ST-NET-RRP-001

SSEN DISTRIBUTION LOSSES STRATEGY

Scottish & Southern Electricity Networks

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1 Executive Summary

Electrical losses are an unavoidable consequence of transferring energy across the electricity network, where they have a significant financial and environmental impact. These losses are classified as either technical (resulting from our assets and the movement of electricity through our network) or non-technical (resulting from electricity accounting issues). Although losses are inevitable, it is still critical to take action to reduce actual losses (technical and non-technical) as they are a marker for how efficiently our network is operating. Over the next few decades, there will be major changes in the Distribution network driven by the UK's transition to Net Zero and ambition to have a fully decarbonised power system by 2035. This will impact on our ability to manage losses. It is and will become more important for Distribution Network Operators (DNOs) to consider whole system thinking, to make their networks smarter and more flexible, and to ensure that existing infrastructure is used as efficiently as possible, ensuring they are enablers for Net Zero and not a blocker.

This document sets out SSEN-Distribution's (SSEN-D) approach to managing losses with the aim to reduce losses on our network to as low as reasonably practicable. The losses strategy forms part of our RIIO-ED2 Environmental Action Plan[1] (EAP) where we committed to implement a strategy to efficiently manage losses on our network in the long-term, reclassify losses as a Scope 2 emission and act to reduce actual losses. We aim to deliver reductions in losses by:

- Setting asset and network design policies and specifications to minimise losses where this is demonstrably the right approach.
- Strategically installing lower loss assets, and optimising network configuration where this is demonstrably the right approach.
- Trialling known and new losses reducing techniques, such as methods to stabilise power factor and improve power quality, to assess suitable applications within our network.
- Tackling electricity theft and calculation anomalies through investigation works and wide-reaching communications highlighting the issue.
- Improving our understanding of network losses through research, innovation and collaboration.

Through our targeted initiatives, we hope to realise a losses avoidance of approximately 466,612MWh by the end of the RIIO-ED2 price control period. Whilst we are doing all we can to reduce our losses, we are mindful not to overpromise on our absolute reductions due to the impact from the growth in electrification of heat and transport, which is likely to drive losses up. The critical part for us overcoming this challenge is understanding losses and where they occur on our network. The output of this work will allow us to make evidence-based decisions for our investments.

We will continue to routinely monitor losses performance through our internal environmental and sustainability reporting mechanisms and disclose our performance externally on an annual basis.

We will keep our losses strategy agile to respond to new challenges and inclusive of new technologies. We will also continue to engage with our stakeholders to share learnings and ensure we have the right approach to managing losses.

[1] A_13.1_EAP_CLEANOFGEM (ssenfuture.co.uk)

2 Introduction

Electrical losses are the inevitable consequence of transferring energy across the electricity network, occurring in both the transmission and distribution networks, however, the percentage of losses is higher in distribution networks due to the proportional relationship between losses and current. Distribution networks, which operate at lower voltages, require a higher current to transfer the same amount of electrical energy compared to transmission networks, therefore losses are higher. Typically, in distribution networks, losses account for between 5% and 8% of the total distributed units and result in both a carbon and cost impact to consumers. In terms of cost, Sustainability First estimates that transmission and distribution losses cost a typical household around £100pa[2]. In terms of carbon, losses account for around 90% of a DNO's total Greenhouse Gas (GHG) emissions.

Figure 2.1 details the annual network losses for SSEN-D's two licence areas, Scottish Hydro Electric Power Distribution (SHEPD), in the north of Scotland and Southern Electric Power Distribution (SEPD) in the south of England. The losses depicted are higher in SHEPD than SEPD as technical losses are a function of the resistance of the network, and this is partly dependent on the length of cables. Whilst there is less electrical demand on our network in SHEPD, energy generally needs to be transported over a far greater distance which increases the losses. For the regulatory reporting year 2022/23, the total volume of electrical losses across SSEN-D was calculated as 2,019GWh, equating to 390,448tCO2e and 90% of our total reported GHG emissions, as shown in Figure 2.2.

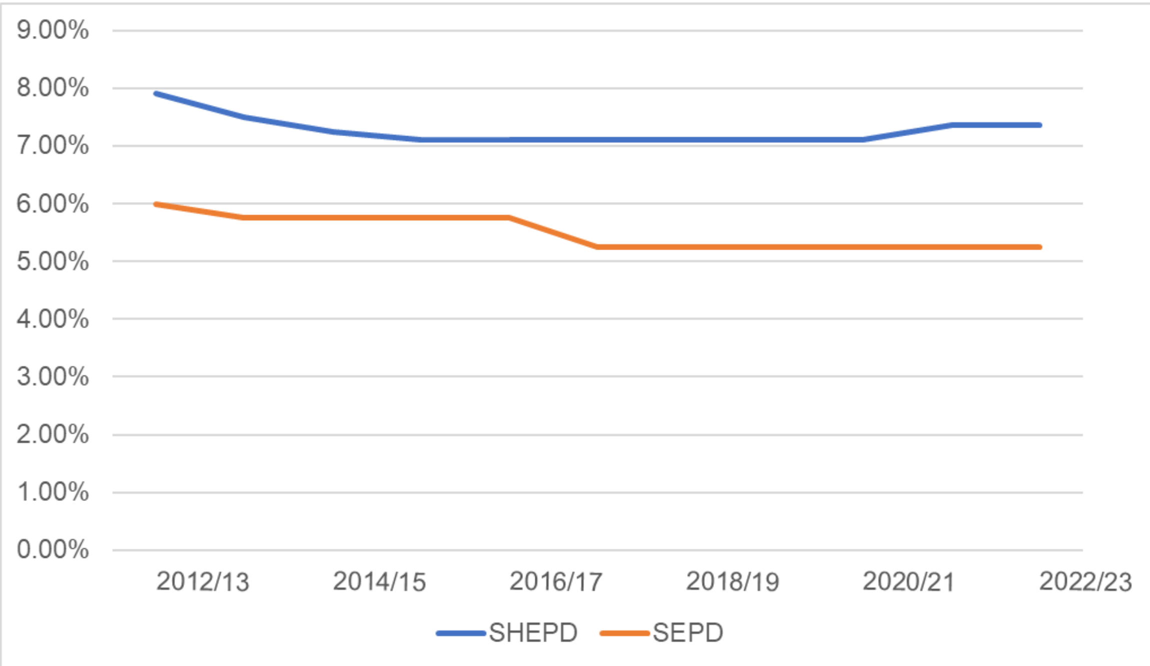

Figure 2.1 – SSEN-D Annual Network Losses

[2] The cost of losses (sustainabilityfirst.org.uk)

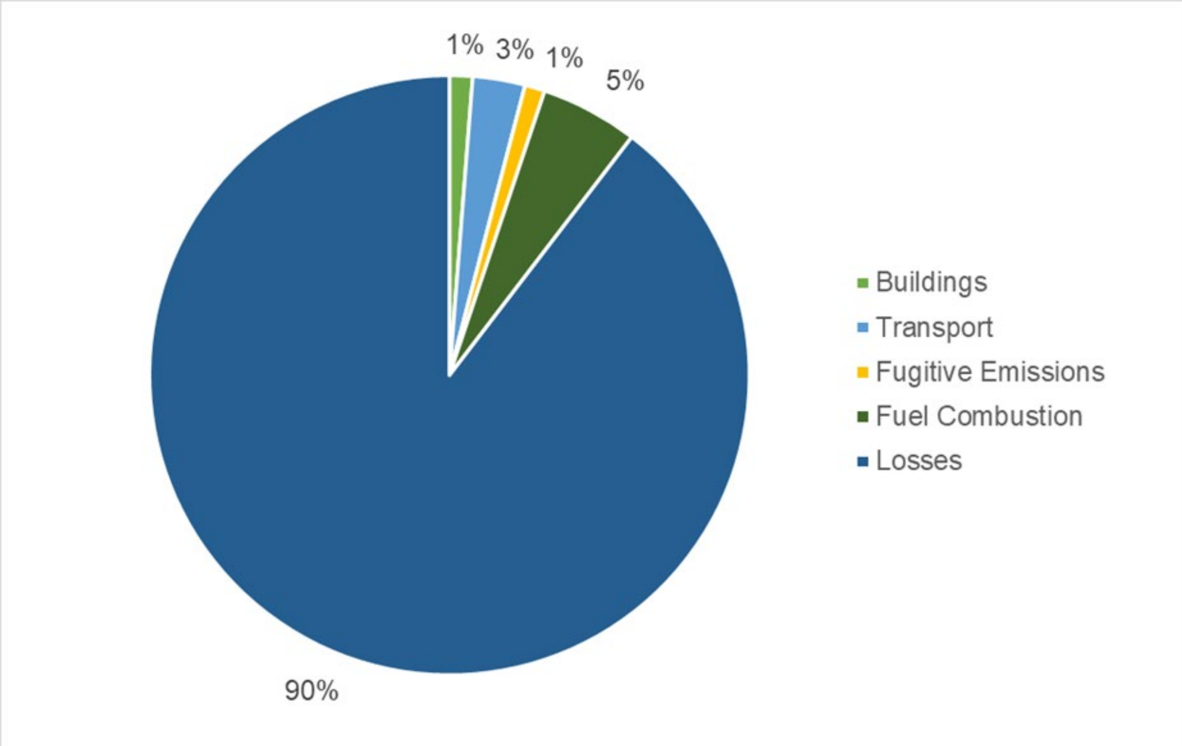

Figure 2.2 - SSEN-D GHG Emission Distribution 22/23

Although losses are inevitable, it is still critical to take action to reduce actual losses due to various key drivers:

a) **Financial:** the greater the losses, the greater the costs to our customers through their electricity bills. This is due to having to generate more electricity to cover losses.

b) **Environmental:** the greater the losses, the greater the carbon emissions and environmental impact to society. This is due to losses representing fuel consumed and emissions produced in the process of electricity generation, which are then lost from the network before reaching our customers.

c) **Regulatory**: we have an obligation under our electricity distribution licence from the Office of Gas and Electricity Markets (Ofgem) to manage Distribution Losses and we must ensure that Distribution Losses are as low as reasonably practicable.

Over the next few decades, there will be major changes in the Distribution network driven by the UK's transition to Net Zero and ambition to have a fully decarbonised power system by 2035. This will impact on our ability to manage losses. The growth in low carbon technologies, electricity storage options like batteries and large demand connections like data centres, will drive demand for increased network capacity, require electricity to be transported from more generating sources and change our generation and consumption patterns. It will become more important for DNOs to consider whole system thinking, to make their networks smarter and more flexible and to ensure that existing infrastructure is used as efficiently as possible, ensuring they are enablers for Net Zero and not a blocker.

This document sets out SSEN-D's approach to managing losses with the aim to reduce losses on our network to as low as reasonably practicable. The losses strategy forms part of our RIIO-ED2 EAP where we committed to implement a strategy to efficiently manage losses on our network in the long-term, re-classify losses as a Scope 2 emissions and act to reduce actual losses. We aim to deliver reductions in losses by:

- Setting asset and network design policies and specifications to minimise losses where this is demonstrably the right approach.
- Strategically installing lower loss assets, and optimising network configuration where this is demonstrably the right approach.
- Trialling known and new losses reducing techniques, such as methods to stabilise power factor and improve power quality, to assess suitable applications within our network.
- Tackling electricity theft and calculation anomalies through investigation works, and wide-reaching communications highlighting the issue.
- Improving our understanding of network losses through research, innovation and collaboration.

3 References

The documents detailed in Table 3.1 - Scottish and Southern Electricity Networks Documents and Table 3.2 – External Documents, should be used in conjunction with this document.

Table 3.1 - Scottish and Southern Electricity Networks Documents

Reference	Title
ST-NET-ENG-001	Strategic Asset Management Plan (SSEN Distribution)

Table 3.2 – External Documents

Reference	Title
Standard Licence Condition 49	Standard conditions of the Electricity Distribution Licence

4 Modifications to Our Losses Strategy

We have an obligation under our Electricity Distribution Licence towards our Losses Strategy as follows:

Standard Licence Condition 49

Part B: The Distribution Losses Strategy

49.4 The licensee must maintain a Distribution Losses Strategy and must keep it under review and where necessary modify it from time to time to ensure that it remains:

(a) calculated to ensure that Distribution Losses are as low as reasonably practicable; and

(b) based upon an up-to-date cost-benefit analysis.

49.5 The licensee must maintain on its Website:

(a) an up-to-date version of its Distribution Losses Strategy; and

(b) an up-to-date record of any modifications that it has made to its Distribution Losses Strategy, including explanations of:

(i) the reasons for and effects of each such modification; and

(ii) how, in the licensee's opinion, the modification better facilitates the requirements of paragraph 49.4 compared with the previous version of the Distribution Losses Strategy.

To meet the requirements of this obligation, our losses strategy, Cost Benefit Analysis (CBAs) and intervention measures will be kept under review by the Strategic Planning & Sustainability Team and updated on at least a two-yearly basis. Revisions may be required in advance of the two-year review period due to the following:

- Revision of investment plans which have a direct impact on our approach to managing losses.
- Changes in the financial, environmental or regulatory landscape which will change our approach to managing losses.
- Significant learnings from the Energy Networks Association (ENA) working groups, other DNOs and innovation projects which will change our approach in managing and monitoring losses.

Table 4.1 will be updated to record the details of the modifications made to our Distribution Losses strategy.

Table 4.1 - Modification Log

Date	Modification	Reason for and effect	SSEN-D Opinion
March 2024	Incorporation of RIIO-ED2 Business plan Losses Strategy, revised structure and addition of latest data and information.	To ensure we have one consolidated strategy, improve clarity of actions we are taking and how we monitor progress for our stakeholders and improve the document control process.	Demonstrates that the strategy is maintained, reviewed and modified where necessary.
Feb 2022	Link included to Losses Strategy submitted as part of the RIIO-ED2 Business Plan.	To communicate the proposed strategy for the next price control period.	Demonstrates that the strategy is being kept under review.
March 2021	Refer to Losses Strategy Change Log 2021 on SSEN-D website		
April 2019	Refer to Losses Strategy Change Log 2019 on SSEN-D website		
April 2018	Refer to Losses Strategy Change Log 2018 on SSEN-D website		

5 What are Distribution Losses?

Electrical losses are the difference between the amount of electricity (real power in kVA) entering the distribution network, from the transmission system or directly from generators, and the amount of electricity leaving the distribution network to our customers. These losses are classified as either technical (resulting from our assets and the movement of electricity through our network) or non-technical (resulting from electricity accounting issues). Electrical losses are calculated and reported in our Business Carbon Footprint (BCF) because they represent fuel consumed and emissions produced in the process of electricity generation, which are then lost from the network before reaching our customers.

5.1 Technical

Technical losses consist of two elements: a fixed amount (a function of the network itself, irrespective of the usage of the network); and a variable amount which is dependent on the amount of energy moving through the network.

- **Fixed Losses:** The loss of electrical energy through heat and noise from assets connected to the network and energised (switched on) with the most significant source being the cores of transformers (generally referred to as iron losses). Fixed losses generally account for between a quarter and a third of the total technical losses on distribution networks.

- **Variable Losses:** The loss of electrical energy through heat from assets being loaded (current running through them) with the most significant source being overhead lines and cables. The heating effect is a function of the resistance and the square of the current flowing through the conductor. If you decrease the resistance, there is a linear decrease in variable losses, however, if you double the current, you quadruple the variable losses. Factors which influence variable losses include the length, material and cross-sectional area of overhead lines and cables, changes in demand, network imbalance, power factor and power quality. Generally, variable losses account for between two-thirds and three-quarters of the total technical losses on distribution networks.

5.2 Non-Technical

Non-Technical losses refer to any electrical energy consumed and not billed. We have categorised them as follows:

- **Metering:** Non-Technical losses resulting from the inherent metering inaccuracy, the electricity consumption required for the meter to function, delays to meter installation or reading errors.
- **Unmetered supplies:** Estimations in legitimate customer or DNO related electricity consumption where metering is not practical or cost-effective e.g. street lighting, traffic lights, road signs, substations.
- **Theft in conveyance:** Unable to accurately bill electricity consumption due to illegitimate customer electricity consumption from bypassing the meter, making an unauthorised connection to our network or when there is no registered supplier at a customer's connection point.

6 Our Approach to Managing Losses

In previous versions of our losses strategy, we identified a number of measures to reduce losses, along with improving our understanding of losses. The measures identified have been reviewed and categorised in Table 6.1 to improve clarity of actions we are taking and progress for our stakeholders. Each measure has been assigned a status category as follows:

- Research – This measure requires further research or trials to decide whether to progress.
- Monitor – This measure has been determined as currently not viable or effective but will be kept under review.
- Discounted – This measure has been fully determined as not viable.
- Adopt – This measure is currently being implemented.
- Continue – This measure has been fully adopted into Business-As-Usual (BAU) but further action may be possible.
- Completed – This measure has been fully adopted into BAU and no further action is required.

Where measures are related to changing assets, we conduct CBAs to identify whether the intervention is justifiable using Ofgem standardised methodology. A summary of the CBA outcomes and losses savings for RIIO-ED1 (2015-2023) and RIIO-ED2 (2023-2028) is detailed in Section 7 Monitoring & Reporting. Sections 6.1 to 6.6 summarise each measure, current work activities associated with the measure and information on losses savings associated with the measure.

Table 6.1 - Summary of Loss Reduction Measures

Category	Intervention Type	Measure	Status
Designing the Network	Asset Design & Specification	Specify minimum rating of transformers	Continue
		Specify minimum sizing of cables	Continue
		Specify minimum sizing of overhead lines	Adopt
		Specify conductor material	Monitor
		Specify minimisation of cable tapering	Adopt
Building the Network	Asset Installation and Replacement	Install Ecodesign Tier 2 Low Loss compliant transformers	Adopt
		Accelerated replacement of historical high loss transformers	Continue
		Install super low loss transformers	Discounted
		Uprating network voltages	Continue
Operating the Network	Network Monitoring	Install LV Substation monitoring devices	Adopt
		Access data from smart meters	Adopt
	Network Modelling	Develop a Digital twin of our network	Adopt
		Develop losses model for our network	Research
	Power Flow Optimisation	Install Transformer Auto Stop Start (TASS) technology	Adopt
		Install On-Load Tap Changing Technology (OLTC)	Research
		Improve power factor	Research
		Improve power quality	Research
		Install low voltage static balancers	Discounted
		Improve LV fault monitoring of contact voltage losses	Research
		Minimise peak demand	Research
Monitoring Losses Performance	Calculation	Improve the calculation of losses	Continue
	Social Impact	Understand the social impact of losses	Research
Minimising Non-Technical Losses	Unmetered supplies	Reduce energy usage at substations	Adopt
	Theft in Conveyance	Resolve conveyance inaccuracies	Continue
Continuous Engagement and Research	Engagement	Improve our understanding of network losses through research, innovation and collaboration.	Continue

6.1 Designing the Network

To ensure that losses are as low as reasonably practicable in the assets we procure for building and configuring our network, we consider lifetime losses costs and benefits to help define our asset and network design policies, standards, and specifications. Section 6.1.1 to 6.1.5 details the outcomes of our analysis for loss reduction measures related to asset and network design.

6.1.1 Specify Minimum Rating of Transformers - Continue

The losses savings gained when upsizing three-phase 315kVA ground mounted transformers (GMTs) to 500kVA, is around 114MWh per transformer over the 60-year life based on a typical load cycle. When costs are considered, the CBA outcome is marginally positive, therefore, we decided to implement a minimum standard rating of 500kVA for GMTs in RIIO-ED1. We have concluded similar analysis for pole mounted transformers (PMTs) and now specify 50kVA transformers as our minimum standard rating on our three-phase high voltage network. During RIIO-ED1, this upsizing equated to losses savings of around 1,140MWh.

Upsizing to 500kVA GMTs and 50kVA PMTs is now our Design Standard for our three-phase network during RIIO-ED2. Further changes to the minimum rating of transformers will be kept under review.

6.1.2 Specify Minimum Sizing of Cables – Continue

Minimum Cable Sizing at LV

Increasing conductor size in cables will reduce losses. We have assessed the potential for increasing the minimum cable size from 95mm^2 to 185mm^2 and 300mm^2 for Low Voltage mains cables. The losses savings gained when upsizing from 95mm^2 to 185mm^2 is around 553MWh/km of cable over a typical 40-year life based on a typical load cycle. When costs are considered the CBA outcome is positive. The losses savings gained when upsizing from 95mm^2 to 300mm^2 is around 779MWh/km of cable over a typical 40-year life based on a typical load cycle. When costs are considered the CBA outcome is positive although by a smaller amount than upsizing from 95mm^2 to 185mm^2. For RIIO-ED1, we specified a minimum cable size of 185 mm^2 for new and replacement installations, where technically viable. During RIIO-ED1 we upsized over 282km of cable at LV resulting in a losses saving of 13,402MWh.

For RIIO-ED2, we have made the decision to upsize the minimum cable size from 185mm^2 to 300mm^2 for new installations, where technically viable. The ability of existing equipment to accept the larger diameter cable will be assessed on the asset type and we must recognise that we will need to use smaller 185mm^2 cable for tapering, and as intermediate cables to joint on to smaller legacy cables or for terminating purposes. When replacing existing cable at the end of its life, a minimum size of 300mm^2 will be adhered to where possible. Further changes to the minimum cable sizing at LV will be kept under review.

Minimum Cable Sizing at 11kV

Increasing conductor size in cables will reduce losses. We have assessed the potential for increasing the minimum cable size from 75mm^2 to 150mm^2 for 11kV mains cables. The losses savings gained when upsizing from 75mm^2 to 150mm^2 is around 495 MWh/km of cable over a typical 40-year life based on a typical load cycle. When costs are considered the CBA outcome is positive, therefore, for RIIO-ED1, we decided to implement a minimum cable size of 150mm^2 for 11kV HV mains cables. During RIIO-ED1, we oversized over 219km of cable at 11kV resulting in a losses saving of 9,479MWh. We have concluded similar analysis for upsizing to 300mm^2 and now specify 300mm^2 as our Design Standard and will be implemented where technically viable.

Minimum Cable Sizing at 33kV

Previously, we made the decision not to upsize new installations due to the increased cost of the larger cable outweighing any losses gain, after net present value is considered.

However, in specific instances, there are opportunities to cost effectively increase the size of 33kV cables to reduce losses. An example of this is submarine cables which are generally more bespoke. The Pentland Firth East submarine cable, which connects the Orkney Islands to the mainland, underwent replacement in 2020. The 240mm^2 cable was upsized to 400mm^2 due to its additional current carrying capacity. Whilst this increase in cable size was capacity driven, it will deliver a losses saving of over 30,000MWh over the cable's life.

Whilst our Design Standard previously allowed the use of a cable size of 95mm^2, cables of 300mm^2 aluminium were generally used in SEPD, with 95mm^2 being more commonly used in SHEPD. As per LV and 11kV, we will formally set the minimum to 300mm^2, where possible.

6.1.3 Specify Minimum Sizing of Overhead Lines - Adopt

Increasing conductor size in overhead lines will reduce losses. We will upsize Overhead Line (OHL) conductors beyond minimum conductor sizing, where technically viable and where proven positive in a CBA for losses reduction. This upsizing should be considered on every new project. Recognising a potential to reduce losses by changing our Design Standard we now specify 50mm^2 aluminium or 32mm^2 copper at high voltage and 95mm^2 aluminium at low voltage as standard.

6.1.4 Specify Conductor Material - Monitor

Increasing the cross-sectional area is a beneficial action in reducing losses, however benefits can also be realised by changing the conductor material from aluminium to copper. The use of copper conductors instead of aluminium conductors can be costly, increase the risk of theft and cause jointing and handling issues. Currently the cost of copper outweighs any losses savings, but we will keep this under review.

In RIIO-ED2, a considerable amount of our asset replacement will involve switching out of old copper conductors for new aluminium conductors, which could drive losses up. In these occasions, we will size the cross-sectional area of the aluminium conductors to avoid an increase in losses as set out in section 6.1.2 and 6.1.3.

6.1.5 Specify Minimisation of Cable Tapering - Adopt

We have updated our Design Standards to minimise cable tapering wherever practicable. Cable tapering will continue where there is a need to connect a larger sized cable onto a small sized cable. The length of the intermediate cable required will be kept to less than 20m. Range taking joints will be used wherever possible to negate the need for tapering.

6.2 Building the Network

To ensure that losses are as low as reasonably practicable in the assets we install, repair or replace, we consider lifetime losses costs and benefits to inform our investment decisions. Section 6.2.1 to 6.2.4 details the outcomes of our analysis for loss reduction measures related to asset and network installation.

6.2.1 Install Ecodesign Tier 2 Low Loss Compliant Transformers – Adopt

Over the course of RIIO-ED1, the transposition of EU Directive 2009/125/EC, which established a framework for the setting of ‘ecodesign’ requirements for energy-related products into GB law, has meant that certain lower loss assets have become obligatory. The Directive sets minimum losses values for transformers and has been implemented to provide an increased focus on equipment losses from a manufacturer’s perspective and to drive innovation in this area. This means that it is now mandatory for all EU network operators to purchase transformers that meet or better the efficiency criteria set out in the Directive.

Previously, we took the decision to ‘strip out’ reductions delivered from installing assets that met the requirements of this EU Directive because they were no longer driven by a SSEN-D specific policy. However, on reflection, these still constitute improvements in our losses performance, and we believe reductions delivered from adopting these new minimum standards should still be counted and included in our reporting.

During RIIO-ED1, we replaced 274 transformers with Eco-design Tier 2 Low Loss compliant Transformers which equates to a losses saving of 47,193MWh.

All new transformers planned for installation on the network during RIIO-ED2 will be low loss as per the EU Transformer Eco-design Directive[3] Tier 2 specification.

6.2.2 Accelerated Replacement of Historical High Loss Transformers - Continue

A past innovation project, ‘Management of electricity distribution network losses’ by Imperial College and Sohn Associates, funded by Western Power Distribution and UK Power Networks, concluded that secondary transformers installed before circa 1960 may have significantly higher combined fixed and variable losses than modern equivalents. Whilst the age of these assets exceeds their expected

[3] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0548&from=EN

useful life, many remain in a healthy condition for continued service, but advancing their replacement with modern equivalents is further supported from a losses perspective.

During RIIO-ED1, we accelerated the replacement of 88 historical high loss transformers with Eco-design Tier 2 Low Loss compliant Transformers which equates to a 2,594MWh losses saving. We will continue to carry out further investigations to identify transformers to replace. Their replacement will depend on fault history, condition, and cost effectiveness but they will be replaced with Eco-design Tier 2 Low Loss compliant transformers as a minimum. During RIIO-ED2 we intend to replace 630 transformers with low loss compliant versions.

6.2.3 Install Super Low Loss Transformers - Discounted

The cost of procuring super low loss transformers is around double that of standard transformers. The high capital costs associated with procuring and installing this equipment do not currently pay back in losses savings over the life of the plant. Therefore, we are not planning on implementing this initiative. Additionally, the larger size of the equipment will increase transportation and civil costs for any potential deployment, which makes cost effective deployment even more challenging.

6.2.4 Upgrading Network Voltages - Continue

As losses are proportional to the square of the current, and current is directly proportional to the power throughput, increasing network voltages can reduce losses for the same power transfer. For example, increasing the voltage of legacy 6.6kV networks to 11kV, although generally driven by capacity requirements, can reduce losses by approximately two thirds.

During RIIO-ED1, we upgraded 77km of our SEPD network cables from 6.6kV to 11kV, equating to a losses saving of 3,968MWh.

6.3 Operating the Network

The way in which we operate the network is rapidly changing with the transition from DNO to DSO. This is driven by the UK's transition to Net Zero and ambition to have a fully decarbonised power system by 2035, which will impact on losses and our ability to manage them. We will need to make our network smarter and more flexible, to ensure that the existing infrastructure is used as efficiently as possible with monitoring and modelling as critical components. Section 6.3.1 to 6.3.11 outline the measures we are taking to reduce losses to as low as reasonably practicable in the operation of our network, whilst recognising the challenge the transition to DSO will bring.

6.3.1 Install LV Substation Monitoring Devices - Adopt

Increasing visibility of the low voltage network is a key requirement of the transition to DSO as load patterns on the network become more complex. The LV monitoring project is aimed at improving network visibility of load profiles on secondary transformers. In RIIO-ED2, we intend to deploy over 21,000 LV monitors at secondary substations, allowing us to monitor load demand, power factor and power quality across much more of the network than before. The data which is connected via a cloud offering to control rooms can be used to identify where there are issues which require intervention such as low power factor where losses will be higher. Better network data will also support more targeted deployment of new flexibility services which enables the ability to shift the timing or location of generation or demand and will be vital to optimise utilisation of the existing network and manage losses. LV substation monitoring data can also inform on losses estimations, further building how we model and then monitor losses. We will work to ensure that the benefits of LV monitoring data can be realised from a losses perspective and will seek opportunities to use this data to inform and target losses reductions. For more information on the LV monitoring project see our Network Visibility Strategy[4].

[4] ssen-network-visibility-strategy-feb-2024.pdf

6.3.2 Access Data From Smart Meters - Adopt

As mentioned in Section 6.3.1, increasing visibility of the low voltage network is a key requirement of the transition to DSO. Data from smart metering can improve network visibility of customers generation and consumption patterns. In RIIO-ED2, through smart metering, we will have better access to half hourly consumption and export data, allowing us to monitor maximum demand, voltage, power and energy profiles, and power quality. The data can be used to identify where there are issues that require intervention such as poor power quality which can increase losses. Better network data will also support more targeted deployment of new flexibility services which enables the ability to shift the timing or location of generation or demand and will be vital to optimise utilisation of the existing network and manage losses. Smart metering data can also inform on losses estimations, further building how we model and then monitor losses. We will work to ensure that the benefits of smart meter data can be realised from a losses perspective and will seek opportunities to use this data to inform and target losses reductions. For more information on the smart meter project see our Network Visibility Strategy[4].

6.3.3 Develop A Digital Twin of Our Network - Adopt

We have plans to develop a digital twin using GIS in RIIO-ED2 which will provide a detailed digital representation of our network and customers. This will help us to better model and understand the current loading and losses on the LV network. The information provided by the digital twin will help us to identify "hotspots" or areas where there is greater opportunity for losses reduction, enabling us to target these areas with interventions. It will also provide us with the ability to consider various future scenarios for better and more efficient decision-making.

An example of how a digital twin could be used to reduce losses is by identifying where it may be beneficial to move an open point to better balance customer numbers between two or more feeders which usually results in improved balancing of load. Open points are where networks are electrically separated via switches, which are strategically positioned to optimise customer numbers, load and to reduce switching operations under first circuit outages.

6.3.4 Develop Losses Model for Our Network – Research

With the increasing amount of network data available to us, it becomes easier to develop a losses model of our network. This will improve our management of losses by identifying assets that need to be replaced or upgraded, network voltages that need to be upgraded or reconfigured, and where other improvements to load management are required from a losses perspective. During RIIO-ED2, we will consider the feasibility of developing a losses model connecting existing initiatives such as the digital twin, LV substation monitoring and smart metering.

An example of how a losses model could be used to reduce losses is by identifying legacy inefficient network configurations, where it may be beneficial to modify the existing circuits or substation configurations to enhance the operational flexibility. This can lead to a losses reduction in some cases.

6.3.5 Install Transformer Auto Stop Start (TASS) Technology - Adopt

SSEN's Low Energy Automated Networks (LEAN)[5] innovation project (supported by Ofgem's Tier 2 Low Carbon Networks Fund (LCNF)) has developed and applied Transformer Auto Stop Start (TASS) technology to reduce losses at 33/11kV primary substations.

The key principle of TASS is to switch off one of two or more transformers in a primary substation at times of low demand to avoid the fixed iron losses associated with that transformer. The TASS system provides local, automated control within the substation to monitor the loading, control the switching and to respond to SCADA alarms and status information from other network assets. In

[5] LEAN | SSEN Innovation (ssen-innovation.co.uk)

addition, commands incorporated into the Distribution Management System provide the central network Control Room with remote supervision and management capability.

The TASS system commenced trial operation in June 2018, and over the 18-month trial period demonstrated losses savings of over 100MWh across 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.

In RIIO-ED2, we are committed to installing TASS technology to reduce our substation losses as set out in our Business Plan[6]. We intend to install 59 TASS systems in SHEPD and 74 TASS systems in SEPD, which will deliver carbon savings of 595.41tCO_2e.

6.3.6 Install On-Load Tap Changing Technology - Research

Conventional 11kV Ground Mounted Transformers (GMT) have fixed tap changers built into them meaning they operate at a fixed voltage level and cannot automatically regulate the voltage on the LV network to maximise efficiency and improve power quality to customers. New transformers can instead be fitted with On-Load Tap Changers (OLTC) and with appropriate monitoring and control system technology, can respond automatically in real time to changes in demand and generation across the 11kV and LV network. This allows DNOs to implement a technique known as Conservation Voltage Reduction (CVR) to reduce the energy consumed by the customers fed by each HV transformer, with associated reduction in losses and cost savings for our customers.

Previous GB DNO innovation projects[7] have proven that CVR can reduce the consumption of network customers by 5-7.5% each year by keeping the LV supply voltage as close to the lower statutory limits as possible. Keeping the voltage low allows various household devices and loads to operate more efficiently and pull less energy from the network which also means lower losses. The LV OLTC can also release capacity on the network by alleviating voltage constraints caused by the adoption of photovoltaics and electric vehicles. This additional benefit enables the distribution network to accommodate a higher penetration of Low Carbon Technologies (LCTs) before wider and costly network reinforcement is required.

The utilisation and penetration of On-Load Tap Changing technology during RIIO-ED2 is being reviewed. OLTC has not yet been deployed at scale across our network so we are exploring the benefits of installing replacement 11kV GMTs fitted with OLTC technology to conserve voltage.

6.3.7 Improve Power Factor - Research

Power factor can be used to measure how efficiently electrical equipment utilises the amount of power supplied to it and ranges between zero and one, where one is a perfect power factor. A poor power factor typically less than 0.95 will increases losses. Work completed within an earlier SEPD Innovation Funding Incentive (IFI) project modelled the distribution network on the Isle of Wight and completed a detailed CBA on the benefits of installing equipment to move the power factor closer to unity i.e. one. The benefits did not justify the investment as the power factors calculated were on average above 0.95, which does not leave significant room for improvement and hence our networks are currently operating efficiently. There may however be specific locations where the power factor is low enough to justify intervention. The outputs from the LV monitoring project will allow us to monitor power factor on more of the network and could assist us in identifying locations that may need intervention, see section 6.3.1 for more details. Further analysis will be conducted should suitable locations become apparent.

In addition to this, ongoing industry work is modelling the typical power factor on the network and its impact on losses. We will review the findings of this work when they are published and consider if it is appropriate for the SSEN-D network.

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6 https://ssenfuture.co.uk/wp-content/uploads/2021/11/5_SSEPD_ENV_LOSSES_TASS.pdf
7 Smart street (enwl.co.uk)

6.3.8 Improve Power Quality - Research

Large volumes of LCTs, controlled by power electronics, have the potential to produce harmonics which may have a cumulative impact of increasing network losses. At present, the penetration of LCTs, such as EVs, is not sufficiently high for this to be a major issue. However, there are ongoing innovation projects that are examining this issue in more detail. We will consider and reflect on the learning from these projects as they progress.

One possible solution to mitigate the impact is the use of active harmonic filters. SSEN-D demonstrated the use of these devices within its New Thames Valley Vision[8] (NTVV) project on the LV network, as part of energy storage deployment. Whilst these devices did help to resolve the harmonic issue, they also consumed energy, which in some circumstances exceeded that of the losses prevented.

Power quality issues could increase in the future as the number of LCTs increases on the network. The outputs from our smart metering project will assist us in identifying locations where power quality is an issue and any intervention required, see section 6.3.2 for more details. Our recently launched Low Voltage Power Quality (LVPQ) project[9] will also help by aiming to test a range of high technology readiness devices that can restore power quality and boost network capacity. Conventional reinforcement takes time and may not always be the most economic solution. Therefore, alongside flexibility, we need a suite of technology-based solutions to address these power quality issues including harmonics, voltage and phase imbalance. Testing will occur at the Power Networks Demonstration Centre (PNDC) with additional testing on the network. The project will also develop the processes for the rapid assessment, selection and installation of the most appropriate solutions.

The learning from our NTVV project and the wider portfolio of innovation projects in this area will help ensure that we have options available to resolve any future issues. In addition, we will continue to engage with the supply chain to ensure we are fully aware of future solutions as they are developed.

6.3.9 Install Low Voltage Static Balancers - Discounted

These devices essentially take power from a highly loaded phase and transfer it to a lower loaded phase, thereby balancing the voltage across the three phases. The device is normally installed at the end of a long feeder circuit with an uneven distribution of load between phases. Although installed primarily to address voltage problems, the device also has the benefit of reducing the peak power on a particular phase, which can reduce the total feeder circuit losses. The imbalance does have to be of a significant magnitude for a sustained period of time for the losses saved to outweigh the energy consumed by the device itself.

CBA and learning from the NTVV project suggests that whilst there is a losses saving of around 210MWh over the 40-year life of a static balancer, this benefit does not outweigh the cost of procuring and installing the equipment. As such, we have not deployed this solution but will keep the CBA under review should specific circumstances result in positive benefits.

6.3.10 Improve LV Fault Monitoring of Contact Voltage Losses - Research

Defects in underground cables lead to the occurrence of losses in networks, which are defined as contact voltage losses. SSEN-D have trialled the use of Mobile Asset Assessment Vehicle (MAAV) technology to detect faults in the LV network. In general, it appears to be more cost effective in urban areas, thus not appropriate for a lot of SSEN-D's network, however, we recognise the potential benefit that fault detection can have on losses so we will keep this under review in RIIO-ED2.

6.3.11 Minimising Peak Demand - Research

As consumer demand for energy isn't consistent throughout the day, there are times when energy use leads to a peak in demand. This causes our network to be run harder and thus increases losses.

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[8] https://www.ssen.co.uk/news-views/2017/2017-ntvv-concludes/

[9] Low Voltage Power Quality (LVPQ) | ENA Innovation Portal (energynetworks.org)

Although our network is built to cope with peak demand, future uptake of LCTs could extenuate the peak or cause it to be extended for longer periods of time which will increase network losses. SSEN-D have a variety of innovation projects targeting network power flows to reduce the impacts of peak demand.

Our ongoing EV smart charging projects[10] and Social Constraint Managed Zone[11] project could be particularly effective in reducing peak demand and helping to reduce network losses. The projects look to better balance consumer demand by using constraint managed services and flexible charging systems to redistribute energy demand and reduce peak power demand. The outcomes and learning from these projects will be further developed and considered for optimising network power flows in the future.

6.4 Monitoring Losses Performance

6.4.1 Improve the Calculation of Losses - Continue

We calculate and report on a variety of losses metrics from our network for SSEN-D's two licence areas, SHEPD and SEPD to demonstrate our performance including:

- The percentage (%), volume (GWh) and carbon impact (tCO2e) of electrical losses from our network.
- The cost benefit analysis (CBA) for implementing intervention measures to reduce actual losses on our network.
- The savings in losses volume (MWh) for intervention measures implemented on our network.

The percentage and volume of electrical losses from our network is derived from an industry standard model utilising both percentage of purchases and sales of electricity from the grid, with the resulting volume converted into the equivalent tonnes of carbon dioxide (tCO2e) using a standardised conversion factor[12]. The methodology has numerous inputs and assumptions which we aim to refine and improve over time. We will also aim to model our losses beyond a pricing perspective in RIIO-ED2 and intend to do so with the support of our academic links.

We utilise the Ofgem specified societal CBA tool to determine the lifetime costs and benefits of implementing intervention measures to reduce actual losses on our network and use this information to report predicted losses savings. This methodology is a suitable approach for assessing traditional methods of reducing losses through changing assets but is more challenging for novel methods of reducing losses such as minimising peak demand. The Ofgem CBA is also based on numerous inputs and assumptions such as the predicted cost of carbon. We will work collaboratively with Ofgem and other DNOs to improve the CBA and framework for assessment and reporting of losses savings.

6.4.2 Understand Social Impact of Losses - Research

Whilst the grid is gradually decarbonising, meaning the carbon impact of losses will lessen, there remains the financial impact of losses on consumers and customers. We need to work to better understand the financial impact of losses to add to and build on the environmental/carbon case for the reduction of losses and help ensure a just transition to Net Zero. We aim to do this with the support of our academic links and partnerships.

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[10] https://smartenergycodecompany.co.uk/modifications/allow-dnos-to-control-electric-vehicle-chargers-connected-to-smart-meter-infrastructure/
[11] https://www.ssen.co.uk/SmarterElectricity/Flex/
[12] Government conversion factors for company reporting of greenhouse gas emissions - GOV.UK (www.gov.uk)

6.5 Minimising Non-Technical Losses

The following section details the work on non-technical losses. The outputs are expected to have an impact on the total network losses within our licence areas. However, given that the impacts cannot be predicted in the same manner as in the technical losses section, this does not quantify the losses savings in the same way.

6.5.1 Reducing Energy Usage at Substations - Adopt

In substations, energy is typically consumed for heating, lighting, dehumidification and cooling equipment, protection/control systems, security systems, oil pumps, air compressors and battery chargers to maintain secure network operation and resilience. The power supplies to substations are usually derived from the grid transformer and associated auxiliary/earthing transformers. Presently, these supplies are unmetered and substation demand is therefore not accounted for separately but still contributes to network losses. SSEN Transmission commissioned the Scottish Energy Centre (SEC) at Edinburgh Napier University to carry out a study on a typical substation, to better understand electricity consumption and identify energy reduction measures. The findings from this study were further developed for application in SSEN-D through work with Strathclyde University and CBAs undertaken to determine our approach for RIIO-ED2[13]. During RIIO-ED2, we plan to undertake refurbishment works at 13 substations in SHEPD and 31 substations in SEPD ranging from 33kV to 132kV.

6.5.2 Resolving Conveyance Inaccuracies - Continue

Situations arise where energy is delivered and consumed but is not accurately recorded in the electricity settlement system and therefore, becomes lost energy. The main causes of these non-technical losses include missing and unregistered metering points (Meter Point Administration Numbers, MPANs) and incorrect recording of unmetered supplies. Such non-technical losses are often regarded as ‘conveyance’ related and we have a dedicated Network Protection team in SSEN-D to investigate and address these discrepancies. The activities of this team include:

- Responding to network tampering notifications and ‘tip-offs’ from a range of stakeholders.
- Undertaking targeted customer site visits and network plant and equipment inspections.
- Effecting repairs to electricity services and mains supplies damaged by tampering.
- Assessing unrecorded energy and updating information systems accordingly.
- Participating in industry and government groups regarding energy theft.
- Preparing cases for enforcement action and pursuing prosecutions.

Since being established in 2014, they investigate on average 4,778 records per month and have resolved an average of 7,821 records per annum.

Non-technical losses associated with missing or unregistered MPANs can be attributed to incorrect registration of the metering point or from theft. Typically, these considerations result in the under-recording of energy consumption. We work closely with suppliers and metering service providers to improve settlement data and metering point registration accuracy. We will continue to focus on reducing the numbers of metering points without a registered supplier and implement tighter controls on the allocation of new MPANs to property developers. We will also continue to proactively monitor the number (and check the status) of metering points registered as disconnected and de-energised by suppliers. We will cooperate fully in Elexon Audits to check settlement data and resolve any inaccuracies identified with corresponding commitments to refine internal processes to prevent any

[13] 6_SSEPD_ENV_LOSSES_SUBSTATION_CLEANFINAL_REDACTED (ssenfuture.co.uk)

recurrence. During the roll-out of smart metering where high volumes of meters will be changed within relatively short timeframes, we will work with all relevant stakeholders to develop robust industry procedures to ensure accurate settlement.

Previously, we have run campaigns to educate our customers on non-technical losses, highlight the risks of energy theft and promote a platform where the public can aid the detection and resolution of incidents. For example, our #NotWorthTheRisk campaign, which ran in 2018 and 2020, engaged with over 1.6 million customers. We will keep under review the need for future campaigns.

Non-technical losses associated with unmetered supplies can be attributed to incomplete database records of unmetered customer loads, inaccurate equipment inventories and errors regarding the assumed demand characteristics. Typically, these considerations result in the under-recording of energy consumption. We continue to work with the main unmetered supply customer groups to ensure equipment inventories are regularly updated and actively pursue customers where inventories have not been received. A proportionate approach will be adopted to improve the accuracy of unmetered supply records by targeting local authorities and large national companies who operate within our networks. Where customers are unwilling to engage regarding asset inventories for their unmetered supplies, we reserve the right to undertake selective and targeted equipment audits in accordance with the Managing Unmetered Energy Street Lighting Inventories document[14]. This allows us to improve the accuracy of consumption information for inclusion in energy settlements.

6.6 Continuous Engagement and Research

6.6.1 Improving Our Understanding of Network Losses Through Research, Innovation and Collaboration - Continue

As losses can be significantly impacted by customer demand, it is important to ensure our customers have access to energy efficiency education and information. We work with various partnerships to educate our customers on energy efficiency measures such as Yes Energy Solutions and will continue to do so over the course of RIIO-ED2 and explore any other opportunities. We will also continue our work to provide energy efficiency forecasts to our customers to improve demand and consumption patterns and to support the rollout of energy efficiency measures where there is a customer and network benefit. For more information, please refer to our Consumer Vulnerability Strategy[15].

In terms of developing new and novel techniques to reduce or understand losses we will continue to work with the Energy Networks Association (ENA), other DNOs, industry, academia and other interested stakeholders through research, innovation, and collaboration. Innovation will be essential in supporting the transition to Net Zero, delivering more for less, and enabling all our customers, including those in vulnerable situations, to benefit from a greener world. More detail on Innovation can be found in the Innovation Strategy[16].

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[14] Unmetered Supplies - Elexon BSC
[15] Consumer Vulnerability - SSEN
[16] Innovation Strategy | SSEN Innovation (ssen-innovation.co.uk)

7 Monitoring & Reporting

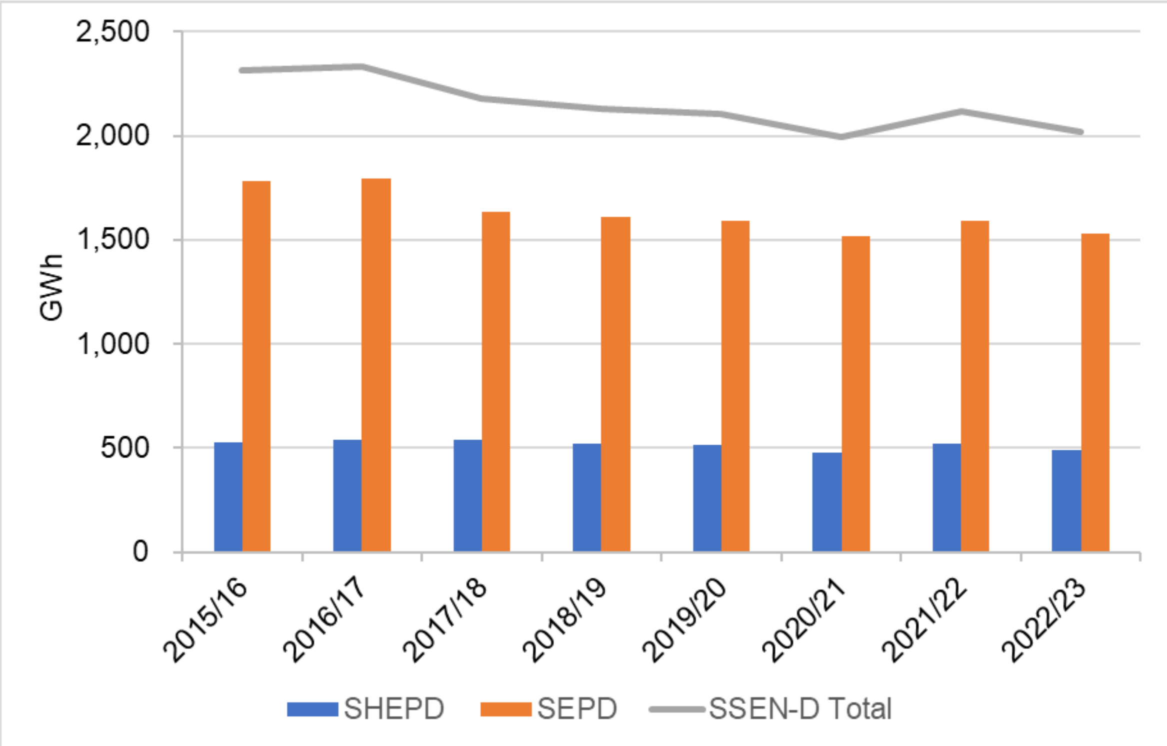
7.1 Historical Performance

Currently, around 5-8% of the electricity distributed on our networks is reported as losses; however, this varies every year depending on various influencing factors, primarily customer demand. The percentage and volume of electrical losses from our network is derived from an industry standard model, utilising both purchases and sales of electricity. The resulting volume is converted into the equivalent tonnes of carbon dioxide emissions (tCO2e) using a standardised conversion factor[12].

Figure 7.1 details the annual losses volume for SSEN-D's two licence areas, SHEPD and SEPD and the combined total. The figure shows that the volume of losses has reduced over the RIIO-ED1 period. Figure 7.2 details the corresponding equivalent tonnes of carbon dioxide emissions (tCO2e) associated with the losses volume, with emissions dropping significantly over the RIIO-ED1 period. The losses reductions are a result of our work to reduce network losses, a significant downward change in the conversion factor used to derive carbon impact (due to an increase in the proportion of renewables in the generation mix) and a decrease in network demand following the Covid-19 pandemic and more recent cost-of-living crisis experienced throughout the UK.

Table 7.1 provides a snapshot summary of the CBA outcomes on the losses reduction measures for RIIO-ED1 and the calculated savings. Overall, we achieved a saving of circa 80GWh by delivering asset related interventions and we spent an estimated £91.9m in SEPD and £64.1m in SHEPD on specific loss reduction activities. We have also achieved a saving of circa 987GWh by delivering interventions to reduce non-technical losses.

For further information on our losses performance over RIIO-ED1 please read our 2023 Annual Environmental Report[17].



[17] ssen-annual-environment-report-2023.pdf

Figure 7.1 - ED1 Annual Network Losses Volume (GWh)

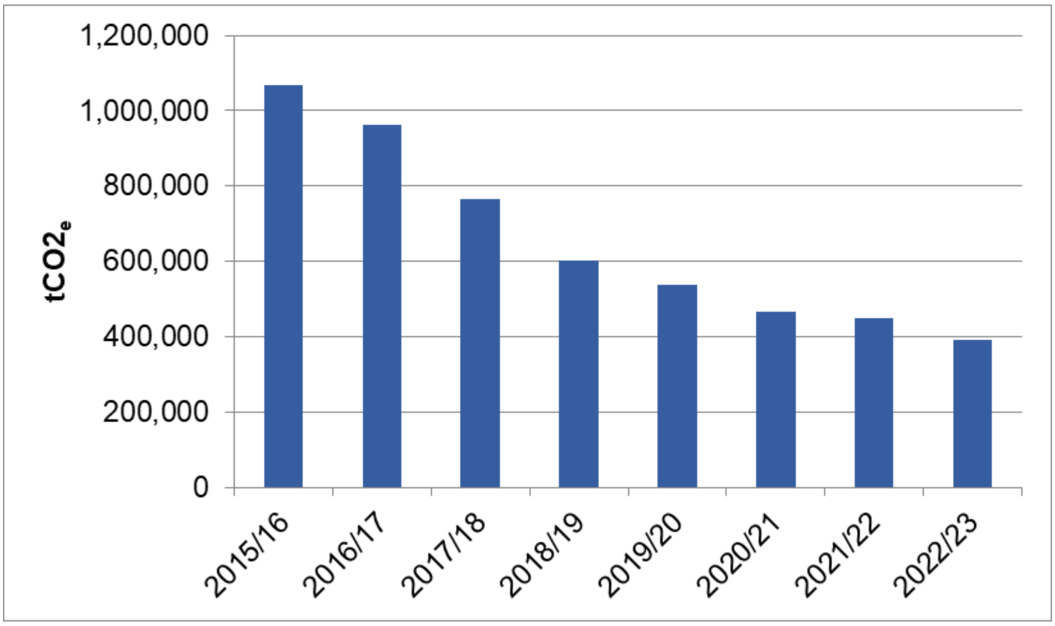


Figure 7.2 - ED1 Annual Network Losses Business Carbon Footprint (tCO2e)

Table 7.1 - Summary of CBA Outcomes and Losses Savings for ED1

		CBA outcome	ED1 Calculated Savings (MWh)
Intervention	**Transformers**		
	Low Loss Transformers	Implemented	47,193
	Super Low Loss Transformers	Not Implemented - cost prohibitive	
	Minimum Sizing of Transformers	Implemented	1,140
	Replacement of historical high loss transformers	Select Incidences	2,594
	Conductors		
	Minimum Cable Sizing at LV	Implemented	13,402
	Minimum Cable Sizing at 11kV	Implemented	9,479
	Minimum Cable Sizing at 33kV	Select Projects	2,144
	Upgrading of 6.6kV to 11kV	Implemented	3,968
	Operational Measures		
	Power factor correction	Not Implemented - not currently applicable	
	LEAN - Switching out underutilised plant	Implemented at trial sites	331
	Power quality	Not Implemented - not currently applicable	
	Low voltage static balancers	Not Implemented - cost prohibitive	
	Measures to alter network power flows	Not Implemented - not currently applicable	
		Total Technical Losses Saving (MWh)	80,250

		ED1 Calculated Savings (MWh
Intervention	**Non-Technical Losses**	
	MPAN rectification – Domestic	686,897
	MPAN rectification – Non-Domestic	300,306
	Total Non-Technical Losses Saving (MWh)	987,203

7.2 RIIO-ED2

The losses strategy forms part of our RIIO-ED2 EAP where we committed to implement a strategy to efficiently manage losses on our network in the long-term, reclassify losses as a Scope 2 emissions and act to reduce actual losses. We have set a Science-Based Target (SBT) with the Science Based Target Initiative (SBTi) for greenhouse gas emissions reduction. Our 1.5°C SBT is in line with the latest climate science and will include electrical losses in line with the GHG Protocol Corporate Accounting and Reporting Standard[18]. Our SBT targets a 55% reduction in GHG emissions by 2033, meaning at least a 35% reduction in our combined Scope 1 and 2 emissions in RIIO-ED2, which for losses means reducing the emissions associated with losses to less than or equal to 350,233tCO_2e by the end of the final year of RIIO-ED2 (2027/28). We have committed to a reduction in our losses after grid decarbonisation and therefore, treating them as a priority. As well as setting an SBT, we will meet Net Zero by latest 2045, and will aim to better this date through legitimate, transparent, and fair methods. We will continue to routinely monitor the percentage, volume (GWh) and carbon impact (tCO_2e) of electrical losses from our network, performance against our SBT greenhouse gas emission

[18] Corporate Standard | GHG Protocol

reduction target and performance against our forecasted losses savings, through our internal environmental and sustainability reporting mechanisms and disclose our performance externally on an annual basis.

Table 7.2 provides a snapshot summary of the CBA outcomes on our proposed losses reduction measures for RIIO-ED2 and the forecasted losses savings. The new proposed measures will see us looking to avoid approximately 345,066MWh in SEPD and 121,546MWh in SHEPD by the end of the RIIO-ED2 price control period.

Table 7.2 - Summary of CBA outcomes and losses savings for ED2

		CBA outcome	ED2 Forecasted Savings (MWh)
Intervention	**Transformers**		
	Low Loss Transformers	Implemented	*
	Super Low Loss Transformers	Not Implemented - cost prohibitive	
	Minimum Sizing of Transformers	Implemented	*
	Replacement of historical high loss transformers	Select Incidences	*
	Conductors		
	Minimum Cable Sizing at LV	Implemented	3,246
	Minimum Cable Sizing at 11kV	Implemented	2,389
	Minimum Cable Sizing at 33kV	Select Projects	No projects currently identified
	Upgrading of 6.6kV to 11kV	Implemented	No projects currently identified
	Operational Measures		
	Power factor correction	Not Implemented - not currently applicable	
	TASS - Switching out underutilised plant	Implemented	20,448
	OLTC technology	Trial	*
	Substation efficiencies	Implemented	48,071
	Power quality	Not Implemented - not currently applicable	
	Low voltage static balancers	Not Implemented - cost prohibitive	
	Measures to alter network power flows	Not Implemented - not currently applicable	
		Total Technical Losses Saving (MWh)	74,154

			ED2 Forecasted Savings (MWh)
Intervention	**Non-Technical Losses**		
	MPAN rectification – Domestic		304,869
	MPAN rectification – Non-Domestic		87,589
		Total Non-Technical Losses Saving (MWh)	392,458
		Total Losses Saving (MWh)	466,612

* Forecast savings to be provided after first year of RIIO-ED2 price control period (2023/24).

Whilst we are doing all we can to reduce our losses, we are mindful not to overpromise on our absolute reductions due to the impact from the growth in electrification of heat and transport, which is likely to drive losses up. To help us to understand this better, and as outlined in Sections 6.3.1, 6.3.2, 6.3.4, 6.4.1 and 6.6.1, we will develop our network monitoring and modelling measures to improve our calculation of losses, better inform our investment decisions and tackle losses. We will keep our CBAs, measures table and strategy under review and update as necessary as detailed in Section 4.

We will utilise internal governance groups focused on asset management and reducing carbon emissions to drive our losses strategy and performance. We will disclose our losses performance in our Annual Environment Report (AER) and the E4 losses report as part of the Regulatory Instructions and Guidance (RIGs) Environment and Innovation reporting pack. And we will work collaboratively with Ofgem and other DNOs to improve the framework for assessment and reporting of losses.

8 Stakeholder Engagement

During the preparation of our RIIO-ED2 Business Plan we sought feedback from our stakeholders and customers on our approach to managing losses and used the learnings to finalise our losses strategy. We will continue to engage with key stakeholders over the course of RIIO-ED2 to ensure that our approach remains appropriate.

In terms of our losses strategy, our key stakeholders are highlighted in light blue in Table 8.1 below:

Table 8.1 - Key Stakeholders for Losses Strategy

Consumers	Domestic Customers	Customers in vulnerable situations	Transient customers	Next generation bill payers	SMEs	Major energy users	
Customers	Distributed generation customers	Builders and developers	Community energy schemes	Landowners/ farmers			
Policy Makers and Influencers	Government	Research bodies, policy forums and think tanks	Media	Consumer groups	Regulators		
Communities and Local Decision Makers	Local authorities	Charities	Academic institutions	Housing associations			
	Vulnerable customer representatives	Local Energy Partnerships (LEP)	Emergency response	Healthcare	Community interest bodies		
Wider Industry and Value Chain	DNOs	Transmission	GDNs	Water	Telecomms	IDNOs	
	Independent Connection Partners (ICPs)	Consultants	Energy suppliers	EV charging	Other supply chain	Storage and renewable providers/installers	Transport and highways agencies
Partners and Enablers	Current and future employees	Contractors	Service partners	Shareholders	Investors	Business advisors	Trade unions

9 Future Considerations

As mentioned in Section 2, over the next few decades, there will be major changes in the Distribution network driven by the UK's transition to Net Zero and ambition to have a fully decarbonised power system by 2035. This will impact on our ability to manage losses. It will become more important for DNOs to consider whole system thinking, to make their network smarter and more flexible and to ensure that existing infrastructure is used as efficiently as possible, so they are enablers for Net Zero and not a blocker. DNOs will be on a journey to become DSOs and SSEN-D's vision for DSO is to make the best use of our electricity networks, data and emerging technology to facilitate the decarbonisation of transport and heat at maximum pace, and at minimal cost to consumers. More detail can be found in the DSO Strategy[19].

10 Conclusion

In RIIO-ED2, we will continue to implement our strategy to efficiently manage losses on our network in the long-term, reclassify losses as a Scope 2 emissions and act to reduce actual losses, whilst removing barriers and deploying solutions that benefit the whole system. We aim to deliver this through:

- Setting asset and network design policies and specifications to minimise losses where this is demonstrably the right approach.
- Strategically installing lower loss assets, upgrading of network voltages and optimising network configuration where this is demonstrably the right approach.
- Trialling known and new losses reducing techniques, such as methods to stabilise power factor and improve power quality, to assess suitable applications within our network.
- Tackling electricity theft and calculation anomalies through investigation works and wide-reaching communications highlighting the issue.
- Improving our understanding of network losses through research, innovation and collaboration.

Through our targeted initiatives, we hope to realise a losses avoidance of approximately 466,612MWh from both SEPD and SHEPD by the end of the RIIO-ED2 price control period. Whilst we are doing all we can to reduce our losses, we are mindful not to overpromise on our absolute reductions due to the impact from the growth in the electrification of heat and transport, which is likely to drive up losses. A critical factor in overcoming this challenge is understanding losses and where they occur on our network. We need to dedicate time and resource to study our network and improve our losses modelling. We believe this is the most impactful piece of work we can do in our battle against losses. The output of this work will allow us to make evidence-based decisions for our investments.

In summary, we will keep our losses strategy agile to respond to new challenges, new technologies, and understanding gained from our proposed network losses study. We will also work collaboratively with other DNOs to share learnings.

[19] Smart, Fair, Now. (DSO) - SSEN

11 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01	Creation of new document - Refer to Table 4.1	N/A	1.00	Shirley Robertson
02				