 2019/20, with a 40% increase in EV fast chargers on our SEPD network and 151% increase in our SHEPD network in comparison to 2018/19.

As EVs become more popular, we expect the current upward trend in charge point installations to continue as both residential and public chargers become more prevalent on the network. In response to this, SSEN is working to understand the potential impacts EVs have on different components of the network, including entering into a Strategic EV Partnership with the Scottish Government and Scottish Power Energy Networks, as well as launching our E-Tourism project to explore challenges resulting from increased numbers of tourists driving EVs in rural Scotland.

Figure 3.1a
Number of EV fast chargers installed ED1



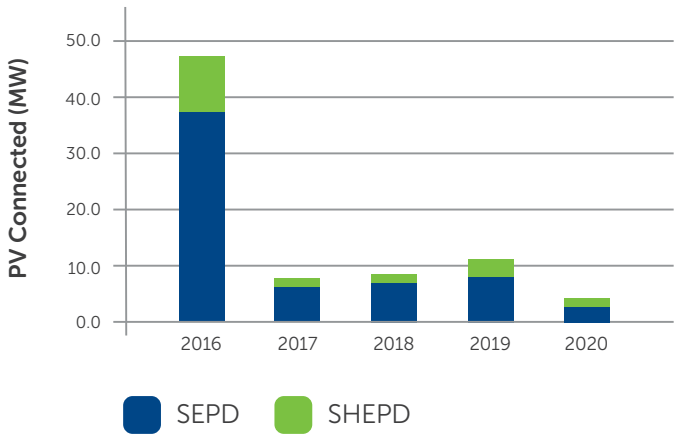
3.1.3.2. Distributed Generation

Photo Voltaic

Whilst our overall distributed generation has increased, we have seen a 47% decrease in PV installations in 2019/20 compared to 2018/19, with a total of 1,500 units installed across our Scottish and Southern networks equating to 4.5MW of generation. We believe that this decline is due to the to the closure of the Feed In Tariff scheme to new applicants as of April 2019.

Whilst the Smart Export Guarantee, introduced by BEIS, came into effect in January 2020, meaning small scale generators are guaranteed a tariff for exports to the grid, we do not anticipate any significant changes in the rate of PV uptake over the next few years.

Figure 3.1b
MW PV generation connected ED1



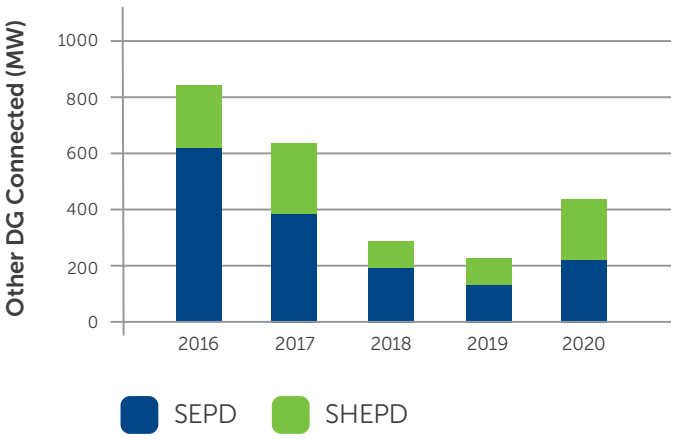
Other Distributed Generation

The volume of distributed generation (excluding PV) connected to our network has increased by 83% in 2019/20 compared to 2018/19, with 438.9MW connected. This is due to a large number of projects being closed in 2019/20.

We expect new connections of distributed generation to return to levels seen in 2017/18 and 2018/19, as the legacy projects which caused a rise in distributed generation this year are now closed.

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

Figure 3.1c
MW Distributed generation connected (excluding PV) ED1



3.2 Progress of the Innovation Strategy

Our innovation strategy aligns with the six RIIO-ED1 primary outputs, which, along with stakeholder input, act as our focus areas for innovation. Projects and initiatives engaged to date have been specifically selected to ensure we have a balanced portfolio of innovations which target focus areas, whilst addressing stakeholder needs, priorities and delivering value. The RIIO-ED1 primary outputs are as follows:

- Connections
- Customer Service & Social Obligation
- Environment
- Reliability
- Safety

Since publishing our innovation strategy, along with our RIIO-ED1 business plan, we have made progress in all six of the innovation focus areas. Whilst we have not made any material changes to our original innovation strategy, we have published additional information which details our approach to key activities in key areas such as our DSO Strategy, Electric Vehicle Strategy and Digitalisation Strategy. We also plan to publish an updated innovation strategy in late 2020 to reflect the emerging challenges associated with Net Zero.

To the end of 2019/20 in RIIO-ED1 we have had 45 projects funded by the National Innovation Allowance (NIA) which is a total award of £12.9m and two funded by the National Innovation Competition (NIC) totalling £20.6m (we have also been partners in a third NIC, Optimise Prime, with UKPN). On top of this we have implemented several innovations into BAU which have fast followed learnings from other DNOs.

Connections

Customer Service & Social Obligation

Environment

Reliability

Safety

A summary of our current innovation portfolio is as follows:

Table 3.2a – 2019/20 Innovation Portfolio

2019/20 Innovation Portfolio	RIIO ED1 Primary Output					
	Status	Connections	Customer Service & Social Obligation Priorities	Environment	Reliability	Safety
Applied Integrated Vegetation Management	Incorporated into BaU processes			x	x	x
11kV Power Electronics	Current NIA project	x	x		x	x
SubSense	Current NIA project				x	x
Informed Lightning Protection	Current NIA project		x			x
Social Constrained Managed Zones (CMZs)	Implemented into BaU		x	x		
LV Underground Fault Location Technologies	Current NIA project		x	x	x	
E-Tourism	Current NIA project	x	x	x		
Electric Heat Pathway	Current NIA project			x		
Technical Interfaces to Scale as a DSO	Current NIA project	x				
Merlin	Current NIA project	x				
Feasibility of Utilising Compressed Dry Air in 33kV Insulated Switchgear	Current NIA project			x		x
Whole System Growth Scenario Modelling (Stage 2)	Current NIA project	x		x		
Smart Hammer	Current NIA project				x	x
Future Fiscal Forecasting	Current NIA project			x		
Overhead Line Vibration Monitoring System (CNI Guard)	Current NIA project		x			x
TraDER	Current NIA project	x				
Regional Energy System Optimisation Planning (RESOP)	Current NIA project	x		x	x	
Skyline	Current NIA project	x		x	x	

3.2.1. Highlights of 2019/20

This year we have completed several trials allowing us to progress our innovation strategy and our pledge for Net Zero. Highlights of these are as follows:

- **Smart Hammer** – we have been developing the X-Model Smart Hammer, which can evaluate the internal condition of wood poles to ensure they are safe for the surrounding community and safe for staff to climb when carrying out work. This tool could also improve asset management by providing a consistent score for asset health, removing subjectivity.
- **Utilising Compressed Dry Air in 33kV Insulated Switchgear** – we have been investigating the use of compressed dry air as an alternative to SF_6 on our 33kV network. This could enable us to reduce the environmental footprint of our activities through limiting our SF_6 use.
- **LV Underground Fault Location Technologies (LVUFLT)** – we have been trialling the potential use of HV Fault finding acoustic equipment on the LV network. This will lead to more accurate fault location, benefitting customers by restoring power supplies quicker with less disruption.
- **E-Tourism** – we have initiated an E-Tourism project to improve our understanding of EVs and the associated impact of EV charging during peak tourist season. Eight tourist locations have been selected for analysis in the North of Scotland. This will help us better prepare the network for future EV uptake.
- **RESOP Whole System Growth Modelling (Stage 2)** – we have been exploring the range of whole system growth scenarios to achieve Net Zero whilst facilitating the economic development plans of local areas.
- **Future Fiscal Forecasting** – we are trialling a new forecasting model from the USA to help inform forecasts of energy consumption. This has the potential to help the energy fuel mix to promote Net Zero opportunities.

A more detailed breakdown of active NIA projects can be found in the 2020 Annual NIA Summary Report located here: **https://www.ssen.co.uk/InnovationLibrary/Distribution/**

Our Innovation Strategy can be found here: **http://www.yourfutureenergynetwork.co.uk/wp-content/uploads/2016/04/Innovation-Stategy-update-ver-9.pdf.**

3.2.2. Large Scale Innovation Projects

During 2019/20, we had four large-scale innovation projects in our distribution business. These focus on the transition to Distribution System Operator and creating a smarter, more flexible network which can support the low carbon transition.

3.2.2.1. Resilience as a Service (RaaS) (SEEN007)

Key activities
The RaaS innovation project (partnered with Costain and E.ON) seeks to develop a sustainable solution to improve network resilience, particularly in remote and isolated areas. The aim is to develop and trial a system which can swiftly and automatically restore power to customers in the event of an outage, using services procured from third party owned, Battery Energy Storage Systems, together with local Distributed Energy Resources.

This approach will provide cost effective, local network resilience, which will improve security of supply to customers, whilst reducing the use of carbon intensive, temporary diesel generation which is conventionally used to mitigate fault conditions.

Expected outcomes
As well as demonstrating the technical concept, the project will develop the commercial framework for RaaS, evaluating the financial case from a DNO perspective and assessing the investment case for RaaS service providers and options for revenue stacking in other flexibility services markets.

The first phase of the project focuses on site selection, system design and refinement of the business case. This stage will validate whether the concept is technically feasible and financially viable, to inform a decision, to be made in 2021, on whether to proceed with the deployment and operation of a RaaS system at the chosen site for a trial period of up to two years.

A number of suitable primary substations (33 kV to 11 kV) have been shortlisted for site surveys to identify the site to be taken forward to the design stage.

For more information see: **www.project-raas.co.uk**

Funding Stream
Ofgem NIC
£10.2m project

Start/end date
2020 – 2024

3.2.2.2. TRANSITION (SEEN005)

Key activities
With the widespread recognition that the GB electricity network needs to become more flexible, DNOs will take an increased role in delivering an efficient, coordinated and economical whole system outcome to support the UK's Net Zero targets. This transition toward the Distribution System Operator (DSO) model is especially significant as the proliferation of low-carbon technologies and solutions become more widespread, allowing households, businesses and communities to engage with the energy system. This includes customers, shifting from merely consuming energy, to producing, storing, balancing and selling energy back to the system.

The objective of TRANSITION (partnered with Electricity North West Limited) is to explore the most effective system architecture to support a smarter, flexible network of the future.

Expected outcomes
TRANSITION is building on the outputs of the ENA Open Networks Project to design, develop, demonstrate and assess the common tools, data and system architecture required to implement proposed DSO models.

TRANSITION has successfully passed its Stage Gate submission, meaning it remains relevant to the energy industry's requirements and will now proceed to the deployment and trials phase. The project will run trials in two areas, with physical trials in Oxfordshire in partnership with the Local Energy Oxfordshire project, as well as simulated trials in the Greater Manchester region in partnership with Electricity North West Limited. This will include trialling local energy flexibility and facilitating new markets, such as peer-to-peer trading, while maintaining neutrality and meeting customer expectations. The project will provide a better understanding of how market rules can be designed to avoid conflicts of interest.

For more information see: **https://www.ssen-transition.com**

Funding Stream
Ofgem NIC
£12.79m project

Start/end date
2018 – 2023

3.2.2.3. Project LEO

Key activities
Project LEO is one of the most ambitious, wide-ranging, innovative, and holistic smart grid trials conducted in the UK. It seeks to create conditions that replicate the electricity system of the future, to better inform how we manage the transition to a smarter electricity system.

Project trials are based around three key themes:

- **Technology** – solar, photovoltaic and hydro technologies are being trialled along with battery storage technology, vehicle to grid technology and demand side response.
- **Local Markets** – IT systems are being developed to support the market. Providing clear information on opportunities for energy services, addressing constraint management and energy exchange between local energy users.
- **Community** – engagement and supporting the democratisation of the energy system is a priority for LEO. The local energy system is being mapped and the data fed into the Local Area Energy Plan for Oxfordshire to upport the transition to net zero.

Expected outcomes
Project LEO will inform how DSOs function in the future, show how markets can be unlocked and supported, create new investment models for community engagement, and support the development of a skilled community positioned to thrive and benefit from a smarter, responsive and flexible electricity network.

Three Minimum Viable System (MVS) trials have been undertaken in 2019/20 to test the impact of low-carbon technology on the network. These include testing the dispatch of energy from a community owned hydro scheme, utilising Oxford Bus Company's batteries to feed energy back into the grid and demonstrating the impact of changing air conditioning settings on the energy system.

The MVS trials replicated scenarios that the UK's energy system will likely experience in the transition to a smarter electricity system. These tests will continue throughout the project, in a larger and more complex fashion.

For more information see: **https://project-leo.co.uk/**

Funding Stream
BEIS Industrial Strategy Fund
£37m project

Start/end date
2017 – 2022

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

Key activities
LEAN was focussed on reducing electrical losses at primary substations by developing and applying Transformer Auto Stop Start (TASS) technology. This allows one of a number of transformers to be switched off at times of low demand to avoid the fixed iron losses associated with that transformer.

Achieved outcomes
The TASS system was trialled at two substations between June 2018 and January 2019. Over the 18-month trial period it demonstrated losses savings of over 100 MWh across the two substations. The technology remains in place and continues to operate as designed, demonstrating the ability to both reduce losses and respond appropriately to different network situations and mitigate security of supply risks.

The TASS system trial demonstrated losses savings of over £6K across two substations. This project closed in January 2020, and SSEN are evaluating the wider application of TASS at additional primary substations for the remainder of ED1 and into ED2.

More information can be found here:
https://www.smarternetworks.org/project/sset207-01

Funding Stream
LCNF Tier 2
£3.1m project

Start/end date
2014 – 2019

3.3. Roll out of Smart Grids and Innovation into Business as Usual

3.3.1. Converting Innovations into Business as Usual

We have a robust process for selecting innovation projects, assessing their benefits and suitability for BaU rollout, and tracking their performance following dissemination.

The process begins with a brief assessment of an idea's scope to ensure objectives align with our innovation focus areas and challenges. Ideas are also assessed for their TRL level, to ensure we have a spread of innovations at different readiness levels to supply a steady stream of innovations for deployment. Successful ideas then undergo a robust Cost Benefit Analysis (CBA) process to ensure that the proposed initiatives have a positive business case. This will involve making a number of assumptions to predict the future benefits.

Following a successful CBA, an idea is taken on to a project. This commences the trial period, where assumptions are tested to give better information on how the innovation will perform on our network. This includes an ongoing assessment of the potential benefits that the innovation will deliver.

At the end of the innovation trial, the business case is 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.

Following BaU rollout, success of the innovation is assessed and tracked to ensure benefits are being realised. We currently have an in-house methodology to track innovation benefits in BaU, but will move to the ENA's Innovation Measurement Framework in 2021 following its approval.

Innovation Fast Follow
In order to monitor the progress of innovation trials performed by other DNOs, various knowledge sharing workshops, conferences and strategic management meetings take place on a regular basis. This allows us to better understand how innovation is benefiting other DNOs and gain insight on effective deployment of the technology into BaU. We have deployed a number of innovations into BaU following learning from projects completed by other DNOs.

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

3.3.2.1. New Innovations Deployed in 2019/20

SSEN have deployed two new innovations into business as usual in the 2019/20 reporting year:

Constraint Managed Zones (CMZ)
Constraint Managed Zones use flexible solutions to offer security of supply during times of peak demand, planned maintenance or fault conditions. The CMZ concept has been recognised in BAU for a number of years. In October 2019, SSEN placed its first CMZ contract which provided flexible generation to cover a network outage on the Isle of Islay. The contract sourced renewable generation from a hydro plant on the island in place of temporary diesel generation which would have traditionally been used to maintain customer's supply. This setup provided a more cost-effective option for supporting the network outage than traditional temporary generation services. As traditional generation would be diesel based, there are also reduced carbon emissions associated with the CMZ contract.

Benefits
The flexible services generated £236k gross benefit in 2019/20 and avoided approximately 2,200 tCO_2e compared to traditional diesel-based alternatives.

Future Deployments
Following on from this success, SSEN seeks to secure an additional 240MWh in 2020/21 with further schemes being identified for the remainder of ED1 and into ED2.

ED1 Primary Outputs
Connections, Environment and Reliability

More information can be found here:
https://www.ssen.co.uk/FlexibleConnections/

Hybrid Generators

In 2011 SSEN completed an IFI project trialling hybrid generators as alternatives to traditional diesel generation. The original hybrid generators had reliability issues, but following advancements in technology, 5 Hygen MX hybrid generators were procured as BaU in June 2019. Hybrid generators are a combination of a diesel generator and battery storage. The diesel generator charges the battery which can then be used to cover an outage. This setup is more efficient than using a diesel generator on its own, as the battery storage system allows the generator to operate at optimum loading levels. This means there is lower fuel consumption and thus carbon emissions when using hybrid generators, whilst significantly reducing noise and providing better air quality for the customer.

Benefits

As the hybrid generators have just been procured in 2019/20, the benefits do not yet cover the purchase costs of the machines. 34 tCO_2e has been avoided to date since acquiring the machines.

Future Deployments

SSEN procured five Hygen MX hybrid generators in 2019/20 and intend to procure an additional five in 2020/21.

ED1 Primary Outputs

Environment, Customer Service and Social Obligation Priorities

This project was originally completed as an IFI Project. More information can be found here:
https://www.smarternetworks.org/project/2011_14

3.3.2.2. Further RIIO-ED1 Innovation Deployments

On top of these new deployments, we continue to support the following innovative solutions which have become business as usual over the ED1 price control period:

Active Network Management (ANM) and Flexible Connections

ANM and flexible connections allow generators to connect to constrained networks through releasing flexible generation capacity. SSEN have implemented ANM in multiple locations across our network to help facilitate the connection of distributed generation.

Benefits

Significant reinforcement costs have been avoided and 324,258 tCO_2e have been avoided for all ANM projects to date in RIIO-ED1.

Future Deployments

In 2021 SSEN will deliver the largest ANM system in the UK through the South West Active Network Management (SWAN) project. For more details see section 3.3.3.1.

ED1 Primary Outputs

Connections, Reliability and Environment

These projects have been 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. Units are installed into substation LV feeder pillars where they automatically switch fuses when one has ruptured. This means customers only experience a brief loss of supply in cases where a fuse change is sufficient to restore power following a fault. 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 £12.3m gross avoided costs, over 321,527 Customer Interruptions and 43,231,387 Customer Minutes Lost avoided to date in ED1.

Future Deployments

SSEN will continue to utilise and realise the benefits of the Bidoyng technology throughout the remainder of ED1.

ED1 Primary Outputs

Reliability, Safety, Customer Service and Social Obligation Priorities

The technology was implemented straight into BaU following learnings from Electricity North West. More information can be found here:
https://www.camlingroup.com/product/bidoyng

Live Line Tree Harvesting

SHEPD have use of two Live Line Tree Harvesters. These machines can cut down trees adjacent to live overhead power lines and are far more efficient than hand felling, whilst reducing the risk of injury to tree cutters.

Benefits

There has been an estimated £7.5m gross avoided costs, 58,036 Customer Interruptions and 12,564,315 Customer Minutes Lost avoided to date in ED1.

This project has also led to 3,651 tCO_2e avoided due to the reduced requirement to run diesel generation.

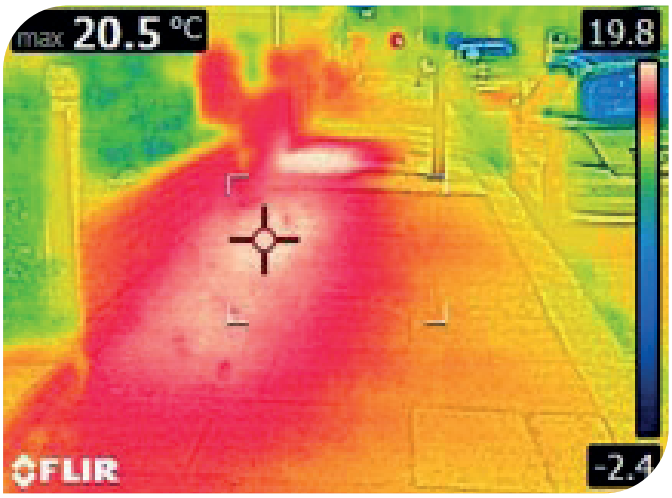
Future Deployments

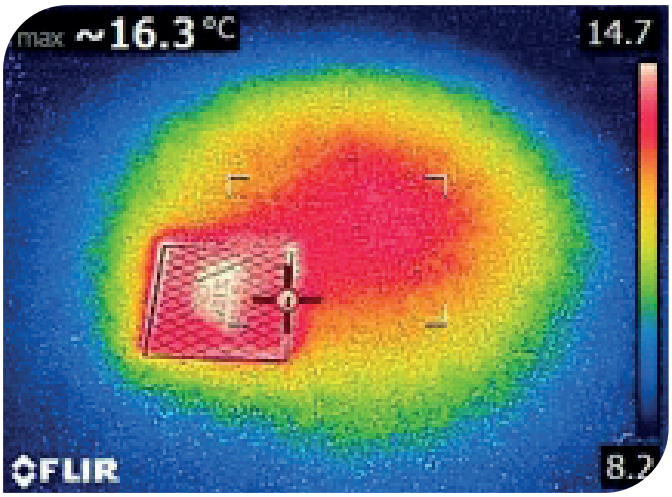
SSEN have use of two live line tree harvesters in SHEPD which will continue to realise benefits throughout the remainder of ED1.

ED1 Primary Outputs

Reliability, Safety and Environment

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. Following the success of the NIA project, 201 thermal imaging cameras were procured as BaU in 2018.

Benefits

There has been an estimated £457k gross avoided costs, 10,131 Customer Interruptions and 914,760 Customer Minutes Lost avoided to date in ED1.

Future Deployments

SSEN will continue to utilise the thermal imaging cameras and realise benefits throughout the remainder of ED1.

ED1 Primary Outputs

Safety, Environment, Customer Service and Social Obligation Priorities

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 by using remotely operated vehicles to carry out tasks associated with forestry mulching around overhead lines. SSEN procured two forestry mulchers in 2017 for our SHEPD licence area.

Benefits

Approximately £284k in cost reductions have been achieved since this technology was deployed as BaU.

Future Deployments

SSEN are considering procuring two new forestry mulchers in SHEPD in 2020/21.

ED1 Primary Outputs

Safety, Environment and Reliability

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

The Cost Benefit Analysis models can be found in worksheet E6, please see worksheet linked to the Appendix of this report.

3.3.3 Innovative Solutions for Connections

3.3.3.1. Flexible Connections

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

SSEN is proud to offers one of the widest suite of flexible connections in the industry, as well as offering flexibility in relation to payment options for connections. The flexible connection offers that we provide can be found below.

Timed Connections

The timed export connection offers the customer the possibility of connecting to the network and exporting during certain periods of the day or week. This is an advantage in areas with low levels of generation diversity.

Intertrip

Legacy type of flexible connection, offering a simple 'on or off' but extremely efficient option for generation connections where network topography does not offer dual circuit capacity for connections in the event of circuit failure.

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 generation in that area.

In 2021 SSEN will deliver the largest ANM system in the UK through the South West Active Network Management (SWAN) project, enabling new generation connections across 60% of its licence area which would not have been possible traditionally due to Transmission constraints. This system will run alongside 4 areas already ANM enabled, including the UK's first and most complex ANM systems on Orkney and Shetland.

SSEN has also undertaken significant development in its ANM systems within ED1, as well as applying efficiencies within the connection processes and informing wider regulatory decisions on ANM implementation. As such ANM connections to all customers are now significantly lower in cost and far more available and timely should connecting customers wish to avoid reinforcement costs related to new connections, examples are available here:
https://www.ssen.co.uk/FlexibleConnections/

Single Generator Active Network Management (SGANM)

SGANM is similar to a full ANM scheme, except instead of managing multiple constraints and multiple generators it manages only one generator and up to two constraints.

3rd Party ANM

There are two types of 3rd party ANM connections for the customer to consider – shared capacity and demand management. Both of which are installed and managed by the customer.

Shared capacity example: An existing generator may have a contracted capacity of 10MW but only have 6MW of connected generation. Therefore, there is the potential for a customer to approach this generator and make use of the spare capacity. The customers will install a system that will ensure the combined export of both generators does not exceed the contracted capacity.

Demand Management example: A new 250kW generator wishes to connect to the distribution network. However due to transmission constraint upstream the generator has a limited export of 50kW. The generator develops a proposal to increase the minimum demand by changing gas boilers to electric boilers on the same circuit as the constrained asset. The generator has calculated this will increase the minimum demand by 200kW. The generator must then ensure that when the 50kW limit is breached that suitable demand is brought onto the network. SSEN will install a fail to safe system so that in the event the customers system fails the generator will be disconnected.

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.

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.

Application Process
Our flexible connections process is available for generation connections above 50kW where there are thermal constraints leading to significant reinforcement works. In existing network areas where ANM schemes are already in place no other flexible option will be available. The main points of the process:

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

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

3.3.3.2. Constraint Managed Zones (CMZ)

A Constraint Managed Zone is a geographic region served by an existing network where requirements related to network security are met through the use of 3rd party Distributed Energy Resources (DER), such as Demand Side Response, Energy Storage and stand-by generators. These techniques are CMZ services provided to SSEN by a CMZ Supplier, however across the wider industry these services are recognised as 'flexibility services'.

SSEN has been at the forefront of implementing flexibility services. CMZs are utilised in areas of our existing electrical network that are or could be;

- Forecast to exceed its firm capacity, where network requirements related to peak electrical demand are met using demand reducing or demand shifting techniques. CMZ techniques will reduce or time-shift demand to avoid capacity constraints and associated reinforcements, driven by load growth or by new connections.
- Subject to planned maintenance works, where DER flexibility services could be employed to maintain network operation or reduce the risk of outage.
- Subject to outages, DER flexibility services are employed to aid in the restoration of normal supply by reducing loading or providing additional power injection.

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 replicable across a range of network scenarios.
- It is compatible with flexible connections and other smart interventions.

SSEN has a published procurement and pricing methodology for placing new CMZs across the reinforcement avoidance (load growth and connection driven), planned outage and fault support scenarios (see links below). Should any of these events occur, a CMZ assessment is undertaken to evaluate the possibility of using a flexible option to deliver the required capacity.

In the event of a CMZ being initiated, an EU compliant tender is implemented to source CMZ suppliers or suitable resources.

SSEN keep a record of all CMZ assessments and decisions at all stages and the results of all historic tenders are available in the links overleaf.

How do people get involved and how can progress be observed?
CMZ Suppliers can provide a service through different alternatives:

- Demand Side Response
  This is via a customer or group of customers connected to the appropriate part of the SSEN network, who have the ability to reduce or increase their energy use at specific times in relation to network constraints.
- Distributed Generation
  These are technologies connected to the SSEN network which have the ability to increase or reduce the amount of power exported in relation to network constraints.
- Energy Storage
  This is via appropriate technologies connected to the SSEN network, which can store or export energy depending on network constraints.

SSEN releases new CMZ opportunities as they are identified. Owners can register their assets on the flexibility register and view details on the procurement process here: **https://www.ssen.co.uk/FlexibleConnections/**

Should you have any questions or wish to discuss CMZ zones please contact the Flexible Solutions Team here: **FlexibleConnections@sse.com**.

3.3.4. Smart Meters

Since SSEN became a live DCC user on the 8th December 2017, a dedicated smart meter operational team has been in place to manage the roll-out of smart meters and ensure compliance with the Smart Energy Code (SEC), whilst preparing to realise benefits from the data smart meters will provide.

There have been a number of challenges in the GB Smart Meter Implementation Programme (SMIP) which have had a knock-on impact on the delivery of a number of functionalities, and a slower roll-out of second-generation meters in both of SSEN's licence areas particularly our SHEPD License area. This has meant that the data, which we'll use to improve our network performance and provide a better service to our customers is not yet available in the volume required to give detailed information.

Due to a number of current key issues within the smart meter implementation programme (SMIP), SSEN have been heavily involved in industry forums to assist in the progression of the issues through to resolution. This has allowed SSEN to understand, follow and implement the necessary changes to ensure smart meter data can be used within the business at the earliest point. This includes reliability of alerts, understanding inconsistent behaviour between smart meters and the introduction of Polyphase smart meters.

Throughout 2019/2020 SSEN have continued to further develop and implement Information Technology (IT) systems and processes to maintain alignment with SEC releases and Data Communications Company (DCC) changes. Most notable, the DCC's SMETS1 Enrolment and Adoption programme commenced which migrates all the first generation SMETS1 meters into the DCC systems and allows the communication between our IT systems and SMETS1 meters. On 23rd April 2020, SSEN had our Data Privacy Plan agreed by Ofgem, this pre-requisite allows SSEN to collect aggregated Consumption Data from smart meters in the future. Alongside this we continue to focus on ways to use and share the smart meter data that will be available to the wider Scottish and Southern Electricity Networks business, in line with our benefits realisation plans.

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

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

- SMETS1 meters provide a significant amount of smart functionality, however they will not provide the same level of functionality to DNOs 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 2019/20 is provided in Table 3.3a.

Table 3.3a – Volume of smart meters installed during 2019/20

	SMETS1			SMETS2		
Licence Area	Installed in 2019/20	Total Installed	% Total Penetration (year-end)	Installed in 2019/20	Total Installed	% Total Penetration (year-end)
SHEPD	20,927	192,916	24.5%	31,726	33,254	4.23%
SEPD	37,352	828,048	26.6%	254,810	296,959	9.23%

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 to the DCC and developed our own systems to manage and monitor alerts sent by smart meters directly into our existing outage management system. Significant effort has gone into ensuring that the design of our systems and infrastructure remains compliant with the SEC which is a mandated requirement for all parties who interface with the DCC.

Our expenditure associated with the development of our IT and communications systems and payments made to the DCC during 2019/20 are detailed in worksheet E5, they are also summarised in Table 3.3b

Table 3.3b – IT expenditure for Smart Meters during 2019/20

Licence Area	SM IT Costs (£k)	SM Communication Licence (DCC) Costs (£k)	Elective Communication (DCC) Costs (£k)
SHEPD	64	893	0
SEPD	257	3,260	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.

In the design of our systems we considered the need to have access to data that will enable us to use the information from smart meters 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 2019/20 are detailed in Table 3.3c

Table 3.3c – Progress on delivery of benefits from Smart Metering throughout 2019/20

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. • Had our Data Privacy Plan approved by Ofgem to enable access to consumption data. • Stage one of our data storage and analytics capability to maximise use of data made available by smart meters has been implemented. Stage two will look to deliver the full productionised capability to retrieve mass volumes of data as the penetration of smart meters increase.
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 into our NDAG application so our Customer Contact Centres can receive and respond to power outage and power restore alerts from smart meters. • Continued engagement with the DCC regarding the future operation of power outage and power restore alerts and polyphase smart meters

Reduction in operational costs to fix faults	• Implemented our NDAG application to ensure that:
	  • We can check the energisation status of individual customers via their smart meter.
	  • Power outage and power restore alerts are available for use in appropriate areas of the business.
	• Implemented the integration of our outage management system into our NDAG application to:
	  • Enable the initiation of supply energisation status checks from relevant locations.
	  • Receive power outage and power restore alerts from smart meters.
	• Continued engagement with the DCC regarding the future operation of power outage and power restore alerts.

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

Category of Benefit	Work Undertaken
Better informed investment decisions for electricity network enforcement	• Implemented our NDAG application to enable access to relevant functionality in smart meters including meter configuration and access to appropriate data. • Developed and submitted our Data Privacy Plan to Ofgem for approval to enable access to consumption data. • Stage one of our data storage and analytics capability to maximise use of data made available by smart meters has been implemented. Stage two will look to deliver the full productionised capability to retrieve mass volumes of smart meter data as the penetration of smart meters increase.
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 our outage management system into our NDAG application to: • Receive voltage related alerts from smart meters. • Enable users to request further information from smart meters regarding recorded voltage measurements. • Continued engagement with the DCC regarding the future operation, and accuracy of voltage data. At the present time inaccuracies mean the current voltage data cannot be relied upon.
Network capacity investment savings from electricity demand shift	• Developing a means to influence suppliers regarding how customer load is controlled.

More details on Smart Metering can be found in worksheet E5 linked to the Appendix of this report.

Looking Forward to 2020/2021

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

- Collaborate with the DCC, Communication Service Providers (CSP's) and Smart Energy Code Administrator and Secretariat (SECAS) on key issues impacting power outage and restore alert performance and inconsistent behaviour in smart meters alongside the implementation of polyphase smart meters.
- Collaborate with the DCC, ENA and other Distribution Network Operators to identify and resolve data quality issues with smart meter data.
- Monitor and progress our detailed plan on benefit realisation and gain early learning from the data we receive from smart meters now and as the roll-out progresses, including SMETS1 enrolment and adoption.
- Support the ongoing DCUSA work associated with the management of RTS meters and SMETS2.

4. Conclusion

We 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 fifth year of RIIO-ED1 provides a clear message to our stakeholders that we have a clear programme to deliver environmental benefits and are aware of our responsibilities to our surroundings and our customers. We have made further progress in the last year and will continue to look to the future and pursue solutions that deliver enduring benefits.

5. Contact us

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

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6. Appendix

Additional Data	Location
Environment Report 2018/19	https://www.ssen.co.uk/DistributionPriceControlReview/
Environmental Report 2019/20 E1-E8 worksheets	
Environment Report 2019/20 E4 & E6 CBAs	
Environment Report 2019/20 E1-E8 Commentary	


SWL 250 Kg.
DANGER OF DEATH
KEEP OFF

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.ssen.co.uk/WorkArea/DownloadAsset.aspx?id=12241**

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
The DNO's strategy for designing, building, and operating its Distribution System in a manner that can reasonably be expected to ensure that Distribution Losses are as low as reasonably practicable.

Environment Report
Standard Licence Condition 47 (Environment Reporting) 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
A document published by the DNO that complies with the requirements set out in the Strategy Decision for RIIO-ED1. This requires the licensee to have in place and maintain an Innovation Strategy for demonstrating the role of innovation within the Electricity Distribution Group of which it is a part.

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

- Heat Pumps
- Electric vehicles
- Domestic Batteries

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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